THE CITY ON GROUND AND THE CITY IN MIND

LINKING CITY MORPHOLOGY AND WOMEN'S TRAVEL IN ISTANBUL, TURKEY

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ABSTRACT

City morphology is known to affect the ways cities function, people moving around and liveability of neighbourhoods and places. Women, in particular, seem sensitive to the design, or morphology, of cities, thus affecting their travel. This thesis studies city morphology and women's travel through the interrelation between urban geometry and activity patterns in the city of Istanbul, Turkey. However, the complexity of urban environment does not leave place for isolation between social and physical aspects of life. The main challenge in this research is combining the qualitative and quantitative aspects of travel and built up environment in terms of human social aspects, urban morphology and the interaction between both. To conduct this research fieldwork in Istanbul, Turkey was carried out. Street interview was conducted with women; questionnaires were collected besides drawing mental maps for their daily trips. , 97 samples were collected but there was lack of randomness in these samples because of time constraints during field work. Moreover, Istanbul Metropolitan Planning and Urban Design Centre in Istanbul, Turkey provide some of base maps for Istanbul.

A framework was developed together with survey tools to trace women movement. Several stages were taken to analyze collected data in field. First, data was prepared in such a way so it can be analysed by means of GIS, scanning mental maps and digitize it, using SPSS and excel as statistical tool. Second, indicators for urban morphology and mobility were designed. In addition, spatial multi criteria analysis was carried out to combine urban morphology indicators and create activeness index. Afterwards, several GIS operations were applied to conclude the relationships between various indicators. One of these relationships was to distinguish areas of fear that women avoid in their daily trip route.

Satisfactory results were achieved. It is found that women travel patterns in Istanbul is affected by activity locations and accessibility. Accessible location attracts trips more. Besides, richness of activity types mean richness in trips attracted to the location. However, travel behaviour is affected by the socio-cultural variance of women, trip purpose where it found that the most motivated trips are social trips. In addition, women activities and cultural aspect is connected to the spatial local characteristic of the place, where space syntax local integration parameters succeed to prove that the area with high concentration of activities is locally highly integrated. Women construct society while streets network shape the movement of women, connectivity of place explains its accessibility, local integration of roads explain its local richness while global integration explains urban unit's boundary. In conclusion, urban morphology is highly linked to urban mobility, urban mobility is carried out by women activates and movements in Istanbul. Women perception in perceiving city problem is applicable where it has been tested by women fear area.

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TABLE OF CONTENTS

List of figures

List of tables

1. INTRODUCTION

City morphology is known to affect the ways cities function, people moving around and liveability of neighbourhoods and places. Women, in particular, seem sensitive to the design, or morphology, of cities, thus affecting their travel. This thesis studies city morphology and women's travel in Istanbul, Turkey.

1.1. Background and justification

Traditional transport planning approaches have explained very little about human need of transport. It has direct effect on households and individual's daily activity schedule, determining the type and quality of activities. Ignoring these elements of human life, raises an urgent need for research on human activities that may lead to better understanding of transport and vice versa its effect on human activities Fox(1995).

Understanding travel behaviour

Transport is a derived demand which arises from people's desire to participate in and out of home activities (Algers, Eliasson, & Mattsson, 2005; Meyer & Miller, 2001). Focusing on the characteristics of activities and potential opportunities, with respect to where and when, it can be carried out, will provide an important insight. This understanding feeds activity-based approaches in transport that integrate knowledge on the nature of activities and their timing with transport networks and their performance (Algers, et al., 2005; Fox, 1995).

Trying to better understand travel behaviour than that in traditional approaches, means facing a lot of challenges, i.e. interpreting human behaviour correctly, dealing with the complexity of urban environment, managing different and detailed layer of data acquired for modelling trips (population data, daily dairy of activities, etc.),the intersection between time space of individual using different types of modes, to name just a few (Lapucci, Lombardo, Petri, & Rotonda, 2009; Miller, Douglas Hunt, Abraham, & Salvini, 2004).

Three main features to be considered when looking at individual travel behaviour. These are individual behaviour, time allocation and space that activities are carried out within the urban areas. These features form the basis for theories and a mixture of modelling approaches that share the common theme that focuses on activities participation as the motivating forces behind travel, called activity based modelling (Algers, et al., 2005; Lapucci, et al., 2009).

Planners are typically occupied with interpreting how urban development is affecting the morphology of urban environments, while bearing in mind that there are important spatial interactions affecting the relation between a human and his/her surrounding urban environment.

Does urban morphology or city structure affect individual's behaviour or it is vice versa?

Lynch (1960) addressed the issue of spatial interaction between human and urban environment. He compared city structure as seen by its citizen (mental map) and its actual map. By exploring the city's physical structure Lynch identified five major elements of urban structure, which were identified by the inhabitants. These elements are Landmarks, Districts, Paths, Nodes and Edges, which are descriptive in terms of urban spatial arrangement. By identifying these elements and its detailed attribute, it is possible to

modify local relationships, between the physical elements, and the social economical factors, surrounding it.

City or urban patterns are the outcome of an interaction between movement technology (mobility, accessibility), communication and land values (Venturi et al. 1972 cited in (Frey, 1999)). Humans create cities based on their activities, while cities restrict our activities and behaviours within it (Long, Baran, & Moore, 2007). Similarly, Hillier & Iida (2005) discussed the motivation behind human movement; previously researchers in cognitive studies studying the process of perception that is thinking, reasoning, remembering, imagining or learning, believed that metric distance and cost are the main explaining variables of human movement which were criticized later as an unrealistic (Golledge, 1992; Hillier & Iida, 2005; Kim & Penn, 2004; Montello, 1997). Instead, they proposed a new concept relating to human perception of distance to the visual geometrical and topological properties of networks, nowadays known as space syntax. Consequently, they show that movement in cities reflects the geometrical and morphological structure.

The Space Syntax Approach, introduced by (Hillier, 1996) builds around the question "how do humans living and culture connect through space?" and is able to measure the relation between spatial patterns in urban space. His approach focuses on measuring the movement of pedestrian, vehicle and the influence of urban pattern. By adopting Hillier's approach, we can find the relation between city structure elements such as (road network and building layout) and activity pattern (individual's movement).

A symbiotic relation exists between transport and urban morphology (Pacione, 2005). In order to obtain a proper understanding of urban environment and its quality, it is necessary to integrate both objectives (landuse, building, street layout, population density, etc.) and subjective (individual's previous experiences, daily behaviour and life pattern, etc.) in our evaluation of the urban system. In other words, considering "the city on Ground and the city in Mind "(Pacione, 2005).

How to join both objective and subjective?

Dickenson,(1950,cited in, Pacione (2005)) explained urban morphology or town plan analysis as "advanced form of description and classification of urban forms". However, Whitehand,(1991,cited in, Pacione (2005)) described it as, analyzing the casual forces behind urban land pattern change. Conzen(1960) in Pacione (2005) divided urban landscape into three main elements (town plan (street layout), building form and land use). His classification was based on the degree of changes in these elements; i.e. land use is most susceptible to change, buildings last longer although its use might change over time. The town plan or street layout is one of the most permanent elements in urban system, thus street layout would be used in this study as main element for reference.

Continuing the discussion which started by (Hillier & Iida, 2005), Penn (2003) argued the possibility to explain people's movement in space syntax, with the challenge to explain why they move in this street, by addressing the question: is it the motivations or individual cognition? Cognitive space, is the space which enrich our understanding of the surrounding environment more extensively than our current visual field, it is not a metric space, but it is about the relation and interrelationship between urban elements(Penn, 2003). To answer that, a new approach was developed to examine the spatial description of urban structure in relationship to observable behaviour, using a non-metric space to extract exploratory movement from the metric visibility graph, resulting in the so called "axial graph"(Penn, 2003).

Axial graph consist a set of lines which are called "Axial lines". Axial lines, are the fewest and longest lines of sight 'visual steps' that pass through every space comprising any system(de Smith, Goodchild, & P.A., 2009) or they are 'lines of direct movement in the 2D public urban space the arrangement of this lines in

space are called 'axial map'(Conroy Dalton & Bafna, 2003). This concept later was used to draw mental maps (Lynch, 1960); a map which represents the knowledge that a person perceives from his environment. The purpose of mental maps is to connect the object (street layout) and the subject (individual's previous experiences, daily behaviour and life pattern, etc.) In other words, to be on the ground while travelling in mind around the city (Pacione, 2005).

Gender issues in travel

Gender is a critical issue in urban environment. Women and men are different in terms of act, dress and behaviour. Women are connected more to the family and indoor activities while men are connected more with outdoor activities and job. Women and men are concern about safety; women are concerned more about perception personal of security while men about road safety. Women travel pattern are distributed in the city were her interest is focused on short trips with multiple purpose, astical view streets while men are interested in long trips with one purpose, main streets and accessibility.

So why urban space and transport is considered as gender issue?

Urban space, transport in it self is not gender, while human responsibilities and perception highly related to his gender. City structure is constructed by transport system while society is built by gender variation in terms of responsibilities, act, and dress up and behaviour (UN-HABITAT, 2008). Travel patterns is one of the most gender issues(Wachs, 1996).

Movement of people is an essential issue for both men and women. Although women are restricted by access, opportunity, family commitment and customs (Pacione, 2005), women trips pattern and frequency seems to be more complicated than those of man. As women have traditionally more responsibilities than man in terms of house, work, they tend to combine different activities in one trip (i.e. work, shopping, taking children from to school, etc.).

Besides, women are more active than men socially, meaning they tend to walk more and use public transport more, especially if they are from a single-car family. A married woman with children seems to have more complicated trip than single women or men. In terms of work trips and location, women tends to choose relatively nearby locations, may be as far as C.B.D, but usually within the city limits, while men travel further, may be to sub-urban area for work purpose (McGuckin & Murakami, 1998; Pacione, 2005).

This study

As mentioned before, individual's behaviour characteristics and movements are related to each other as well as they are affected by the surrounding environment. Urban trips are clearly connected to individual needs for travel; men and women as they have different needs, responsibility and perception. In this study researcher will focus on women travel behaviour which can be achieved in three steps:

1. Analyzing travel patterns in the city; through creating a scenario for each individual, that describes the daily trip of each individual (i.e. start location of his trip, next stop location, time duration at each stop, location and time of last stop and mode used).

2. Connecting different activities with physical structure of the city through locating the day trips of individuals into the physical form of the city; referring to the physical layout of the city e.g. street layout though (road network, axial lines), spatial distribution of the activities, building layout, physical area of streets and buildings layout and spatial configuration of the neighbourhood.

3. Linking urban morphology with urban mobility, through activity spatial location and trips spatial distribution.

In conclusion, the complexity of urban environment does not leave place for isolation between social and physical aspects of life. Satisfaction of the people can obtain by integrating both social and physical dimension of life. Looking to the world problem *"The City on Ground"* should be from society perception*" City in Mind"*. Using this approach in transport may create a new vision to solve current and future transport problems.

1.2. Study Area

The present study is conducted in Istanbul, Turkey. Istanbul is located in north-western part of Turkey in the Marmara Region with a total area of 5,343 square kilometres (2,063 sq mi). The Bosporus, which connects the Sea of Marmara to the Black Sea, divides the city into two parts (European and Asian part). Having its unique location, as the only metropolis in the world, which is situated in two continents, Istanbul is designated to be the alpha world city. With a population of 12.8 million, Istanbul is considered the largest city in Turkey and the fifth largest city in the world (Turkish Statistical Institute). That makes it the second largest metropolitan area in Europe by population. Istanbul is megacity, as well as the cultural, financial, and economical centre of Turkey.

The transportation system in Istanbul is facing a range of problems. As a Metropolitan city, it is suffering from road congestion, insufficient capacity of road and public transport systems (trams, light railways and metros), which is not enough to cope with public transport demand (IMP summary, 2007). However, current transport policy in Istanbul is becoming more oriented towards sustainability giving priority to improve public transport and pedestrian movement while reducing transport cost, pollution, congestion and improving vehicle infrastructure and sea transport.

1.3. Research problem

Transport planning has traditionally focused on a simplified representation of travel behaviour based on behaviour aggregation, generalized costs and utilities. However to fully understand travel behaviour and the role of the urban environment, the traditional method is insufficient to fully understand people travel behaviour without incorporating some of these needs.

Urban planning and management has focused largely on the use of social, economic, cultural and governance factors in evaluating urban change and development. GIS techniques have been applied to accumulate, aggregate and analyze complex spatial data that urban planning and management needs. However, little emphasis is given to the detailed form or geometry of the city and its effect on mobility and vice versa. On the contrary, within urban design there has been some focus on geometry and form of cities and human understanding of the same e.g. through cognitive mapping. Little work has been done on linking urban form (structure or morphology) and the underlying social, economic, cultural and governance factors (e.g. Chang et al. (2007)), let alone relating mobility.

This research is attempting to capture detailed urban mobility patterns for a sample of individuals and relating this to urban design principles through applying a combination of different spatial and non-spatial techniques such as time-use survey (Bhat & Koppelman, 2003), street interviews, drawing mental guided by referenced maps (Kim & Penn, 2004; Long, et al., 2007). Better understanding is sought by studying these patterns in a GIS environment both qualitatively and quantitatively by relating observed travel behaviour (of women in Istanbul) to urban morphological characteristics. .

The main challenge, which is addressed further in this research, is the combination of both the qualitative and quantitative aspects of travel and the built environment in terms of:

- Human social aspects (individuals' needs for mobility and movement).
- Urban morphology (road network, building layout).
- The interaction between both.

Looking to urban environment from this perspective would help to identify and analyse its problem from society perception considering gender variance which have different needs and responsibility. In addition it will provide decision maker with better understanding of the problem thus will help to apply and develop the right policy in terms of transport and urban morphology.

1.4. Research Objective and questions

1.4.1. Main Objective

The main objective is to study the interrelation between urban geometry and activity patterns of individuals, focusing on women, in the city of Istanbul, Turkey.

1.4.1.1. Sub-Objectives

The following sub-objectives are established to complete the framework of this study:

1. To develop a framework and survey instrument for studying daily activity patterns of women in Istanbul.
2. To model and map the urban geometry of Istanbul, focusing on expressing urban street morphology.
3. To study the effect of built environment structure (in terms of urban street morphology) on urban mobility and activity patterns of women in Istanbul.
4. To conclude on physical and social obstacles that women face during their daily trips.

1.4.1.2. Research questions

The research questions are related to the four main sub-objectives:

1. To develop a framework and survey tools for tracing daily activity patterns of women in Istanbul.
   3.1. How to trace women movement in the city?
   3.2. How locations and accessibility of activities affect travel patterns?
   3.3. How socio-cultural variances and urban structure affect activity patterns and travel behaviour of women in Istanbul?
2. To model and map the urban geometry of Istanbul, focusing on expressing urban street morphology.
   3.1. How can urban form be defined and quantified?
3. To study the effect of built environment structure (in terms of urban street morphology) on urban mobility and activity patterns.
   3.1. How does human activity and cultural aspects affect urban structure in the city?
4. To conclude on physical and social obstacles that women face during their daily trips.
   3.1. How street network shape movement in cities?
   3.2. What are social barriers that woman face in their daily trips?

1.5. Research Hypotheses

The aim of this research is to test the effect of a city's physical structure on urban mobility. The research hypothesis is that women's activity patterns and schedules can be (partly) explained by urban morphological structure.

1.6. Methodology and Conceptual model:

1.6.1. Methodology

The main point is to achieve a sustainable solution for one of the most critical issues of our daily life (i.e. mobility), and to integrate all the elements that might be involved in satisfying people demand.

This study will be carried out in three main steps:

- Tracking individual's daily trip through city structure.
- Analyzing travel patterns of women in the city of Istanbul.
- Combining activities carried out around the city with the city's morphological structure through a GIS-based spatial analysis, as shown in Figure 1.

A first step in this approach would be analyzing travel pattern in the city; by creating a "daily plan" for each individual (in this case women), through describing her daily trips:

- Start location of his trip (she will indicates her house or the point she would like to start her trip from).
- Next stop location (will be the location that she attained to visit after she leaves the start location).
- Time duration at each, stop (how much time she spends at each location i.e. at shop or visiting friends).
- Mode used (what would be the travel mode mode(s) that she would use within her trip and for which part).

This step will be carried out based on two approaches, first using time-use survey (questionnaire) (Bhat & Koppelman, 2003), which contains questions concerning:

- Home based trips, purpose of the trip, Activities (location XY-coordinate, duration time, start time, end time).
- Individuals socio –economic characteristics:
    - Social statues (employed, students, households)
    - Income level.
    - Marital status and gender.
    - Number of children.
- Mode used (walking, cycling, private car, public transport).
- Transport networks (pedestrians, cycling, private car street and public transport route, stops and schedule).

The second step will be carried out based on Lynch (1960) in creating mental maps using sketch map technique, by asking individual to draw their daily trip through city structure as seen by them depending on their own knowledge and background, then comparing these with a referenced map (Google map or GIS map).

Sketch maps will be used to acquire rich knowledge and information from the interviewed persons, without putting any constraint to her/his thinking. By comparing a sketch map it is inferred that reference map give us realistic information about the paths individuals follow with less detail than sketch map in terms of the stops and the time they spend in their trips (Kim & Penn, 2004)p.485.

By exploring the city physical structure Lynch (1960) identified five major elements of urban structure which are identified by the individual inhabitants. These features are landmarks, districts, paths, nodes and edges.

These elements are descriptive in terms of urban spatial arrangement by identifying these elements and its detailed attribute. It is possible to modify local relationships, between the physical elements itself and the social elements of urban spatial arrangement represented by human and his activities in the city.

To study the effect of built environment structure (in terms of urban street morphology) on urban mobility and activity patterns:

By connecting activity that individuals do over the course of day, with physical structure of the city (Landmarks, Paths and Nodes).

- Activities (locations X, Y).
- Road network (links id, from node, to node, capacity, speed, number of lanes).
- Axial lines for pedestrians, cyclist and private cars (Hillier, et al., 2005; Long, et al., 2007).
- Public transport routes, stops XY.

Using individual's plans (knowledge and information about route, time and locations) extracted from previous approaches (questioner, mental map and referenced map), though converting those plans to Digital form in GIS, Excel and Google earth. The third step will be linking urban morphology with urban mobility through indicates design integrated in SMCE and GIS to generate activates spatial distribution and trips patterns that provides a base for further analysis.

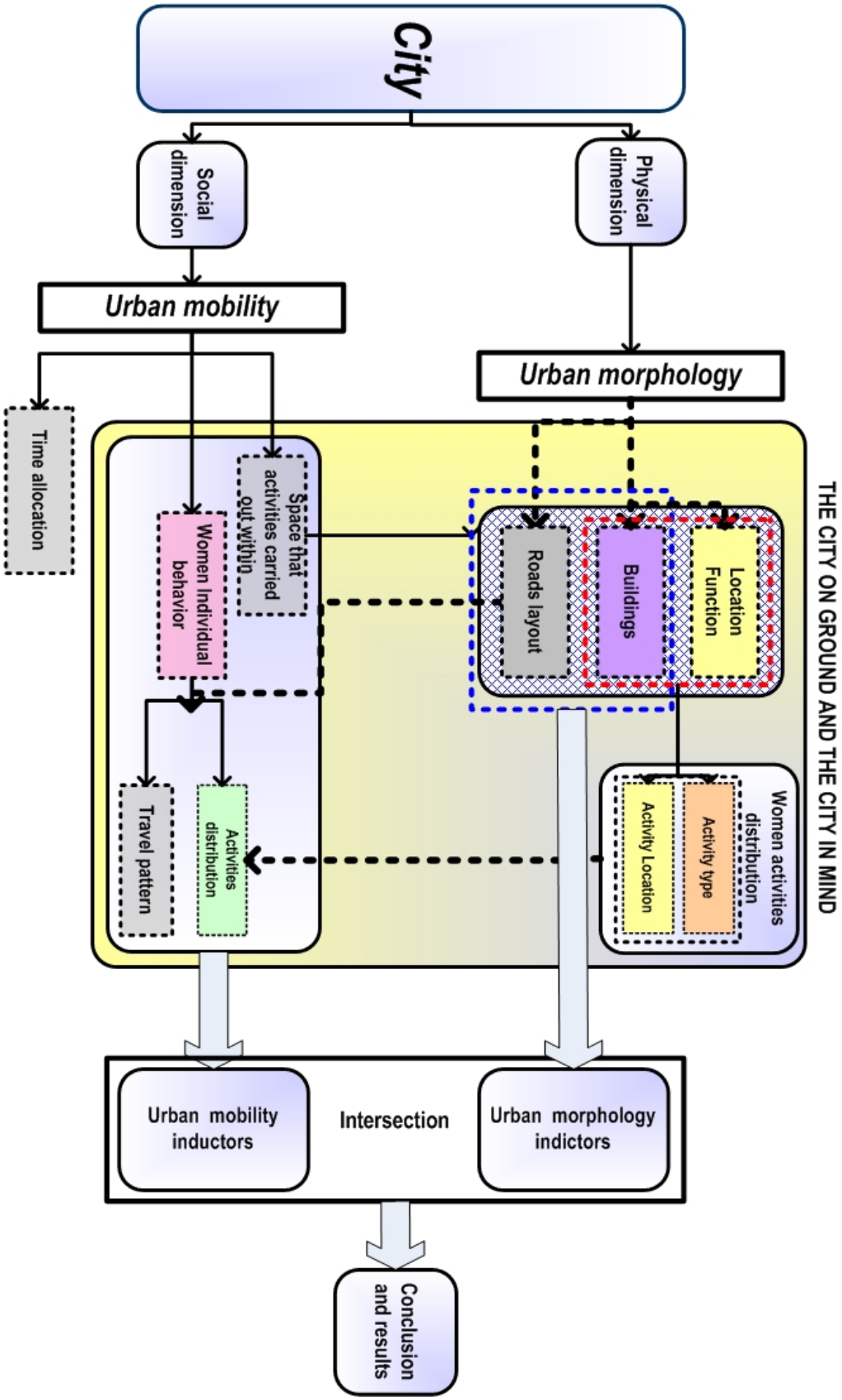

Figure 1-1: Conceptual framework

1.6.2. Data requirements and data collections:

To carry out the research in sufficient way, an over view of the methods, which can be used are addressed in the Matrix

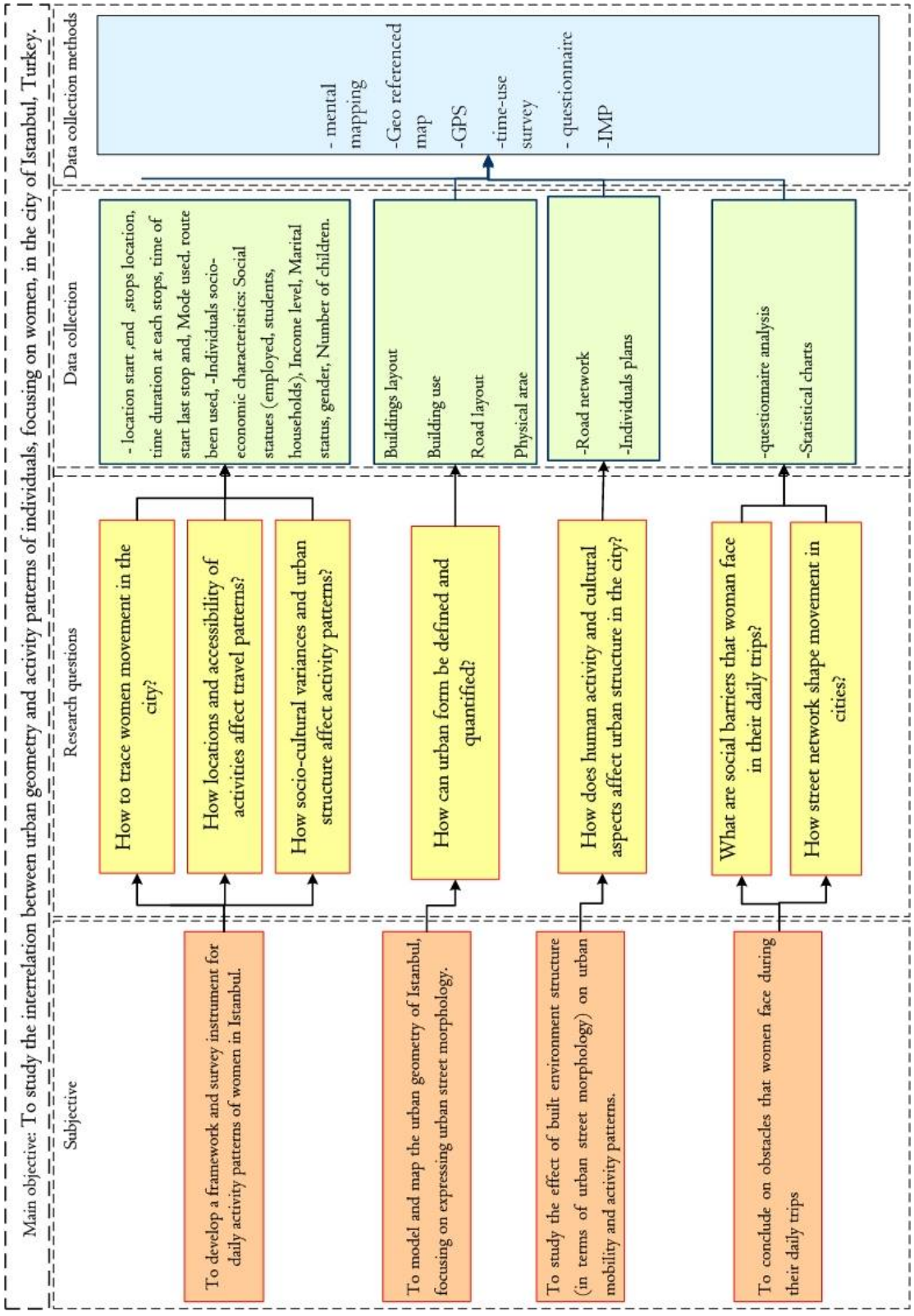

Figure 1-2: Survey matrix

1.7. Thesis structure

Chapter one is introduce the traditional transport planning approach, followed by an overview of the possible alternative that could be a solution focusing on one target group. Then addressing the research problem, objectives, questions, hypotheses and then chosen methodology that will be carried out to achieve the objective. **Chapter two** is discussing varies combination of *literature* focusing on filling the gaps between transport planning, urban planning and urban design. As the research propose that linking Transport planning, urban planning and urban design will help in better understanding human's daily need through urban area. **Chapter three** is providing a description of fieldwork pre and post established by study area selection, sample methods, the steps that been carried out in the field as well as fieldwork limitations and summary. **Chapter four** is addressing the methods and techniques used within the research. This chapter demonstrate the methods been carried out for data preparation and indicators design. **Chapter five** will provide an overview on the analysis that been carried out in Spatial Multi Criteria Analysis. **Chapter Six** presents as description for the achieved results. **Chapter seven will** discuss those results. Finally, **Chapter eight** will include conclusions, recommendations.

2. CITY SIGNATURE AND IDENTITY

2.1. Introduction

This review of literature addresses the complexity of the urban environment with respect to travel behaviour, trying to fill one of the known gaps in social and transport science. This gap was created by the separation between urban design practices from the one side, and urban and transport planning from the other side, leaving the relation between human needs and problems unsolved. Therefore, this review combines different theories from urban design, transport planning (urban mobility), urban morphology and participatory GIS techniques and practice, in an attempt to link them.

In order to integrate all dimensions of the city, it is essential to find the linkages between these dimensions instead of focusing on one dimension as the main driving force. The structure of this chapter will be focusing around the three core elements of this research:

- The actors (human and their social dimension).
- The foundation (urban morphology and geometry).
- The driving forces (human activities and mobility).
- Interactions between them.

A city is a complex unit; which is characterized by social diversities of its residents, the physical structure of the city and its variation (built environment) and the dynamic richness in terms of the activities carried out in the city, all these things gives it a unique signature and identity to the integrated city-transport system.

2.1.1. The actors

All social groups in the city live in the same urban space. Each individual in this unit is active and has different needs (i.e. children need playgrounds to play, disabled people need a ramp to move, and women need street lighting so that they can feel safe outside their homes at night) (Beall, 1996). Women, men, the elderly and children all form the city experiences and all participate in forming the image of the city in different ways. "What changes are not the processes of work shaping the physical structure of the city, but rather the role which man give to the city"(Vance, 1977).

2.1.2. The foundation

City or urban patterns are the outcome of an interaction between movement technology (mobility, accessibility), communication and land values (Venturi et al. 1972 cited in (Frey, 1999)). Urban morphology or town planning is an advanced form of description and classification of urban forms (Dickenson,(1950,cited in, Pacione (2005)). Whereas, Whitehand (1991, cited in, Pacione (2005)) described it as "analyzing the casual forces behind urban land pattern change" Figure 2-1.

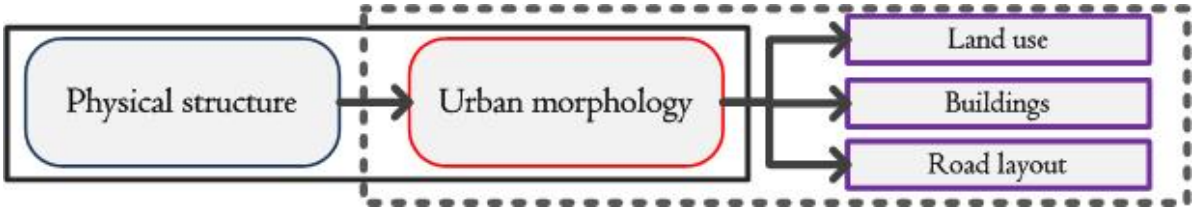

Figure 2-1: Urban morphology elements

Conzen(1960) in Pacione (2005) divided the urban landscape into three main elements, i.e. the town plan or street layout, building form and land use. His classification was based on the degree of changes in these elements; i.e. land use is mainly subject to change, buildings are physically long lasting while its history and use might changes over the time, town plan or street layout as the most permanent elements in the urban geometry, thus street and buildings layout will be used in this study as the main elements.

2.1.3. Driving forces

People mobility are the strongest force that shape cities physical structure, but people's roles are the real force behind that form, mobility is the pulse of the city (Johnson, 1967; Latham, McCORMACK, McNAMARA, & McNEILL, 2009). People move to achieve their social and economical needs (Algers, et al., 2005; Meyer & Miller, 2001; Vance, 1977). This movement is called a "journey" and the connection between different destinations, "functional cluster of activities" is called "linkages"(Latham, et al., 2009; Vance, 1977). Transport has direct effects on households and side effects on an individual's daily activity schedule, as well as on the type and quality of activities(Fox, 1995).

2.2. Linkages between actors, foundation and the driving factors

Human needs in terms of transport planning can be achieved through relating the three elements, **actors**, **foundation** and the **driving forces** together. Their meaning and relationships among themselves contribute to that achievement. For actors, Latham, et al.(2009) explained human perception of the city as a virtual unit, that human experience and memories is not definite as city's physical structure. However, concerning foundation, Bentley (1985) related the city with meanings captured by human sight regardless what urban designer is trying to proof by their city design. Driving forces for creating cities is carried out by human activities. However, cities restrict our activities and behaviours (Long, et al., 2007).

2.3. Transport planning, urban planning and urban design

Urban planners focus on urban change, usually its is directed only toward cultural, social and economical factors, while human interaction with its surrounding environment is often forgotten.

Tradition and social custom are shaping the activities that have been carried out by men and women. Society has been treating women and men differently, and expecting different contributions and participation from women in term of community building. While, in planning they have been treated similarly or sometimes women's role have been ignored completely (Beall, 1996).

Traditionally, transport planners, often ignore the direct effect of transport on households routine and the side effect on individuals activities type and schedule (Fox, 1995). Moreover, planners do city zoning which is grouping activities within the same place (i.e. commercial and shopping area, residential, etc). While people do not, in addition women and men have different needs(Beall, 1996).

In their way finding study, Nenci & Troffa,(2003) found that there is considerable differences in the way that women choose their way than men. Women choose longer routes, motivated with aesthetics in particular pleasantness and panoramic features of the selected route. While men choose shorter route motivated by looking for the route rapidity or complexity, in other words he is looking after the "shortest way" and "main streets" (Ritchie & Lewis, 2003)

Urban designer and architects are busy with studying urban geometry, buildings layout, and history. While missing the connection with the social, economic, cultural and governance factors(Chang, et al., 2007; Latham, et al., 2009),ignoring human needs of movement. That leaves us with three main concerns,

controlling human life, shaping city structure and directing the way that the activities within the city function without almost no link between them.

2.4. Filling the gaps

In order to fill the gap between the three disciplines of transport planning, urban planning and urban design, applying and combining a combination of methods and techniques is essential. The conceptual framework in this research Figure1-1 suggests one of the possible combinations to link these disciplines, while targeting one social group (women).

To address the identified gap between urban planning, urban design principles and transport planning several approaches can be addressed. using urban design principles like space syntax, mental and sketch mapping (Kim & Penn, 2004; Long, et al., 2007) with a transport planning techniques like time-use survey and street interviews (Bhat & Koppelman, 2003) a connection between urban design and transport would be created. Thus, it will be important to link human activities(Algers, et al., 2005; Lapucci, et al., 2009) and travel patterns through activity mapping, travel behaviour analysis, and urban morphological analysis in (Balmer, Meister, Rieser, K.W., & Nagel, 2009; Nagel & Flötteröd, 2009)

2.4.1. Gender issues in urban transport

Human mobility, although it is an essential issue for men and women, in this study will be directed towards women's mobility. This is due to three reasons.

Although women are restricted by access, opportunity, family commitment and customs (Pacione, 2005) in many societies, women trips pattern and frequency seems to be more complicated than those of man and children. As women have more responsibilities than men in terms of house, work, they tend to combine different activities in one trip like work, shopping, taking children from to school, etc. (Mauch & Taylor, 1997). Women are facing many obstacles, (i.e. insecurities of the road, mobility problems while carrying out their daily household responsibilities (i.e. they depend on public transport which is mostly crowded, unreliable and irregular)). However, men tend to use private car more frequently and do not depend on pubic transport ((Beall, 1996; McGuckin & Murakami, 1998; Pacione, 2005).

Traditionally, women have been linked to private spaces i.e. home. While men dominate the public space outside of house with paid employment while women dominate the house and society work and men. Although, women play an important role in urban development, were she is actively participating in developing the neighbourhood she live in, there is no enough attention has been given to their specific needs. In today's cities, neither women nor men can be identified as workers or homemakers, the choice and work opportunity is identifying their responsibilities informed their identities, choices or opportunity costs"(Beall, 1996).

2.4.2. Urban design

Human interact with her/his surrounding environments virtually through vision, form memory about the place, time and records experiences. Addressing the issue of spatial interaction between human and urban environment, Lynch (1960) compared city structure as seen by its citizen (mental map) and an site map of the city. By exploring the city, physical structure Lynch identified five major elements of urban structure, which were identified by the inhabitants. These elements are Figure 2-2

- Landmarks: are fixed and identifiable objects which give a sense of the place and can be referenced from outside).
- Districts: are Sections of the city fabric. That have an individual fibre, which provides coherence, allowing the entire to seen as a single unit like neighbourhood boundary.

- Paths: are Channels of travel through the environment such as major roads or footpaths.
- Nodes: are important points of interest along certain paths. (e.g. road joints or town plazas) been described as the place where people had to take a decision.
- Edges: are linear elements providing boundaries to districts or linear obstacles.

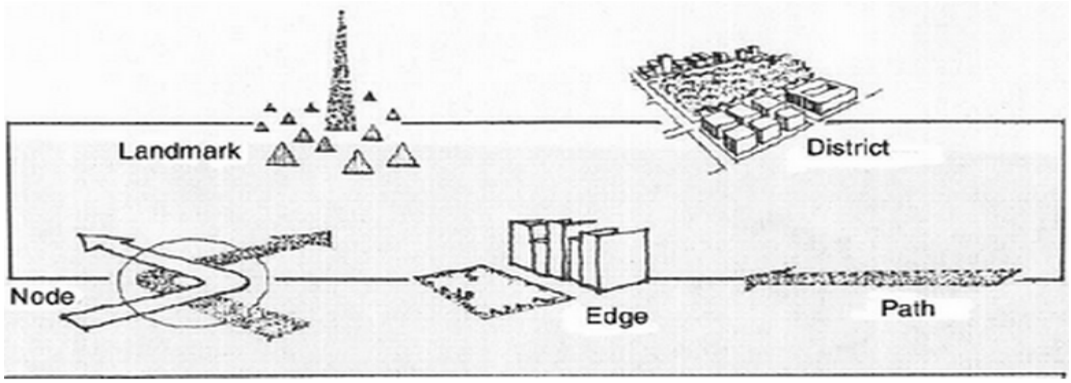

Figure 2-2: Lynch, 1959 (Key elements pp 47-48)

These elements are descriptive in terms of urban spatial arrangement. By identifying it and its detailed attribute, it is possible to modify local relationships, between the physical elements itself, and the social economical factors, surrounding it.

By addressing the question, "how do humans living and culture connect through space?" (Hillier, 1996) introduced "space syntax approach" and was able to measure the relation between spatial patterns in urban space. His approach focuses on measuring the movement of pedestrian, vehicle and the influence of urban pattern. By adopting Hillier's approach we can find the relation between city structure elements such as (road network and building layout) and activity pattern (individual's movement).

The concept is developed using human physical sense (human vision), based on constructing axial lines within the street layout between building edges. Which had been derived from the original road network ,with max length 1500m (human vision limits(Moughtin 2003),(Bentley, 1985) (de Smith, et al., 2009)). Connecting two points (i.e. from 1-to A), considering the first as human eye and second will be the limit of his vision within that space also it will be presenting human motivation and target of movement as shown in Figure 2-3.

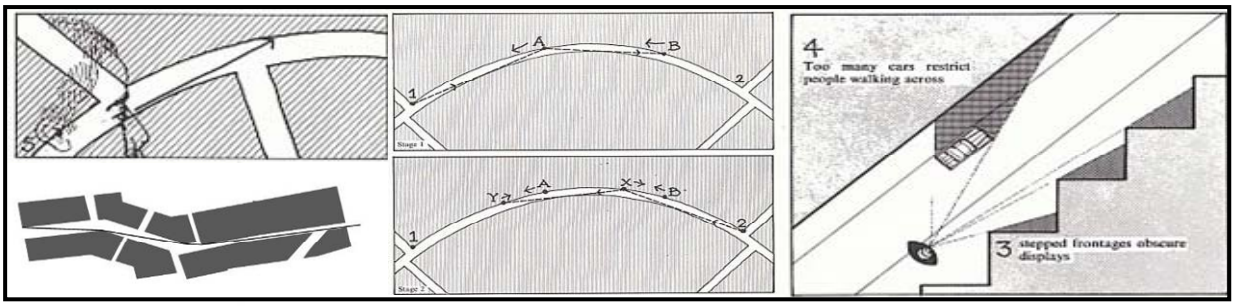

Figure 2-3: Visual step and axial lines, source (Bentley, 1985)

In architecture and urban design, human perception is forgotten, especially differences in gender perception. Van Nes & Nguyen(2009) observed that gender differences in urban public spaces is not visible in the day time within the city. They linked gender differences, use of the public space and time of the day. In addition, they observed that gender differences in urban public spaces appear at night when shops are closed. Since women cannot go out alone, they start to use the streets as passage and go out to the public space with a men company.

In social science, women and men safety is related with the space that they carry out their activities in. In nature women are more vulnerable than men; that make her more exposed to public spaces risk especially where public transport services occupy the space(Kunieda & Gauthier, 2007).Urban safety is categorized into two groups, road safety and perception of personal security. Road safety is related to public transport services, road speed, percentage of death and road accident, percentage of injuries between pedestrians and cyclist by car, this type of safety get more attention by men.

However, perception of personal security is getting more attention by women, personal security is related to the way of dressing up, physical strength, verbal harassment and physical harassment (Kunieda & Gauthier, 2007). In Istanbul women perception of safety is differ from place to place. SECOR (GÖKARIKSEL & MITCHELL, 2005; 2002) addressed one of the women issues in public space which is related to the perception of personal security. However, women wearing veil are facing obstacle in their daily motilities connecting that to community perception and secularism.

2.4.3. Individual movements

Hillier assumed that human movement in the city is based on visual steps. Women concern about perception to the city is connected to aesthetic and safety (Nenci & Troffa, 2007)(Kunieda & Gauthier, 2007)Thus she change her travel behaviour if she feel unsafe, where she tends to change her travel route and travel time (Kunieda & Gauthier, 2007). In order to link this concept to urban mobility, and being able to explain women activities and movements patterns, participatory mapping techniques and GIS based spatial analysis can be used to trace and analysis women movement patterns as well as using gender differences policy when looking to community problem (UN-HABITAT, 2008).

To conclude, the complexity of urban environment does not leave place for competition between the different disciplines. In order to solve human needs and peoples' satisfaction, all disciplines should interact together. Individual's behaviour, human movement are linked with each other, as well as the affect of the surrounding environment on Individual's behaviour.

3. CASE STUDY SELECTION AND FIELDWORK

3.1. Introduction

This chapter discusses the various steps, which has been carried out to answer the research question related **to tracing women movement in the city**. The activities were undertaken during, pre and post fieldwork in Istanbul. Information and data collection, as well as the methods and the analysis techniques used. This chapter comprises of three main parts.

Figure 3-1: Istanbul city centre.

In the first part of the chapter, the study area selection has been done. The city of Istanbul was selected as the study area; the selection process will be described in the following sections, which deals with the fieldwork activities pre and post fieldwork in Istanbul concluding on fieldwork results and limitation.

In the second part of the chapter, the sample selection, methods advantage disadvantage will be descried and then results, limitation and conclusion on fieldwork experiences.

In the third part of the chapter the data compilation, implementation, analyses, and evaluating survey approaches, analyzing activities and travel pattern of the selected sample has been done. In summary data preparation results is shown.

3.2. Fieldwork

The Istanbul fieldwork aimed at incorporating Istanbul city authorities presented by (IMP) Istanbul Metropolitan Planning and Urban Design Centre and citizens in the data collection and analyses. It focuses on "women's" experiences and perception to map the mobility and activity patterns in Istanbul with a target of collecting 100 random samples. By means of a questionnaire and geo-referenced sketch maps, women's interaction formed by their experiences, areas of interests and the obstacles faced within their daily trips in the city were analysed.

This been proposed previously as a method, which might show the interaction between peoples and urban physical structure. Generally, this section has two main parts, which are primary and secondary data collection.

3.2.1. Study area selection:

In the pre fieldwork phase, a decision been made to use Istanbul as the research study area. Istanbul is a metropolitan city with rich history and spatial characteristics with a population over 12 million that contained a rich mixture of socio-economic characteristic in terms of culture, religious and economic activities. Istanbul is the first largest city in turkey; with 40 (Ilce) districts, 841 (Muhula) neighbourhoods and 8 main buildings use (see figure 4-2). Urban mobility is a serious concern for Istanbul citizen where it affecting them in term of economic activities, time management, city attractiveness and human health(Gerçek & Demir, 2008),Istanbul is a highly congested city. According to EU legislation, decision

maker should consider and recognized the rights and obligations of transport user in turkey, and increase public safety and awareness(Gerçek & Demir, 2008)

Istanbul city centre was set as a start location for the survey. While the final selection of study areas were within two main districts in Istanbul, Beyoğlu and Fatih. Beyoğlu is one of the largest and central districts of Istanbul with a very rich historical background that is located in the centre of Istanbul. According to the new administrative boundary, the old district of Fatih and Eminönü combined into Fatih district. Fatih is located in the historical peninsula of Istanbul, the house of historical 144 mosque, church and temples and bounded by Faith stone creating what local people call as "Old Istanbul". Within these two districts, the following neighbourhoods selected to start the survey with, In Beyoğlu: "Cihangir and "Koca Mustafapaşa" in Fatih. The survey ends up with trips and activities located or passed by 462 neighbourhoods (see Figure 3-2).

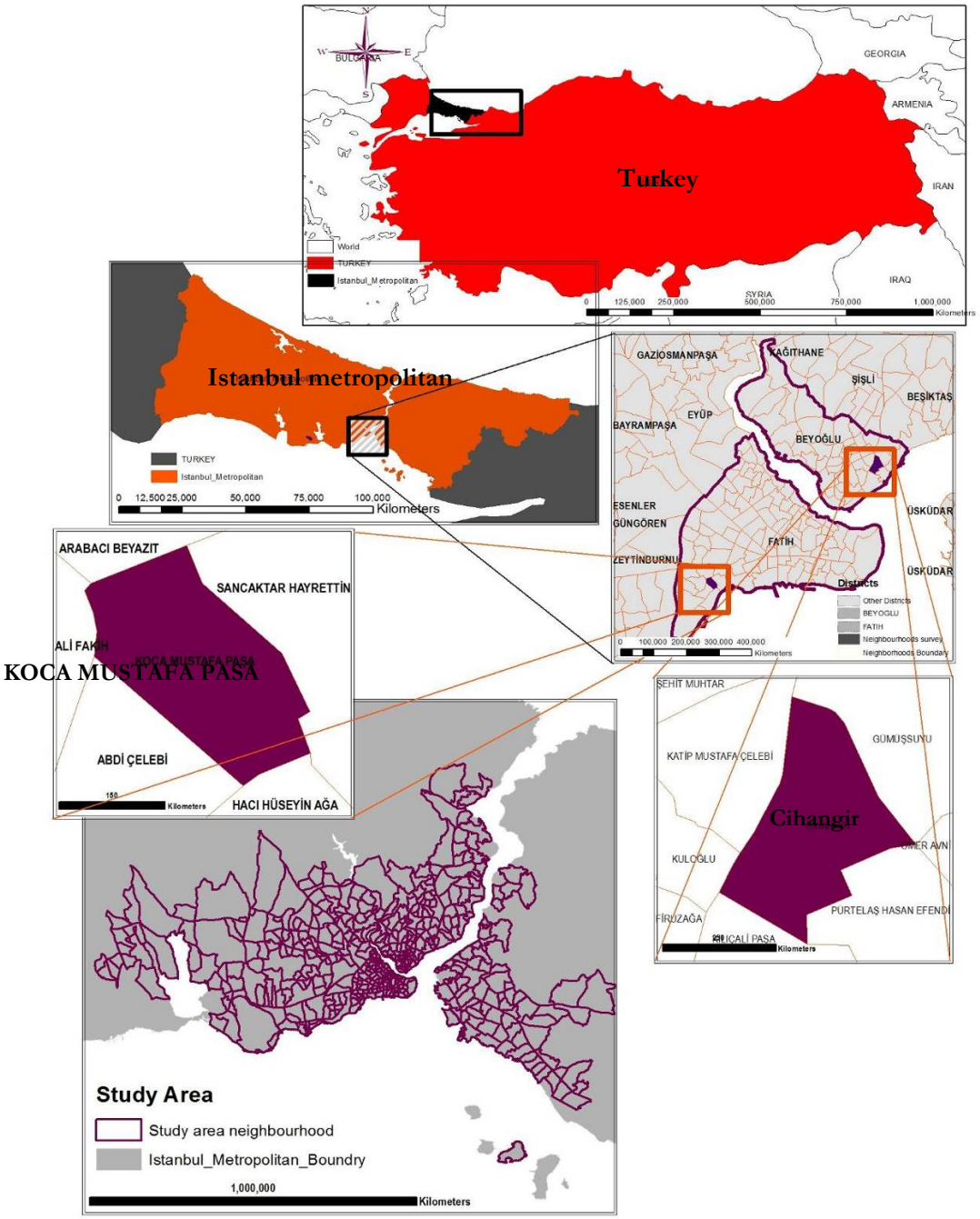

Figure 3-2: study area location.

Why was this area selected?

The selection of the specific surveyed areas in Istanbul was done based on local knowledge by the host institution (IMP) Istanbul Metropolitan Planning and Urban Design Centre. Criteria used were variety of uses (residential, commercial, educational etc.), services (transport, education and religion services), transport mode availability and accessibility to the area.

3.2.2. Fieldwork preparation

The fieldwork preparation had two stages, i.e. pre and post fieldwork. In the pre fieldwork stage the questionnaire design and the selection of variables to be measured to get a clear picture on women's travel were executed. Given the limited time and financial resources, the sampling in the study was stratified, both in terms of area selection as well as in terms of respondent selection.

Data collection

In general, the data collected for this research have two main sources. First is primary data, i.e. the data been collected in the field by means of survey and mapping of mobility and activities of selected women respondents. Second was secondary data, provided by the host institution (IMP) Istanbul Metropolitan Planning and Urban Design Centre. The following section will describe in details the two types of data collection.

3.2.2.1. Primary data

Primary data collected in two main steps. First study area selection (described in the previous section). Second, determination and selection for sample size using three sampling methods. The reason for using different types of sampling methods was mainly due to time constraint, insufficient translator availability within the first two weeks and tight fieldwork budgets. The following section describes the adopted sampling techniques:

1. **Quota sampling**: this method has been carried out by dividing the population into spatial sub groups (selecting the City centre area). Followed by, selecting a group from the spatial sub groups based on a specified proportion (active neighbourhood in sense of work and movement (the neighbourhood where located in the new part of the city centre which have different characteristic than the old part.

   For example, in this research the requirement was to select a sample of 100 females between the ages 15- 52 from the total population of Istanbul .which means targeting a specific group within the population. Then, the selection will processed by selecting individual cases in non-random approach. For example, the interview had done while walking in the street and interviewing the first female that accepts to fill the questionnaire and the Map).

   Although, quota sampling is limited and biased in terms of giving the population equal chance of selection, still it is useful in dealing with time constrain, proceeding without sampling frame, dealing with a very tight research budget or when in-depth study is required and detailed accuracy is not important. To recover some of this constraint, a good knowledge and additional information of the population characteristics are required. That improves the credibility of the results. Using this method 17 samples collected in Cihangir Neighbourhood.

2. **Flow populations**: this method has carried out by approaching people in a particular location or setting (i.e. at a Job centre, a doctor's waiting room or outside a school. This will be useful when approaching households is not possible (Patton, 2002).

   This method is useful when the people have the will to participate in the study, seeking their permission to contact them at their home to describe and discuss the study in detail, (i.e. the researcher and the interpreter asked for permission to interview the females in IMP (Istanbul

metropolitan planning), 17 females has been interviewed by using this approach (Ritchie & Lewis, 2003).

3. **Snowball method**: this method has carried out in the old part of the city centre. Simply by interviewing some females and then asking them for a possible candidate for the study, which in turns each female guide us to meet her friend or neighbour (Ritchie & Lewis, 2003)

   Although, this method comparing with quota and flow population was quite faster in approaching the individual samples (i.e. householders), Cheaper, simpler and cost-efficient. As well it needs little planning and fewer workforce compared to other sampling techniques.

   Nevertheless, this method is still limited, in terms of controlling sample distribution; hence absence sampling bias, which means representing the population, is not guaranteed in these cases. It is uncertain whether the population shares the same characteristics and interests as 63 samples were conducted using this approach.

Conducting the interviews

The survey was a combination of two main parts, a questionnaire and activity mapping, which has been integrated together, the survey were conducted with the help of two native Turkish speaking interpreters. The questionnaire was designed to collect information on women's social-economic, daily activities, movement's pattern and the obstacles they face in their daily movement in the city (see appendix 1 for questionnaire English version). The questionnaire aimed to extract the following information:

1. Demographic information
   - Sex, age, income, education level and work title.
2. Activity tracing:
   - The activity duration, start and end of the activities, the daily schedule, preferred timing to do the activities and
   - Mode used and daily routine and combination of the activities.

While the mapping process was conducted by asking people to point out the location of their

- Home, work, preferred shops, children school, relative house, interest areas, areas to avoid, as well as
- The path that she would follow to go (from - to) the activities.

3.2.2.2. Secondary data

Secondary data collection was mainly obtained from IMP (Istanbul Metropolitan Planning and Urban Design Centre); by direct request from the experts assigned by the institute to communicate with ITC team.

3.2.2.3. Data description

The following table contained a detailed description of the data type and source obtained in fieldwork:

Type of data	Location	Description	Source and date	Data condition
spatial data	Faith and Beyoğlu district	time use -survey	street survey, Istanbul citizens	questionnaire
spatial data	Faith and Beyoğlu district	Interview locations	GPS 2010	GIS shape(vector)
spatial data	Istanbul metropolitan boundary	activities location	sketch maps, Istanbul citizens	paper maps
spatial data	Istanbul metropolitan boundary	Bus, Metro station	IMP ,Istanbul 2006,2010	GIS shape(vector)
spatial data	Istanbul metropolitan boundary	Building use	IMP ,Istanbul 2010	GIS shape(vector)
spatial data	Istanbul metropolitan boundary	Neighbourhood	IMP ,Istanbul 2007	GIS shape(vector)
spatial data	Istanbul metropolitan boundary	District	IMP ,Istanbul 2007	GIS shape(vector)
spatial data	Istanbul metropolitan boundary	Istanbul metropolitan	IMP ,Istanbul 2006	GIS shape(vector)
spatial data	Istanbul metropolitan boundary	Road Network and hierarchy	IMP ,Istanbul 2006	GIS shape(vector)

Table 3-1: Data Collection

3.2.2.4. Fieldwork challenges

Any fieldwork activity comes with limitations and challenges. The main ones are depicted below:

1. Language barrier was the biggest issue that the researcher faced in the field, together with insufficient translation. This made data collection in the first two week too slow and inconsistence.

2. Unfortunately, no direct contact with the interviewer was possible, except two or three females who were able to speak either English or Arabic (the researchers speaks both). This made the information exchange depend heavily on the translator.

3. The secondary data obtained from IMP mainly is in the local language, which needs a lot of effort and is time consuming.

4. Study area selection done in the field according to the local knowledge.

5. Insufficient demographic data and information (i.e. total population, neighbourhood's population).

6. Unavailable micro-scale street map for whole Istanbul (available scale was 1:75000).

7. Differences in the data georeferencing due to some kind of projection errors (shift toward northeast).

8. GPS point's (secondary data) that were taken in the field had a shift in the XY axes and in the angle (how it have been fixed!! fortunately this technical error where discovered in the field. to solve that, extra points with certain constraints where taken. Used later in fitting (rotate and shift) those points to the original place on the buildings layer.

9. Official barrier, should asked for a lot of permission before starting the actual fieldwork. As a result, a lot of time been wasted. In the case of this research, many interviews had done according to social network (Snowball), which based on people personal permission and relationship.

10. Telling the interviewers that the research objective is purely academic and the researcher is a student, give it more credit and assistance from the females.

From the fieldwork experience, it observed that the researcher should be:

- Flexible and solve his/her problem in a way he can achieve his/her objectives and aims.
- Try as much as possible to fix the study area before leaving to the field, which give time to prepare the maps with the scale that the research aim to.
- Preparing a map for the whole city with a logical scale. In a research related to transport, mobility or movement of people, it should give the attention that it is not possible to control or pick a bounded area (i.e. neighbourhood or district).the researcher should be ready to trace the sample in the whole urban area in the city and sometime even in the suburban.

3.2.3. Summary of field work

The fieldwork in Istanbul, in its own is a very interesting experience. However, despite the limitations and obstacles that the research faced in the field, the aim was almost achieved, because in summary:

- Ninety-seven samples have been collected, while 100 samples were the target.

- A lot of social and cultural knowledge has transferred to the research, throughout the women's eyes, experiences and participation.

The knowledge and the experiences gained by working within a big institute like (IMP), at metropolitan level, which certainly give an over view of how to communicate with such institute in the future. As well as the experience get, you get from dealing with the big team of experts and professional people in the field. As conclusion, the fieldwork experience was successful and the objective of the trip achieved.

4. METHODOLOGY

Development for a framework and survey instruments is used to trace and analyse daily activity pattern of women in Istanbul. Details about this development are discussed further in the text below.

The framework development composed of in three main phases. **First phase** focus on theories and concepts describing urban planning, design and transport. That is in attempt to analyse and relate women's mobility patterns in an urban environment with respect to urban morphology elements as explained in chapter 2.

However, the **second phase** consists of two main parts, Istanbul fieldwork and data preparation. First part is related to study area and sample selection. This is done by combining transport survey techniques and GIS based mapping techniques (include participatory mapping), that will be described further in sections 4.2.1and 4.2.2. In the second part, data preparation is involved. It is carried out by data compiling, implementing, analysing and evaluating survey approaches. Besides, activities and travel pattern for the selected women are analysed.

Moreover, the **third phase** of the research is considered the most important phase. It include indicators design, implementation and spatial elevation of the criteria that been used in the analysis. The **fourth phase**, discuss the conclusion on the results that been achieved during the research.

4.1. Preparing data for analysis:

In this section, a detailed overview on the followed steps in data preparation and analysis is discussed followed by the preparation of sketch maps, as converted from a hard format (paper maps) to digital format in GIS. Data preparation proceeds, using network analysis, service area and nearest facilities ending up with activity location's map and samples network. Survey tools and techniques used in the fieldwork followed by the different steps, methods and software used to transfer the data from the traditional format (paper-based format) into digital geo database and GIS are discussed.

In addition, a description of data processing is provided in the following sections. That will be answered in the first question addressed by sub-objective one, i.e. to develop a framework and survey instrument for daily activity patterns of women in Istanbul.
Sample collection was done as follows:

- Locating the sample, asking for the permission to participate in the survey (done by the translators).
- Filling the survey question(appendix 1),
- Asking the sample (female) to locate the main activities that she visits and the possible routes she follow , Using (wooden board A3,Istanbul map scale 1:75000, trace paper and pencil). The outcome of this process is a Questionnaire and a Sketch map (see Figure 4-1).

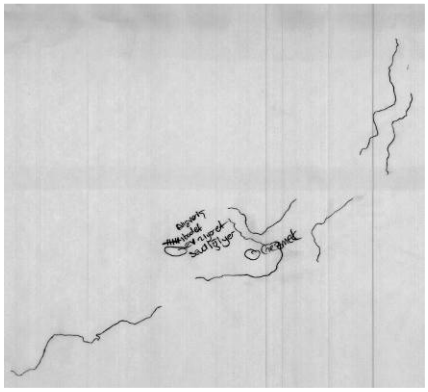

Figure 4-1: sample sketch map

4.1.1. Sketch maps:

The very first step in this process, started with transferring the ninety-seven samples from mental maps (paper format) into images to integrate it in GIS environment. GIS is the most essential part in this research. The procedure steps are mentioned as follows:

- Scan the mental maps using light scanner, which allow us to get an image format (.Jpg or .Bmp) of the maps.
- Using "Img2Cad.v7.0" software to convert the images to .dxf format that is recognized by GIS as group of layers.
- In a single file dxf Group Layer, there are .dxf(Polygon, MultiPatch, Polyline, Point, Annotation).Adding the .dxf group layer to GIS one by one, only Polyline were exported to shape file.
- After the last step, projection is defined. Istanbul projection had a problem and thus was not possible to fit different sources of data for the area together. A valid projection file from IMP dataset (district) was used which will also be used later as base map.
- The shape file is georeferenced, but still it is not in the right location. Furthermore, the sample needs to be spatially adjusted to fit the base map. How to do that? By using spatial adjustment tools in GIS like (move, rotate, scale, control points and project) until the shape gets the best fit.

After these steps, each sample has its own data entry in GIS.

4.1.2. SPSS and Excel analysis

In parallel to the conversion of the data from paper-based format to digital form, the questionnaire answers were inserted into SPSS, and used later for further analysis.

4.1.3. GIS analysis

In the GIS environment, extra data preparation was required. This is discussed further in the text below:

Buildings type layer: originally, the layer source is IMP, and it represents the buildings outlines (polygons) and the buildings' use in different levels (data table). The main problem in this layer was the language, as the data available were in Turkish and translated into English.

In the mean time, to use this data as locater of the activities, the polygons were converted to points using Convert feature to point. Why this layer is important? This layer was used most frequently in data preparation and analysis, where activity location urban form configurations, physical built up area were extracted from this layer. It was also used as visual indicators when other analysis was done (i.e. service area, nearest facilities).

Public transport stations: this file consists of public transport point (tram, metro and bus stations). IMP provided the data, but unfortunately, it was only points without identity (no station name).

In this research, it is essential to know the name of the station, as the samples identify it either as the stations that they use or as a locater for their home or any other activities. To solve that, GMap "UCL free software" was used. This software is web-based provide the user with an environment similar to Google map with the difference that you can upload your shape file into that environment and with the resolution you need (i.e. 0.5 meter) by that, the points get its identity. Details about this software is available here http://www.casa.ucl.ac.uk/software/gmapcreator.asp

Network: two road networks are provided by the source (IMP).The first network shows more detailed segments (denser) of roads within the neighbourhoods while the second network is a generalized version of the first one.

These two networks have been used in this research. The first one to trace the female's movement, resulting in "samples network", while the second was used to calculate space syntax of the city as a whole (it was not possible to use the denser network in the space syntax calculation). To use the networks in correct topological order, network dataset was created and all topological errors were corrected.

To this point, the necessary data was ready, the output datasets are as follows:

- Streets network (detailed and generalized),network dataset,
- Buildings use(polygons),
- Buildings use(points),
- Samples sketch maps,
- District, neighbourhood polygons (used as base map).

4.1.4. Samples daily routines and activity tracing:

This part is the core of activity tracing. In order to explain it clearly, the explanation will apply to one sample as a general case, which is applied to the other samples as well. The process was as follows:

1. Adding base map (districts and neighbourhood), this layer help in identifying the address of the samples house which in the most cases was considered the base to trace all the other activities as well as, the trips.
2. Locate the house, shop, school, etc. where it was pointed by the sample within the survey (sketch map ,see Figure 4-1)
3. In some cases the exact house location or the other activities is not clear from the samples (due to the map scale, a macro scale map of Istanbul was not available). Thus, the sample was encircling an area, where the female points the location of her house. In some of these cases, beside the location the neighbourhood name was mentioned. As well, the street name, where it can be located from the detailed road network.
4. In other cases where the street names were not mentioned, network analysis was used to locate the activities. For example, when there is one school in the neighbourhood and the distance is known from there to the home. The house was located in the intersection of the circle (drawn by the sample) with the area created by service area analysis. The buildings use information was used to differentiate between the nearest and farthermost side to the facilities.
5. Different combination of methods was used (i.e. locate house points, service area, nearest facilities) or (using street name locate the house and then using service area located the shop and other activities), each case considered differently with its available information.
6. After locating all possible activities for a single sample (as described before), network analysis shortest route analysis is applied to digitize the route between the points that the sample visit.
7. Applying the same process to all her trips, (i.e. home-shop-home, home, social visit-shop-home, etc.) resulted in sample(x) daily trips.
8. In the next step all samples trips were copied into one file, called "daily trips" and activity centres were called "locations" which contained activities type and sample number.

The output of this process is two maps, one is the possible activities location and the second is the samples network (samples routes). To end up with this part, the study area delineated by the intersection of the samples network with the neighbourhoods.

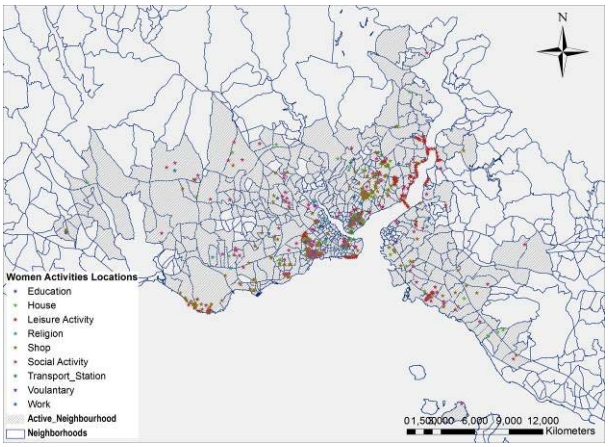

Figure 4-3: activities locations that been visited by the samples, categorized by type of activities.

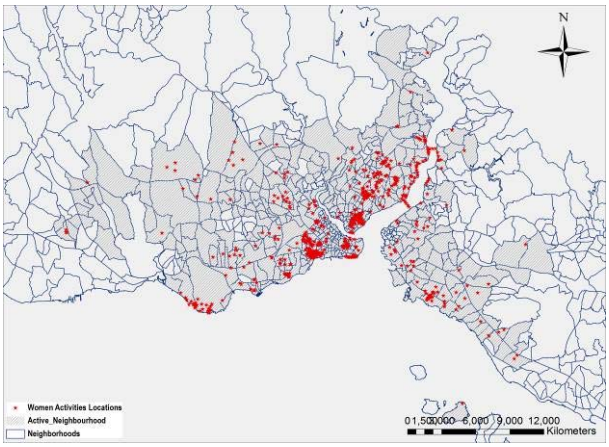

Figure 4-2: activities locations that been visited by the samples, categorized by activity distribution

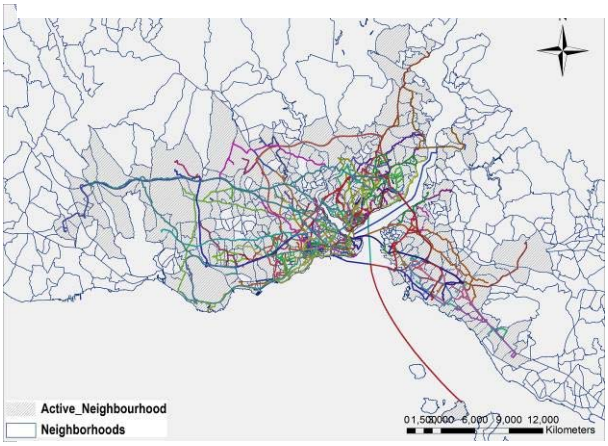

Figure 4-5: daily travel network, categorized by the individual sample

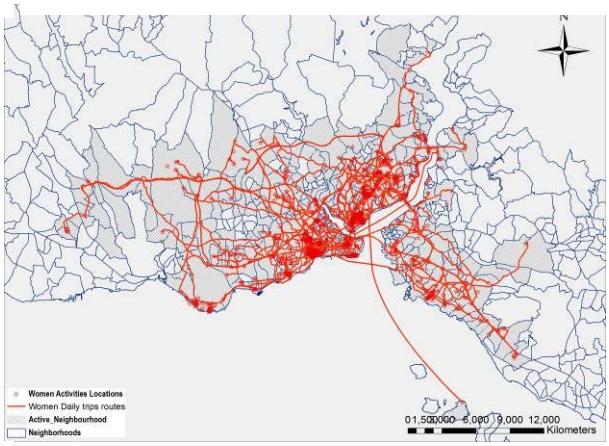

Figure 4-4: daily travel network.

4.2. Statistical analysis

Based on conducting the survey in Istanbul, some statistical overviews of the sample will be presented SPSS and Excel:

4.2.1. Demographic characteristics:

The sample survey conducted in Istanbul consisted of ninety –seven female sample aged between 18-52 years and above (see Figure 5-7). The sample included females with different marital status (single, married, widowed and divorced), from various study levels background (never attained school, primary school graduated, high school, undergraduate, college graduated and high academic degree (MSc., PhD)) and professional backgrounds (housekeeper, artist, engineer, urban planner, high school student, etc.). The income level varied between less than 300 euro per family /month to more than 3,300 euro per family/month (see Figure 4-12).

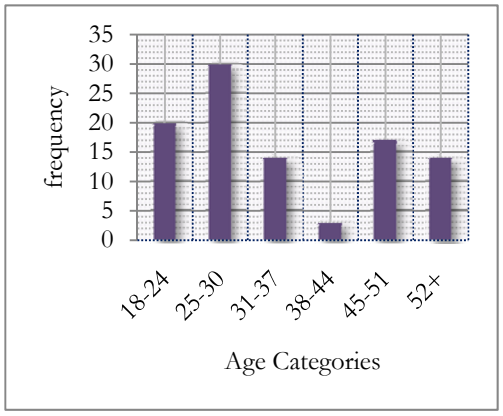

Figure 4-6: Age categories for the interviewed women

Although, the sampling method was a snowball method, the variation in observed characteristics of the interviewees was valid. The sample distribution covers an area of (465,374) km square within the central part of Istanbul. This area covers a variety in activities and mobility behaviour.

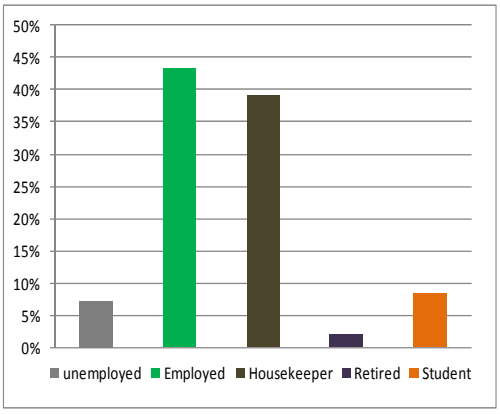

Figure 4-7: Employment statues for the interviewed women

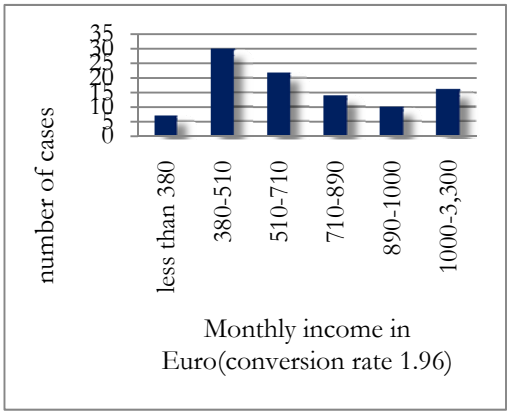

Figure 4-8: Monthly income for the interviewed women

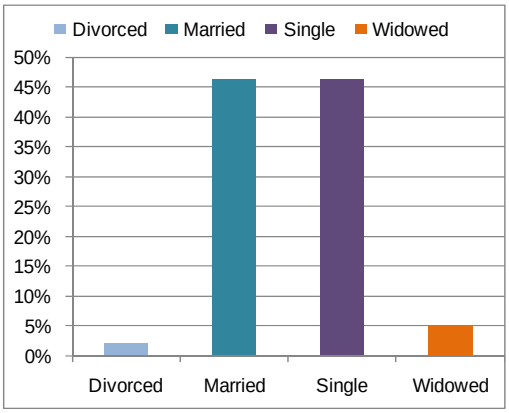

Figure 4-9: martial statues for the interviewed women

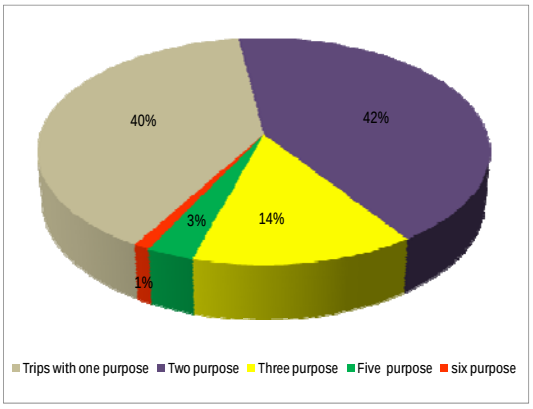

Figure 4-10: women trips chain.

4.2.2. Travel behaviour

Women tends to combine activities within their trips, as they combine several destination within one trip (Kunieda & Gauthier, 2007). However, the researcher found that women in Istanbul have six type of trip chaining (see Figure 4-10) and the dominate purpose number per one trip is two purpose chains. 40 % of the samples have trips with one purpose, 42 % with two purpose trips, 14 % with three purpose trips, 3 % with five purpose trips and 1 % with six purpose trips. To conclude on the number of trip purpose that women in Istanbul have, it is found that the majority prefer to carry out to activities per trip or one activity. While minority of the women prefer to carry out six trip purpose.

4.2.3. Travel distance:

Women trips are connected with its purpose as well as the distance travelled. Women in Istanbul on average travel 11 kilometres. Where the minimum distance travelled is 0.39 km and maximum distance travelled 75 kilometres.

4.2.4. Travel motivation:

Urban mobility is highly connected with the motivation to do the trip. Women in Istanbul have six reasons to do a trip, where social activities are the strongest activates that make women leave the home (see Figure 4-10). However, the recorded activities were from high to low, social, shopping, work, leisure, study and religion. In conclusion, women in Istanbul tends to carry out social activities more frequently than others while Religion activity is the least activates that been carried out.

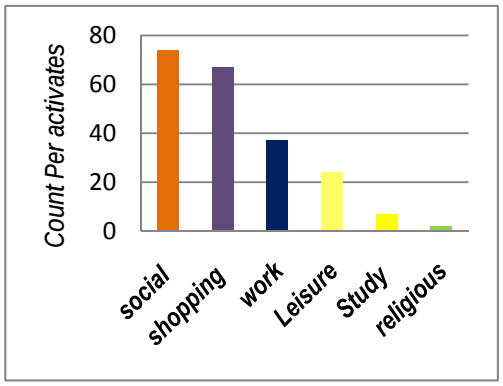

Figure 4-11 : Women motivation to do a trip, count of number of the responses.

4.2.5. Times spend per activities:

Any activities carried out are connected with time duration. In Istanbul, women spend on average 2 hours per activities, the highest time spend was in social activities (see Figure 4-12). It is found that women spend minimum time to carry out religious duty were they spend from 15 minute to 5 hours while they spend maximise time to carry out social activities, were they spend from 1 hour to 16 hours. From 15 minute to 8 hours in housekeeping, 20 minutes to 7 hours in voluntary activities, shopping 20 minute to 8 hours shopping.

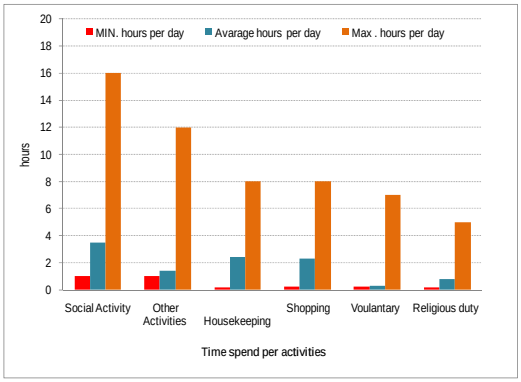

Figure 4-12: times spend by interviewed women per activities

Concluding that minute time send to carry out an activities in Istanbul is 15 minutes for housekeeping and religious duty and 5 to 18 hours to carry out social activities.

To conclude on the collected sample, women in sample have variation in the socio-economic characteristics in term of age, income, martial statues and education level. However the interviewed women are showing active travel pattern and variation in term of activities distribution, travel motivation, time spend per activities, distance travelled and trip chains that been carried out.

4.3. Indicators design :

This chapter provides an overview of the morphological indicators as well as mobilisation indictors as described in literature and operationalized in this research. First, the indicators election is discussed, followed by justification, preparation and comparison. Finally results and conclusions are given.

4.3.1. Indicators

The aim of each individual indicator is to describe one aspect of urban morphology based on Lynch taxonomy (see chapter 2). A matrix of morphology indicators (see the following section) will be providing a conclusion on how all urban elements are interacting with human behaviour (the women's travel) and with each other.

4.3.2. Indicator selection

To explain human behaviour, in ideal environment, the investigation should consider two main dimensions linked to human life, which are social and physical dimension. Social dimension means, human communicate among each other, performing their daily chores like (shopping, school, work, etc.) and observing the surrounding environment based on his/her personal vision and experiences. While, physical

dimension means, human interaction with built-up elements like (building, streets and the use of those elements (i.e. commercial blocks of buildings, main streets, playgrounds, etc.).

Logically it is not possible to follow each individual and capture what he/she sees and observes. While, scientifically there are a number of researches that has been studying human behaviour, dealing with different aspects of human daily life (Bentley, 1985; Hillier, 1999; Kim & Penn, 2004; Lynch, 1960). In order to be able to track that behaviour which considers as a qualitative aspect, it is essential to provide some measurements. These measurements are based on number of measurable quality keys (i.e., visual permeability, variety of use, connectivity and accessibility).

So what are these quality aspects means and what it will measure? Bently (1985) linked the number of choices that a place offers to its permeability. Likewise, he addressed visual permeability of a place, with its location inside the surrounded routes network. Where, those places become visually accessible when the network surrounds them.

Variety of use is the variety of choices that a place offers in terms of access or use(Bentley, 1985). When that happens, that place directed toward high attraction and permeability. As the place become highly attractive, the concept of natural movement applied to that place. as the attraction increase, the place become like a magnate and attract more and more movement toward its (Hillier & Iida, 2005). Whereas, accessibility is a function connected to structure pattern, connectivity and legibility of the place (Steniner,F. et al., 2007). Based on what been addressed on quality aspects, a number of indicators have been established.

4.3.2.1. Urban morphology indicators

The chosen indicators in terms of urban morphology have two main categories. The first set of indicators are based on the physical elements of the built environment, while the second are based on the function of these elements

Physical classification

1. Physical area
    a. Built up, street area percentage (per neighbourhood).
    b. Structure pattern (per neighbourhood).
2. Network topology
    a. Connectivity,
    b. Local integration and
    c. Global integration.

Functional classification

1. Location use.

Figure 4-13 shows urban morphology main elements as well as urban motilities extracted elements .In addition th figure shows the link between urban morphology and urban mobility indictors.

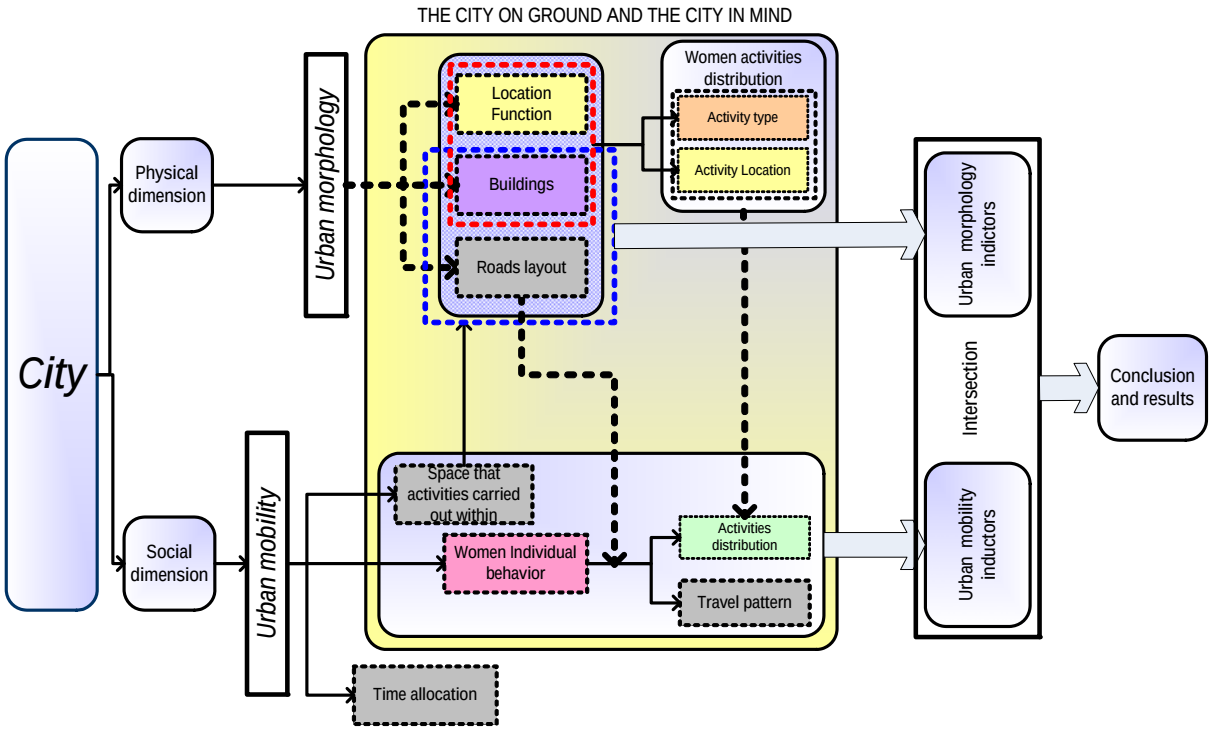

Figure 4-13: link between urban morphologhy with urban mobility .

Physical Indicators

Any physical feature can be defined by describing it's geometric measurements (width, length, high, area and volume). As well as it's physical shape as linear, curved or irregular. Then linking both configurations such as grid, grid and square, radial, web, irregular or curvilinear can be obtained. Therefore, a set of indicators is set to define these characteristics in terms of

- Physical area percentage (street, buildings area).
- Urban form physical configuration. Figure 6-2 shows urban morphologies elements that been used to extract its indicators as well as the interrelationship between the key quality measurement that the indictors set to measure.

The aim of these indicators is **to model and map the urban geometry of Istanbul, focusing on expressing urban street morphology**. Moreover, answering the question **"How can urban form be defined and quantified?** " and **partly studying the effect of built environment structure (in terms of urban street morphology) on urban mobility and activity patterns.**

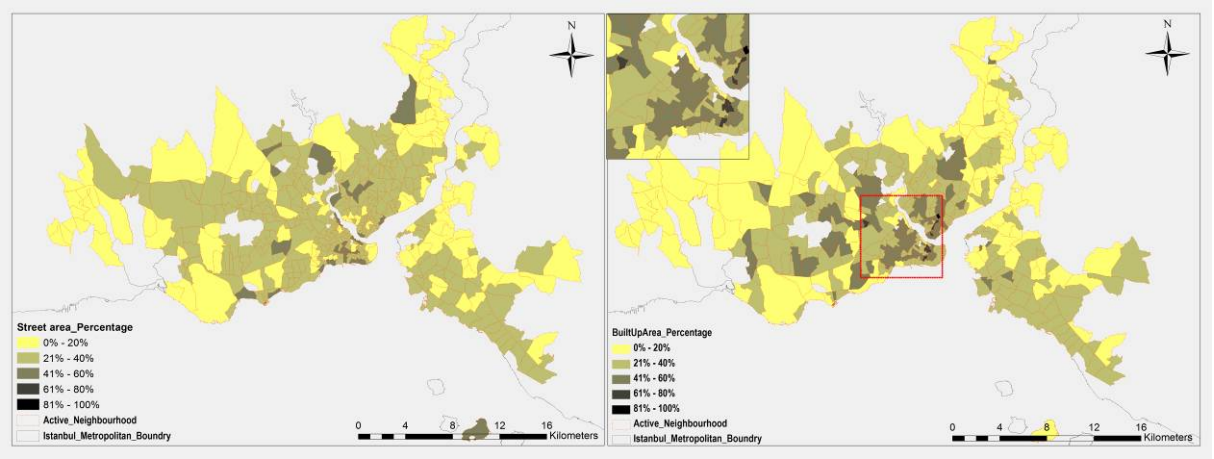

Figure 4-14: (a) physical area percentage (street) area per neighbourhood. (b) Physical area percentage (built uP) area per neighbourhood.

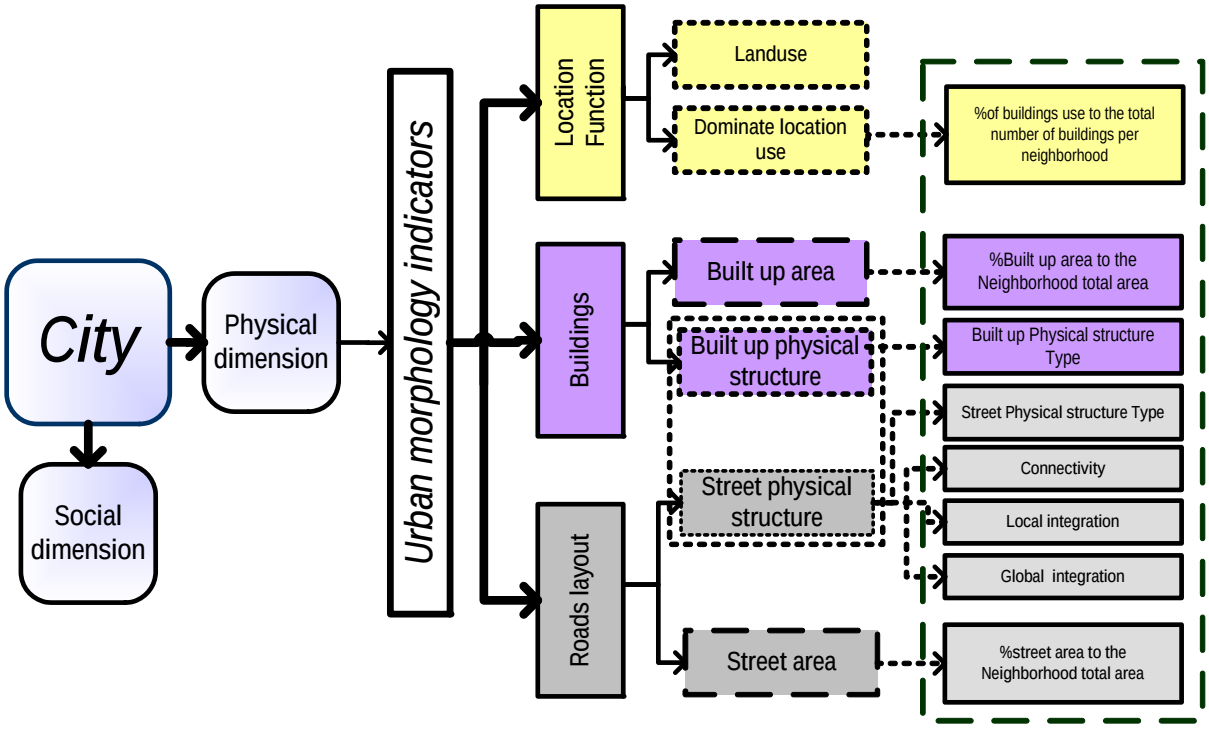

Figure 4-15: urban morphology inductors extraction.

A. Physical area (built up, street area percentage) per neighbourhood

Physical area is the percentage of area located for the buildings, streets per an urban unit i.e. neighbourhood (Gerçek & Demir, 2008).This indicator is highly connected to the physical urban form (reference) and location use (reference) indicators. Designers locate an area with a certain geometrical measurement (length, width and area) to an urban unit, shape it physically and assign a specific function to its elements such as street and buildings.

By setting this indicator, the effect of the build-up area, in terms of street area in the neighbourhood can be studied. A global figure states that at least one-third of all developed urban land is devoted to roads, parking lots, and other motor vehicle infrastructure.(GÖKARIKSEL & MITCHELL, 2005).

The hypothesis is that a neighbourhood with a high percentage of built up area around 60% and street area around 40% will increase pedestrian's walk ability. As well as, it will increase the location variety of use. That category is considered as the highest attraction zone within the study area in terms of physical area percentage. Figure 4-14(a) shows the study area categorized into five equal categories of streets per neighborhood. While, Figure 4-14(b) shows the study area categorized into five equal categories of built up neighborhoods.

B. Urban form physical configuration

This is the physical configuration of urban environment, meaning the arrangement of physical shape within an urban unit (street, buildings) in the way that urban designer sees it as the best arrangement of the physical form. Traditionally, designers and planners tried to improve the physical form of urban edges; ignoring the physical and social impacts of standardized streets patterns on urban environment(GÖKARIKSEL & MITCHELL, 2005). Standardized streets patterns, have a big effect on location use suitability (Figure 4-16).

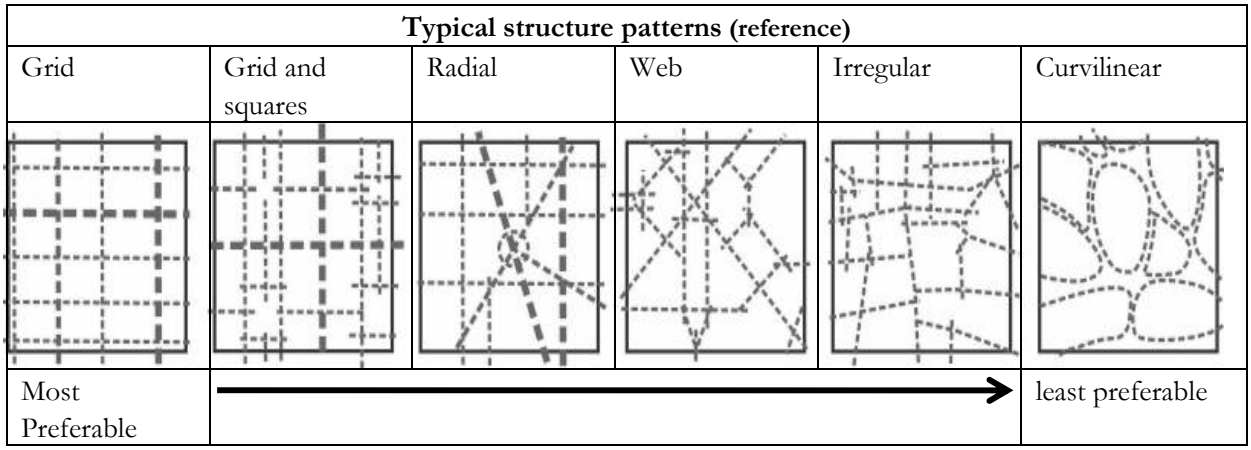

Figure 4-16: Typical structure patterns ((Gerçek & Demir, 2008))

Similarly, Southworth & Ben-Joseph (2005) linked neighbourhoods spatial configuration with the suitable function for that neighbourhood. They found that a Grid structure configuration of a neighbourhood makes it suitable for dense buildings, commercial use and most likely to be a city centre. That type of structure would make it visually highly permeable and accessible for pedestrians. They also found that a neighbourhood with a curvilinear structure should be highly suitable for single row houses and residential use which make that neighbourhood highly accessible for vehicles and less desired for pedestrian walk.

Figure 4-16 shows a general comparison between the most preferable structure pattern by the neighbourhood resident and the least preferable pattern. Place quality is affected by its design, in terms of the choices that it would be offered to peoples within that place(Bentley, 1985). Missing the link between the design and the function assigned to the place, would make it unresponsive to use.

Physical structure type	Rank	Benefit	Disadvantage
Grid	1	+Attractive for pedestrian walking trips +Suitable for Commercial use +Attractive for properties developer +High accessibility +Mostly is in the city centre	+Pedestrian Longer trips +Vehicle congestion +More street utilities (i.e. lighting) +Fewer vehicle routes +High percentage of street area +Highly polluted +Unsafe for children, neighbourhood unfriendly
Curvilinear	8	+ Attractive for vehicle trips +Orienting the traffic towards large classified roads +Mostly is in the suburban area	+Pedestrian shorter trips, high cross section between pedestrian and others transport modes +Disorienting for pedestrian +Low accessibility

Table 4-1: comparison between a two typical structure patterns grid and Curvilinear in term of Suitable location use, accessibility and attractiveness.

Figure 4-17, shows the physical structure of the study area. A total of eight different types of the structure patterns, six of them are similar to the typical patterns (figure 4-16) was found. While two of them are a transformed structure pattern from the original one like irregular +grid and square and irregular +Grid, figure (4-17)shows detailed examples of all structure patterns found in Istanbul.

C. Network topology

This group of indicators is focusing on physical topology of road network. To answer question 2-sub objective 3, three measurements of space syntax are chosen, connections, global integration and local integration. The following paragraphs will include the main theories of space syntax and the three measurements. In order to evaluate the influence degree of urban structure arrangement on the movement within built up environment. Hillier(1999) established the concept of space syntax, Based on two theoretical concepts "Natural movements" and "Movement economy".

Natural movement concept is proposed in order to attract and generate movement within an area, that area should have a homogenous distribution of urban form. That distribution will lead to equality within all other elements, and will give the opportunity to use the spatial network arrangement to explain the movement within that space, based on considering the movement as the linkage between the buildings in the system. Whereas, the ***movement economy*** concept, proposed that there is a "central dynamic" behind the spatial growth of a cities. Where it link the spatial growth of any city with its own developed grid structure ,its natural movement to the density and distribution of its land use and built forms. Using gravity concepts, where new areas with attractive landuse (i.e. markets and retail) will attracts naturally high movement, while land use with low attraction will redirect movements towards high attraction area.

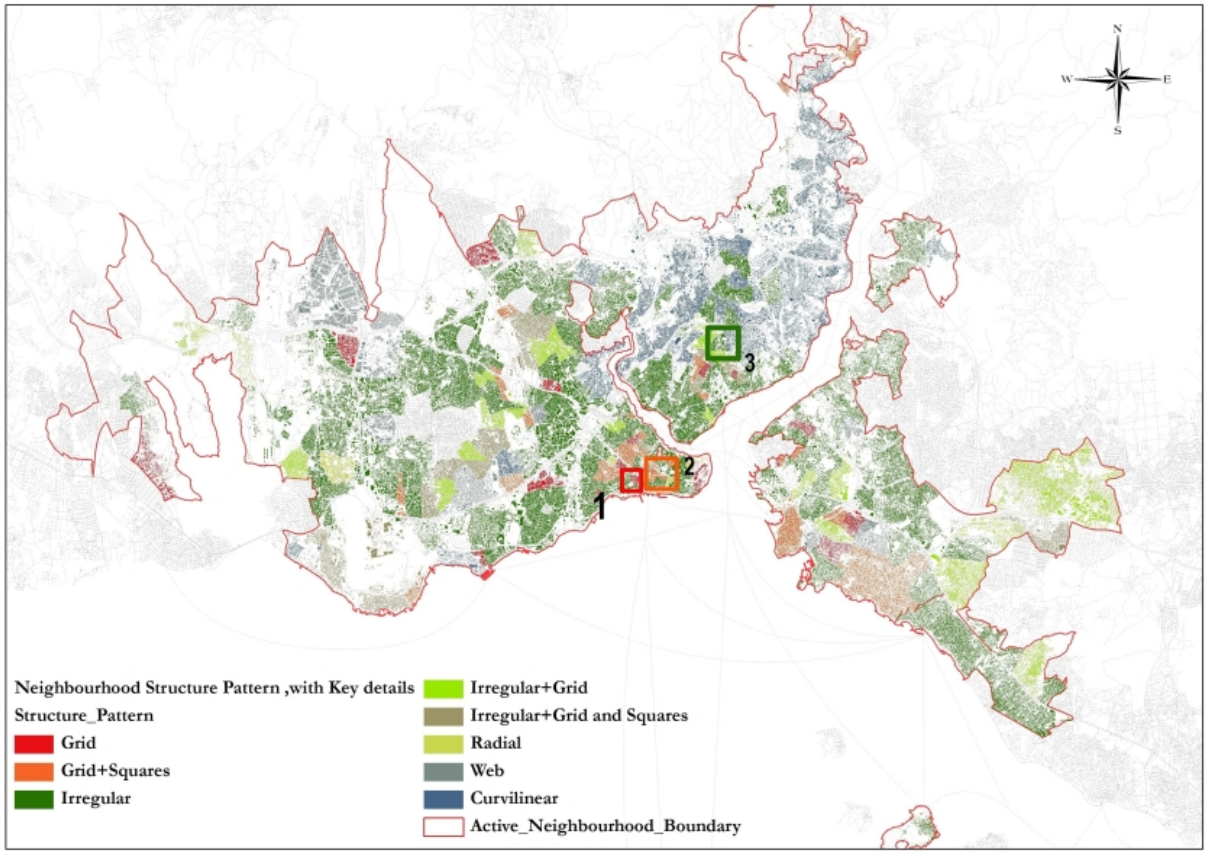

Figure 4-17: Neighbourhood structure configuration, Istanbul 2006, source IMP.

Figure 4-18: Neighbourhood structure configuration, details analysis

Using graph theory, the abstract topological relationships between network elements can be investigated. Network essential elements are lines, nodes and junction. Space syntax is focusing on lines instead of nodes or junction. In space syntax the output of the street graph is not planar, thus it is not proper to call it as graph map instead it have been called as axial maps and the lines as axial lines (Batty, 2004).

This study will use three space syntax measurements. These measurements are, connectivity based on the direct elements of the network (Figure 4-19), Global Integration (Figure 4-20) and Local Integration depending on the indirect links of the network (Figure 4-21).

a. Connectivity:

A connectivity measure is the measurement that depends on the direct links between elements, measuring the direct contact between point _line or line _ line that is directly linked to them (Batty, 2004).

b. Global integration

This index called as "Global integration index (GIntg)" or "Integration Core Index". Basically it is the sum calculation of the minimum number of dominant lines that must be used in a whole or in part, to go from Line to another with no limits or radius-n (Hillier, 1999). Although, this measurement index gives us a clear indicative, still it has limited logic on how the city structured and how it functions. As the Global index is limited to the in giving a macro scale explanation, Local Integration index would be efficient at that level.

c. Local integration

"Local integration (LIntg)" or "radius-3 index", it have pure spatial capability in explaining movement patterns for both pedestrian and vehicle(UN-HABITAT, 2008). Local Integration, basically is the sum calculation of the minimum number of intervening lines that must be used in a whole or in part, to go from line to another with a restriction of three lines on the radius of the measure (Hillier, 1999).

Local integration index, indicative movement's pattern locally, at the same time gives across area structure. Through, presenting more detailed depiction of the movement structure, showing the real busy route within the city which is highly used by its people. Local integration is important at the level where we want to connect to area with each other while Global integration will be influenced by the connection between the new area(certain areas boundary) or the core with the whole (city boundary limits).

Function

4.3.3. Location use

It can be defined as the dominate characteristics of the buildings use per neighbourhood (i.e. 50 % residential _ 30 % Institutional, 20 % commercial), the calculation of this indicator is done by:
Count of the number of buildings with a certain use i.e. commercial use in a neighbourhood to the total number of the buildings percentage.

$(\sum$ Buildings of the same use per neighbourhood$/\sum$ total buildings in the neighbourhood $)\%$

Then compare the different type of location use to get the dominate location use per neighbourhood.

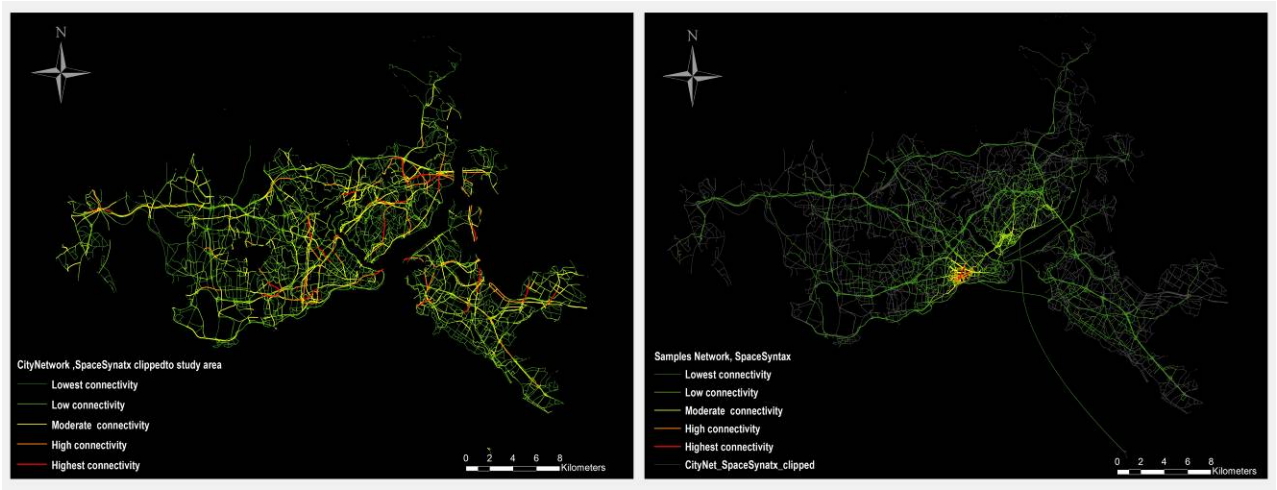

Figure 4-19: (a) space syntax "connection "index for the city ,(b) space syntax "connection "index for the sample.

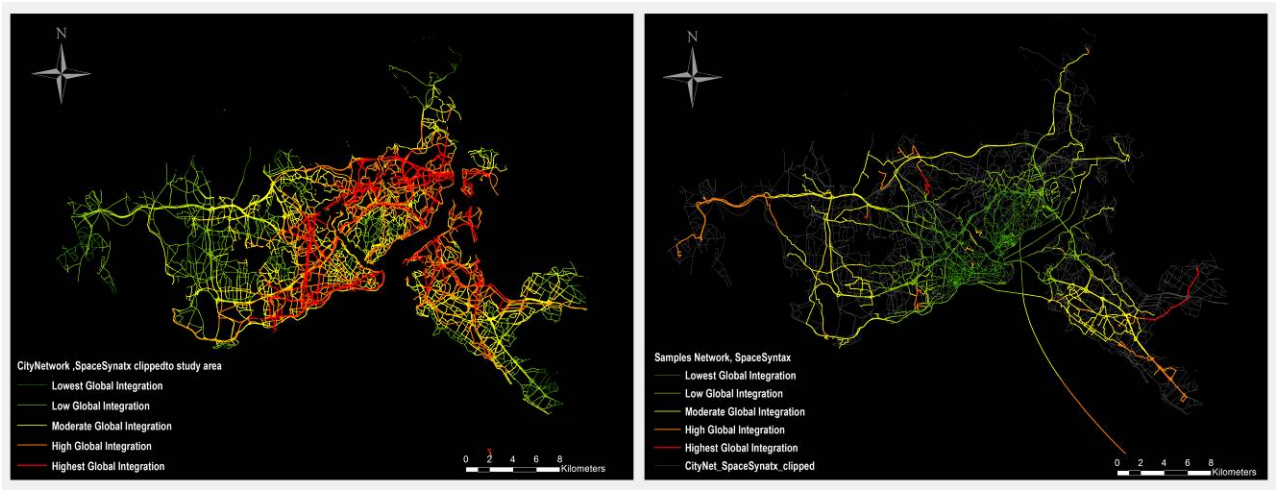

Figure 4-20: (a) space syntax "Global Integration "index for the city, (b) space syntax "Global Integration "index for the sample.

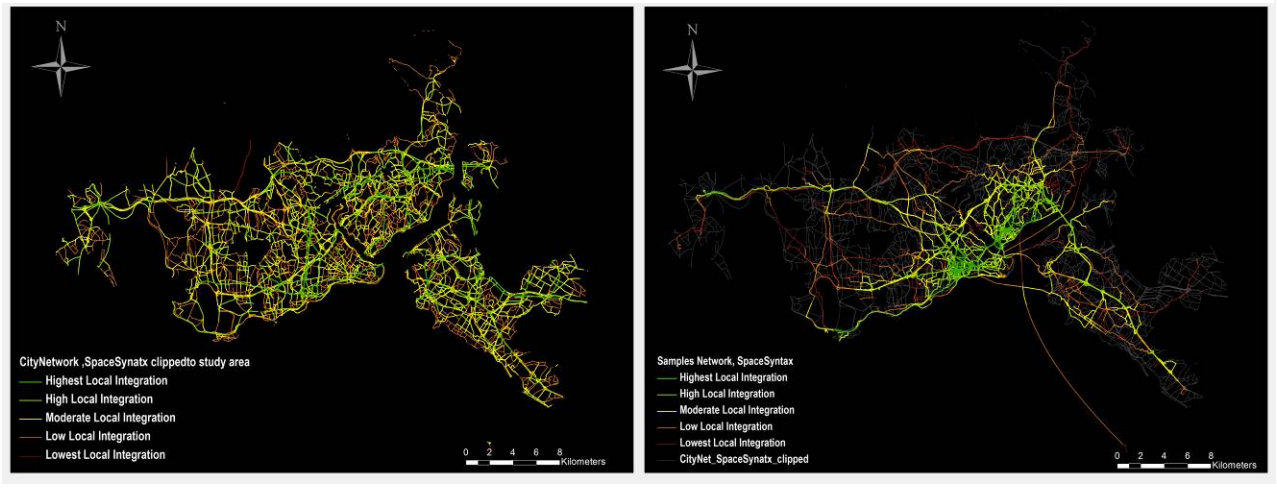

Figure 4-21: (a) space syntax "Local Integration "index for the city, (b) space syntax "Local Integration "index for the sample.

In the setting of this indicator, it is hypothesised that attractiveness level of a neighbourhood is connected with the mixture of building use in that neighbourhood. Increasing the mixture (mixed use (residential and shops), commercial, social and institutional) would attract more people to it while increasing the industrial and commercial only will make that neighbourhood less attractive. Thus, the variety of use, permeability and accessibility will increase; more females will be visiting that area.

In order to apply that, a reasonable categories of location use was essential .were, two main references are adopted. That been addressed as follow, First, based on the samples collected from the field, the statistical analysis shows activities ranked based on women's motivation to leave the house(see figure 4-11), the time (Hours per day) women spends per each activity (figure 4-12). Second, based on architectural guidelines for traditional neighbourhood design, Summarized in the table below

Land use	Commercial	Civic	Public	High residential	Low Residential	Work places
Min	2%	2%	5%	20%	60%	2%
Max	30%	-	-	60%	-	30%

Table 4-2: architectural guidelines for Traditional neighbourhood design ((Gerçek & Demir, 2008)

Category
Neighbourhood more than 60% Mixed use _ less than 30 % Commercial
Neighbourhood 45-60 % Mixed use _ 20% Industrial
Neighbourhood 30-60 % Mixed use _ 1-30 % Institutional
Commercial Neighbourhood >30%
Industrial Neighbourhood >30%

Table 4-3: neighbourhood location use found in the study area

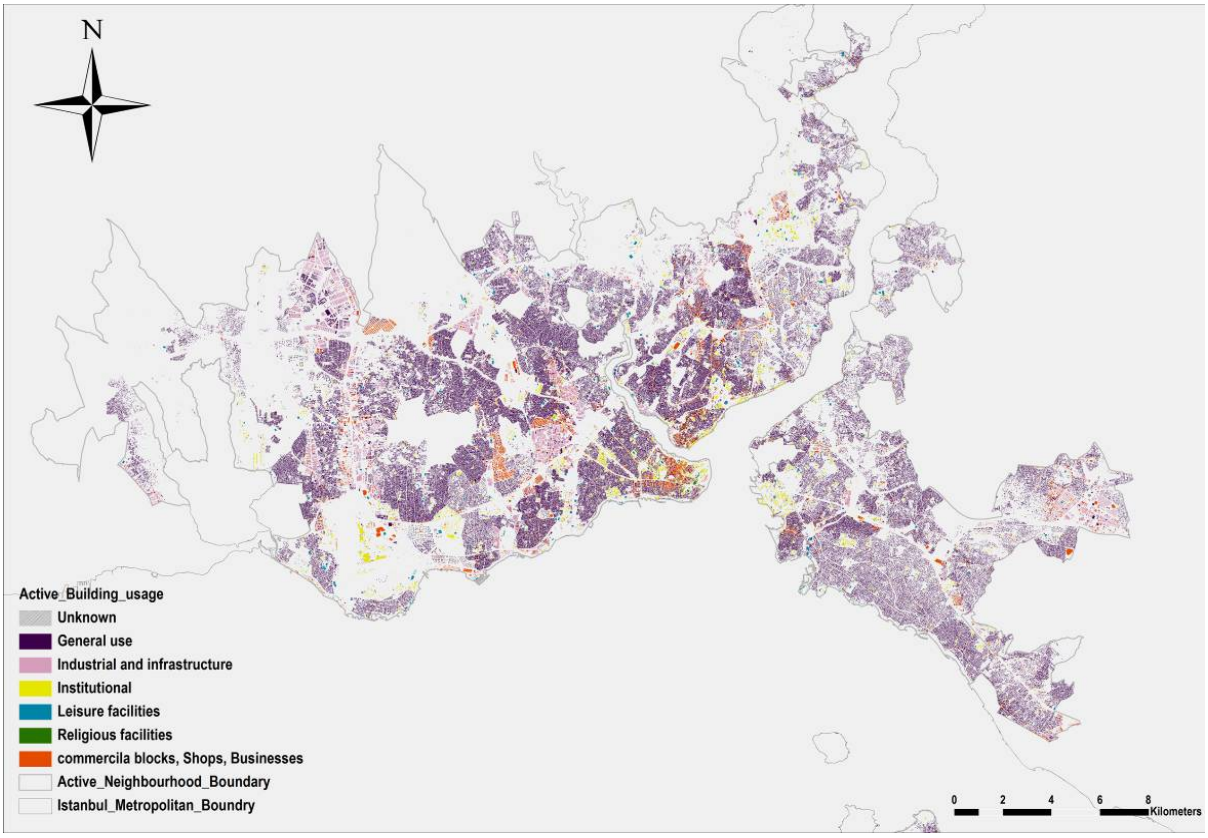

Figure 4-22: Building use, Istanbul 2006, source IMP.

To observe the effect of urban morphology on urban mobility, it is essential to provide a link between urban morphology elements and urban mobility elements, focusing on human activities. This link is addressed in figure chapter .to achieve that, the following paragraphs will be addressing urban motilities indictors which has been designed to measure and analysis that effect.

4.3.3.1. Urban mobility indicators

Human is the connection between urban mobility and urban morphology. Women and men have different requirements and activities need to be carried out in urban space. These needs are spatially distributed within the urban space, generating activities location. This can be called travel generator, as it is the motivation to travel. The connection between these activities is called a trip which is spatially distributed within the urban space. Accordingly, the following indictors were set:

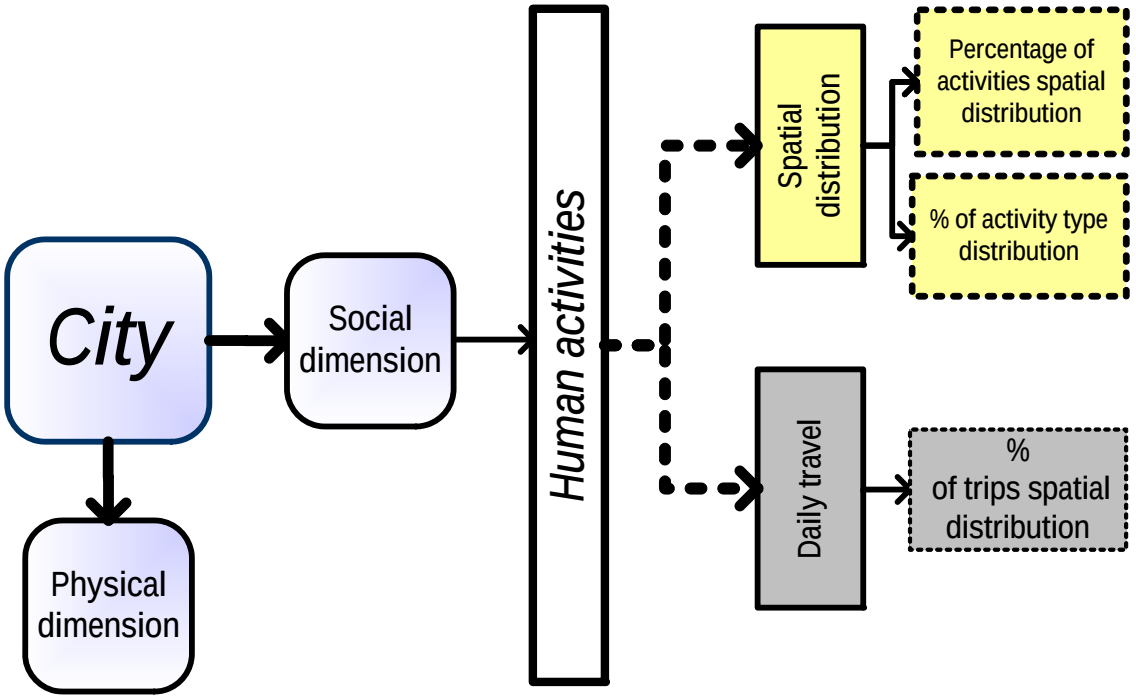

Figure 4-23: Urban mobility Indicators

A. Spatial Activities distribution:

This group of indicators will be dealing with spatial location of the activities that been carried out in the city by the samples. The available knowledge for these indictors is the spatial location of activities in terms of percentage of activities distributed within one attractiveness zone and percentage of activities type distributed per one attractiveness zone. The aim of this group of indictors is to measure the effect of urban morphology indictors on the spatial activities distribution and type.

a. Percentage of activities spatial distribution*:*

This indictor is set to measure the effect of urban morphology individual's elements and urban morphology cumulative index effect on the spatial distribution of the activities, which has been carried out by the women. To process with that, the work will be done on three levels:

First, selecting the activity points that are located within all attractiveness zones per each indictor. The selection will be done by spatially locating the points of activities, which have its centroid inside the attractive zone. Second, recoding the count and finding the percentage of activities point within that attractiveness zone. By that, the research can observe the effect of single indictors of the spatial distribution of activities location, by applying the following formula: ***Single indictor effect degree = highest percentage of points location per one attractiveness zone / total percentage of activities per that zone***.

	No. of total activity point within	*Leisure*	*Religion*	*House*	*Education*	*Shop*	*Social*	*Transport*	*Voluntary*	*work*
Lowest attractiveness	*13*	1	0	3	1	2	6	0	0	0
Low attractiveness	*71*	30	2	4	0	23	11	0	0	1
Moderate attractiveness	*137*	23	6	15	4	45	36	1	1	6
High attractiveness	*407*	54	23	50	8	170	86	1	0	15
Highest attractiveness	*161*	43	2	24	4	40	21	7	0	20

Table 4-4: activities location distribution in respect with physical area indictors

Physical structure	Leisure	Religion	House	Education	Shop	Social	work
Lowest attraction	1%	0%	3%	6%	1%	4%	0%
Low attraction	20%	6%	4%	0%	8%	7%	2%
Moderate attraction	15%	18%	16%	24%	16%	23%	14%
High attraction	36%	70%	52%	47%	61%	54%	36%
Highest attraction	28%	6%	25%	24%	14%	13%	48%

Table 4-5: percentage of activities location distribution in respect with physical area indictors

b. Percentage of activity type distribution:

This indictor is set to measure the effect of urban morphology individual's elements and urban morphology cumulative index effect on the spatial distribution of the activities types i.e. commercial, mixed-use, industrial etc. which have been carried out by the women. Following the same step as in the previous indicator, this indictor will be processed.

B. Daily travel:

Women in city tends to take more shorter trips at more varied time(Kunieda & Gauthier, 2007)their trips seems to be more costly In terms of time and money. In addition women trips travelled to far destinations seem to be more at off peak. That was found comparing mean kilometres travelled to the mean kilometres of the total network they (Kunieda & Gauthier, 2007).

a. Percentage of trips spatial distribution:

This indictor is set to measure the number of women trips that travelled per urban morphology attractive categorize. The objective of this indictor is to see on average how much each trip is affected by categorize attractiveness. To operational this indictor, first intersection is done between the trips carried out by the women with the Attractiveness categories of each individual indicators and the urban morphology indices.

Followed by finding the percentage of trips passed by the indictor's attractiveness categories and find the percentage to the total number f the trips.

% of the samples pass by	Location use	Structure configuration	Physical area	Space syntax City	space syntax Sample
Highest attractiveness	96%	50%	4%	2%	0%
High attractiveness	0%	41%	95%	56%	21%
Moderate attractiveness	3%	6%	1%	41%	55%
Low attractiveness	1%	3%	0%	1%	18%
Lowest attractiveness	0%	0%	0%	0%	5%

Table 4-6

% of the trips pass by	Sample Activeness index	sample Attractiveness categories	City Activeness index	average % of trips pass by Attractiveness categories _City
Highest attractiveness	7%	37%	33%	38%
High attractiveness	74%	39%	67%	48%
Moderate attractiveness	15%	16%	0%	13%
Low attractiveness	3%	6%	0%	1%
Lowest attractiveness	0%	1%	0%	0%

Table 4-7

Second, a comparison between the average percentages passed by each categorizes for the individual indictors. For example;
Location use indictor, % of the trips pass by highest attractiveness categories +
Physical configuration, % of the trips pass by highest attractiveness categories +
Physical configuration, % of the trips pass by highest attractiveness categories +
Physical configuration, % of the trips pass by highest attractiveness categories = sample Attractiveness categories then compare that % with the sample Activeness Index per categories.

That is done to see the difference in the effect between the individual indictors and the cumulative value. To understand the interrelationships between the quality keys and the established Indicators, (figure 4-13) is addressing the connection between the different elements. In order to achieve the indicators aims, it is essential to create an index combining all the measurement values that each individual indicator carries. The resulted index will be measuring neighbourhood's activeness in terms of location variety of use, visual permeability, walk ability, accessibility and connectivity. The calculation and the combination of all urban morphology indicators were done in ILWIS. While the link between urban morphology and urban mobility is done in GIS and Excel which will be discussed further in results chapter. The following chapter will be giving a detailed description on the process carried out in ILWIS.

5. ANALYSIS

5.1. Spatial Multi Criteria analysis

This chapter will discuss in brief the process that has been followed to evaluate the indicators and create an activeness index of urban morphology for Istanbul in ILWIS. To achieve this, it is essential to combine, weight, balance all indicators (spatial factors), and create the "Activeness Index". To do so, Spatial Multi Criteria Evaluation (SMCE) analysis has been applied.

Multi-criteria analysis gives possibility of considering large range of information layers. That is through identifying, developing and evaluating the system environment. Besides, it facilitates choosing and producing different alternatives for the same problem. However, multi-criteria analysis gives intensity for preference with quantities. It gives opportunity to choose specific criteria for a given alternative, attach weight to each single criterion and evaluate the relationship of each single alternative with all the other alternatives (Fülöp, 2005; Munda, 2003).

Moreover, SMCE has some disadvantages. Some criteria might have a high advantage and another criterion has low advantage. In the process of combining all criteria, the high value might cover the lowest value, resulted in an aggregated vision of the problem.

To overcome this drawback, the research uses the final output of SMCE together with the output of each individual indicator to observe the hidden cause behind the problem. For example, low value of the individual indicator such as investigating the reasons behind the areas that the women try to avoid in their daily trips.

5.1.1. Multi criteria tree:

SMCE is processed by creating a multi criteria tree, followed by applying equal weight to the four main groups of the spatial factors listed below:

- Physical area percentage per neighbourhood;
- Structure pattern per neighbourhood;
- Network topology (Connectivity, Local integration and Global integration.) ; and
- Location use.

For each group of factors (per indicator factors) different weighting methods are applied, mainly "Outranking _Pairwise comparison" and "Rank Ordering _ Rank sum" Methods is used.

5.1.2. Weighting methods:

5.1.2.1. Outranking _Pairwise comparison:

This method is based on Multi-attribute Utility Theory (MAUT) and outranking methods used when the factors cannot compensate each other. This weighting method applies the nominal variable to identify that variable and though compare it with others (Fülöp, 2005; Sharifi, van Herwijnen, & van den Toorn, 2007).

MAUT methods are organized based on combining the different criteria into a function, which has to be maximized". This theory allows complete compensation between criteria, i.e. the gain on one criterion can compensate the lost on another"(Fülöp, 2005). A partial ranking of an outranking method may not render the best alternative directly. Some of the alternatives are determined in such a way that they are not in the subset outranked by at least one member of the subset to make this subset as small as possible. This

subset of alternatives is considered a shortlist that has a good compromise alternative can be found by further considerations or methods.

5.1.2.2. Rank Ordering _ Rank sum:

Rank sum method, is a weighting method where a numerical weights is generated from a rank order of the criteria combined with a multi-criteria method that always lead to complete ranking. The rank order is not always in agreement with all the possible quantitative weights and is therefore not entirely certain .However, for rank order method, the most important factors are at the top where rank-order calculates a numerical weight using either the expected value method or the rank sum method (ILWIS help guide).

5.1.3. Urban morphology indicators:

A. Physical area (built up, street area percentage):

As described in section 4.3.2.1A this indicator consists of two main elements

- Percentage of built up area
- percentage of street area

In Istanbul city within the study area, it is found that on average the street area is 26 % of the neighbourhood's area while the built up area is 34 % of the neighbourhood area. According to chapter 4, indicators selection and categories, the following table shows the categories values been adopted in the evaluation of the indicator:

Per Neighborhood	**Attractiveness For people**
High % Built up area	*Highest attractiveness*
Low % Built up area	*High attractiveness*
High % Street area	*Low attractiveness*
Low % Street area	*Lowest attractiveness*

Table 5-1: neighbourhood evaluation value.

In order to give a reasonable weight to the spatial factors, outranking _Pairwise comparison method has been used; Table 5-2 is providing an overview of the weight process. The outcome of this process is presented in figure 5-2 where dark green represent the most attractive zones while dark red represent lowest attraction zones.

Per Neighbourhood	High % Built up area	Low % Built up area	High % Street area	Low % Street area	Weight results
High % Built up area		*Strongly more important*	*Strongly more important*	*Strongly more important*	0.613
Low % Built up area			*Moderately less important*	*Equally important*	0.089
High % Street area				*Moderately more important*	0.209
Low % Street area					0.089

Table 5-2 : Weight process using outranking _Pairwise comparison.

B. Location use:

This indicator mainly depends on five nominal categorizes. According to chapter five, indicators selection and categories that been summarized in table (7)

Per Neighborhood	Attraction Level
Neighbourhood more than 60% Mixed use _ less than 30%Commercial	*highest attraction*
Neighbourhood 30-60 % Mixed use _1-30 % Institutional	
Commercial Neighbourhood >30%	
Neighbourhood 45-60% Mixed use _20%Industrial	
Industrial Neighbourhood >30%	*Lowest attraction*

Table 5-3: location use indicator categorizes, ranking order and weighting justification

The method been used in the weighting process is rank ordering. The percentage of mixed use and industrial use is mainly used in the decision to assign the ranks. The criteria to rank the neighbourhoods were set as follow:

Category	Rank	Weighting method(Ranking order)	Weight results
Neighbourhood more than 60% Mixed use _ less than 30%Commercial	*1*	*1st*	*0.29*
Neighbourhood 30-60 % Mixed use _1-30 % Institutional	*2*	*2nd*	*0.24*
Commercial Neighbourhood >30%	*3*	*3rd*	*0.19*
Neighbourhood 45-60% Mixed use _20%Industrial	*4*	*4th*	*0.14*
Industrial Neighbourhood >30%	*5*	*5th*	*0.10*
No data	*6*	*6th*	*0.05*

Table 5-4: Location use indicator categorizes ranks and Weight method

The evaluation of this indicators shown in figure 5-1.

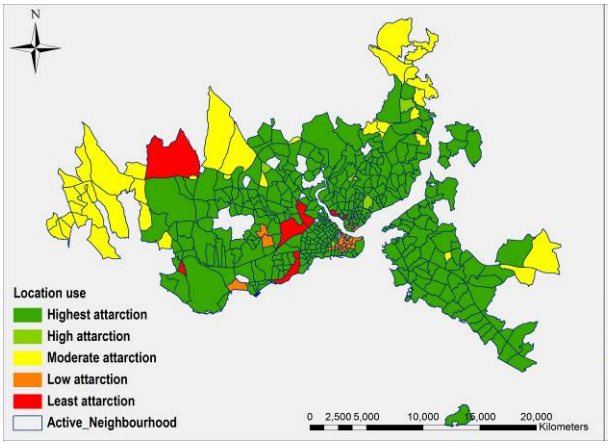

Figure 5-1: Neighbourhood percentage of location use

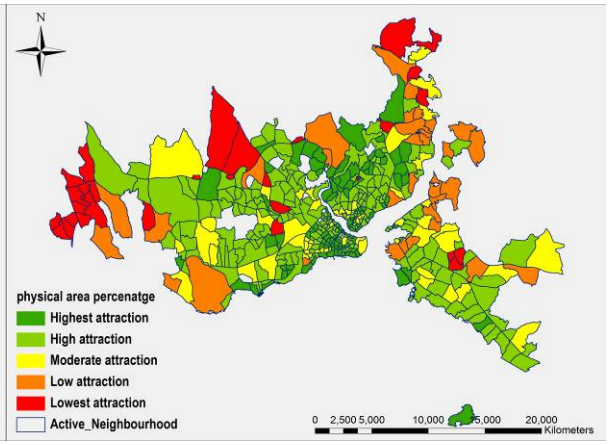

Figure 5-2: Percentage of physical area per neighbourhood (Street, built up) area

C. Urban form physical configuration:

Based of the visual interpretation of physical shape of urban unit, the setting of this indicator were done Figure 4-17.According to that the different categorize were ranked, weighted and evaluated as follow:

Category	Accessibility	Rank	Rank sum	Weight results
Grid	*highest attraction*	1	*1st*	*0.22*
Grid and Squares		2	*2nd*	*0.19*
Radial		3	*3rd*	*0.17*
Web		4	*4th*	*0.14*
Irregular + Grid		5	*5th*	*0.11*
Irregular + Grid and Squares		6	*6th*	*0.08*
Irregular		7	*7th*	*0.06*
Curvilinear	*Lowest attraction*	8	*8th*	*0.03*

Table 5-5: structure configuration

The weighting methods that been used for evaluating this indicator factors was rank sum. Figure 5. Shows the output of the evaluation.

D. Physical network:

As this indicator deals with different measurement, each one of these measurements is explaining the movement patterns in the city differently; the decision was to assign equal weight and rank to each:

Category	Rank	Weight results
Connectivity	*Equal*	*0.333*
Local Integration	*Equal*	*0.333*
Global Integration	*Equal*	*0.333*

By taking a subset (daily trips network) from the original city network, the physical attribute of urban morphology's have been changed. Thus, this indicator will have two evaluations output maps Figure 5-3 and Figure 5-4.

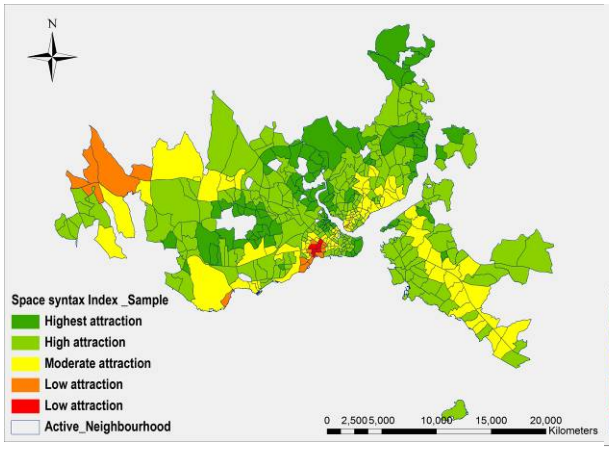

Figure 5-3: Space syntax Index, daily trips network.

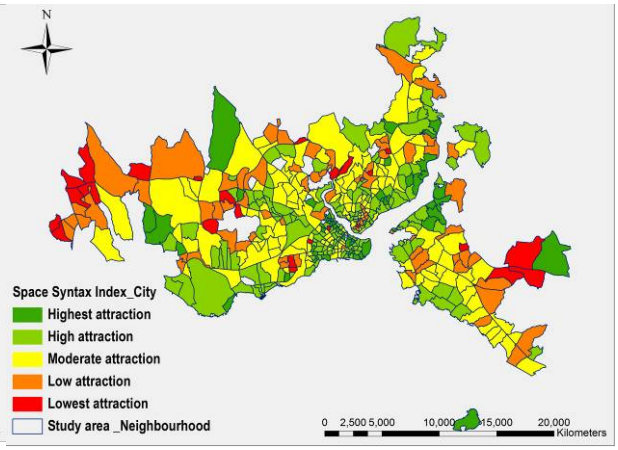

Figure 5-4: Space Syntax Index, Original City Network

5.1.4. Activeness index

Activeness Index, represent the neighbourhoods that have an activeness values between (highest activeness, high activeness, moderate activeness, low activeness and lowest activeness). The results give the cumulative values of the individual indicators measurement. After combining urban morphology

indicators in SMCE, equal weight in the criteria tree is applied to the group spatial factors. The spatial factors within each individual group are given a specific weight as justified in the previous sections.

The creation of the index is carried out at two levels, first at city level as a whole (within the available data and knowledge), Second at the area, which have been visited by the interviewed women in Istanbul during their daily movements (participation in activities) is displayed in term of activities distribution or trip route passing by the area. That will provide the research with interesting knowledge by comparing the cumulative effect of the problem on individuals as well as the effect of certain subset on the same area. Figure 5-7 shows City Activeness Index, while Figure (26) shows Sample Activeness Index. By visually comparing the two indices, it appears that there is similarity as well as differences in the zones categories.

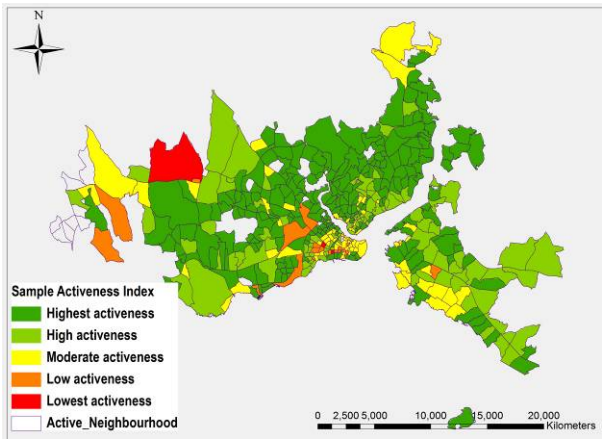

Figure 5-5: sample activeness Index

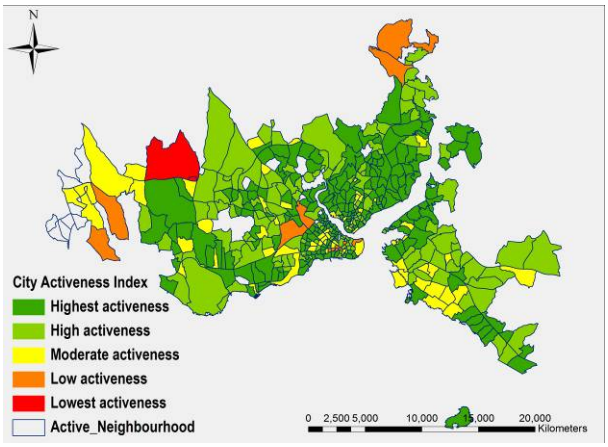

Figure 5-7: City Activeness Index

Further explanation will be done in the discussion chapter by a combination of urban mobility and urban morphology indictors adding to that women sample index and City Index. To prove a base for the discussion the hypothesis that, an interaction between urban mobility and urban morphology exist. That might has different effect with different element i.e. the interaction between location use and spatial distribution of activities could be higher than the interaction between spatial distribution of activities and physical area by the neighbourhood.

6. RESULTS:

This chapter will be discussing critically the outcomes and results from the previous chapters. The discussion will build on literature and researcher observation.

6.1. Urban morphology indictor's effect on spatial distribution of activities:

The graphs below is addressing the effect of Urban morphology on activates location, through activates distribution within individuals urban morphologies indicator. Table 6-1 and Table 6-2 shows urban morphology indicator both (sample and City the level) on activates distribution showing Location use effect as the highest effect. However, space syntax measurement as the lowest effect on activities distribution.

Figure 6-1 is a comparison between the individual indicator and Sample Activeness index and City Activeness index on activities distribution. It found that location use indicator have higher effect on the activities distribution that cumulative effect of the city index or sample index. Which mean that Activity distribution is highly effected by Location use. Similarly, structure configuration has a higher effect on the activity than the indices. Space syntax and physical area has lower effect. In conclusion activities spatial distribution is highly effected by location use and structure configuration, which proves partially that urban mobility is linked to urban morphology.

Urban morphology indicator	*Degree of effect by urban morphology indicator on activity Distribution*
Structure configuration	79%
Physical area	52%
Location Use	89%
Space Syntax city Network	49%

Table 6-1: Degree of effect by urban morphology indicator on activity Distribution -City level

Urban morphology indicator	*Degree of effect by urban morphology indicator on activity Distribution*
Structure configuration	79%
Physical area	52%
Location Use	89%
Space Syntax Sample network	37%

Table 6-2: Degree of effect by urban morphology indicator on activity distribution City level

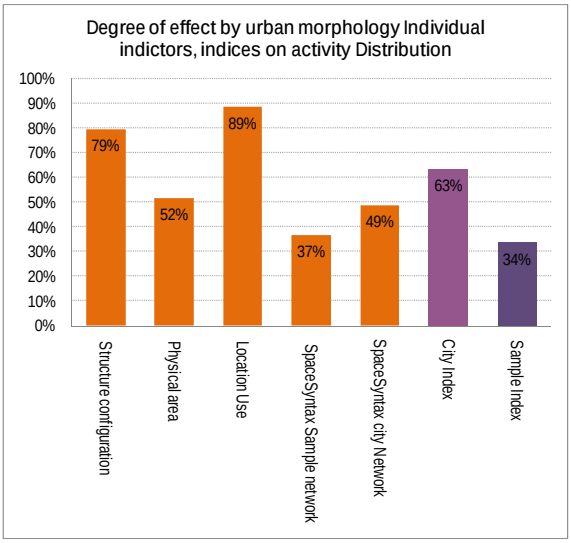

Figure 6-2: Degree of effect by urban morphology individual's indicator, Activeness indices on activity Distribution.

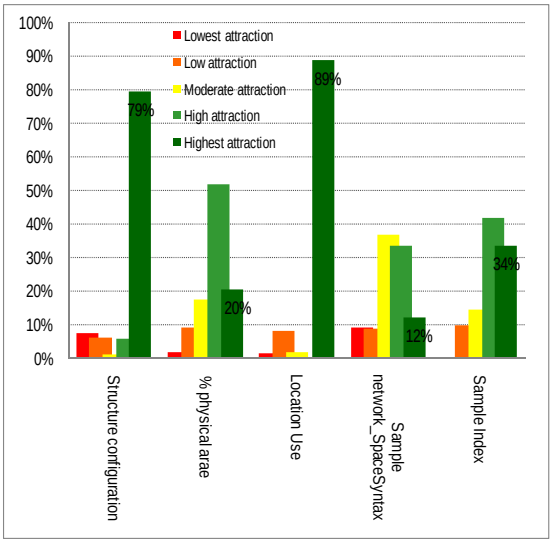

Figure 6-1 distribution of activities location in respect with Urban Morphology Indicators City

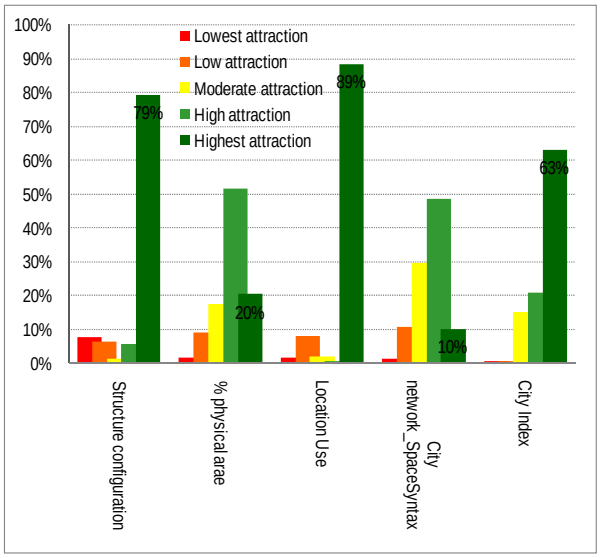

Figure 6-3 distribution of activities location in respect with Urban Morphology Indicators _City

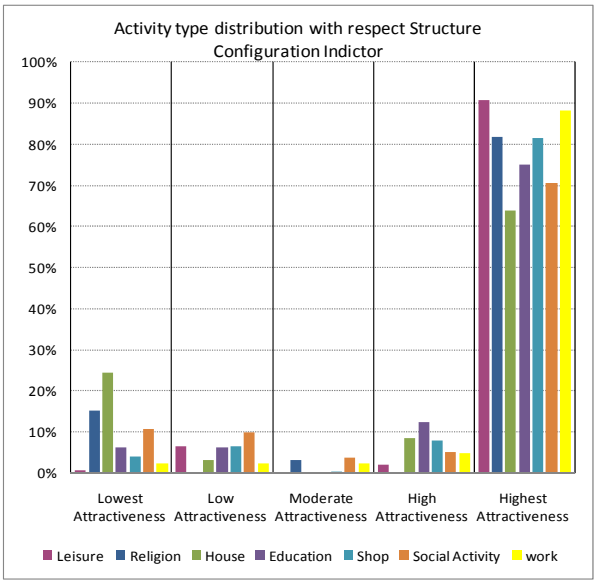

Figure 6-4: activity type distribution in respect with Structure Configuration

6.2. Urban morphology indictor's effect on spatial distribution of activities:

In figure 6-4 to figure 6-11 is showing activities type distribution in respect with urban morphology indicators, Sample and city Activeness Index. It observed that activates type on Individuals indicators level, is highly affected by location use where the most of the activities is located in the highest attraction zone. While the lowest effect is located in space syntax sample indictors (see figure 6-19). However, the most activity type that affected is housing in respect with location use, leisure is the lowest affect in respect with physical are.

	House	Social Activity	Education	Shop	Religion	work	Leisure
Structure configuration	64%	71%	75%	81%	82%	**88%**	**91%**
physical area	52%	54%	47%	61%	70%	48%	36%
Location Use	***97%***	***88%***	***88%***	***87%***	***94%***	***88%***	*88%*
Sample network _ Space Syntax	35%	42%	47%	50%	33%	56%	41%
City network_ Space Syntax	39%	53%	65%	40%	82%	62%	52%
Indicators average effect	57%	62%	64%	64%	72%	68%	61%

Table 6-3: summary for urban morphologies indicators on activities type distribution.

On average, the most affected activity is religion (see Figure 6-6). In conclusion urban morphology affects activities type distribution, the affect is varied according to activity type. Activities attractions depends on individual's urban morphology by this it proved that urban mobility and activities distribution is linked to urban morphology elements.

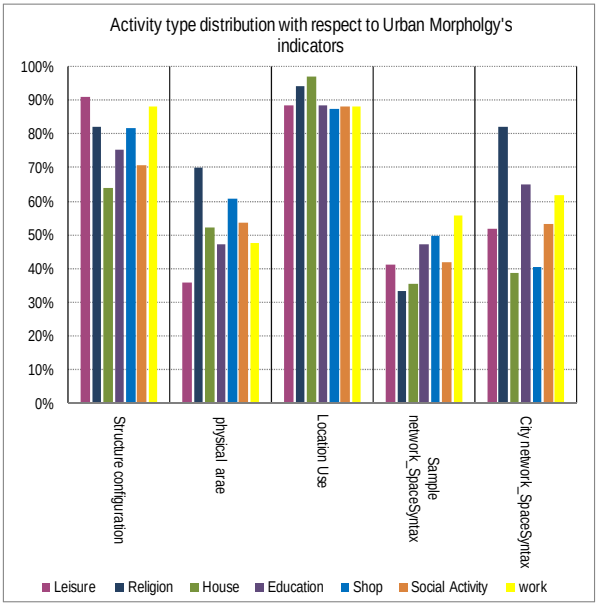

Figure 6-6: activity type distribution in respect with urban morphology indicator.

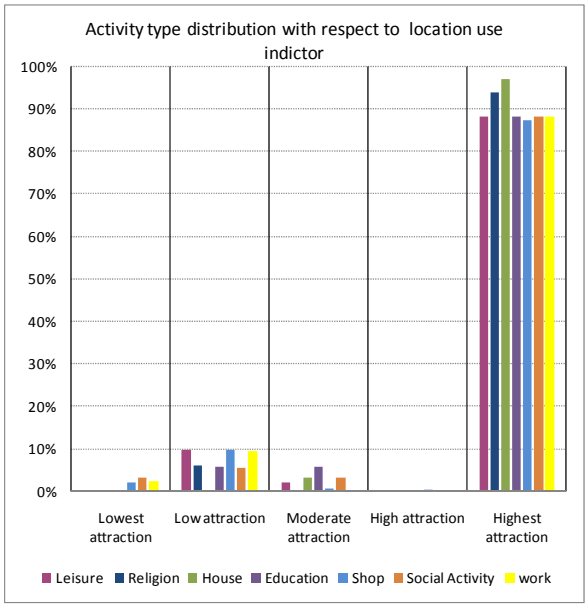

Figure 6-5: activity type distribution in respect with location use.

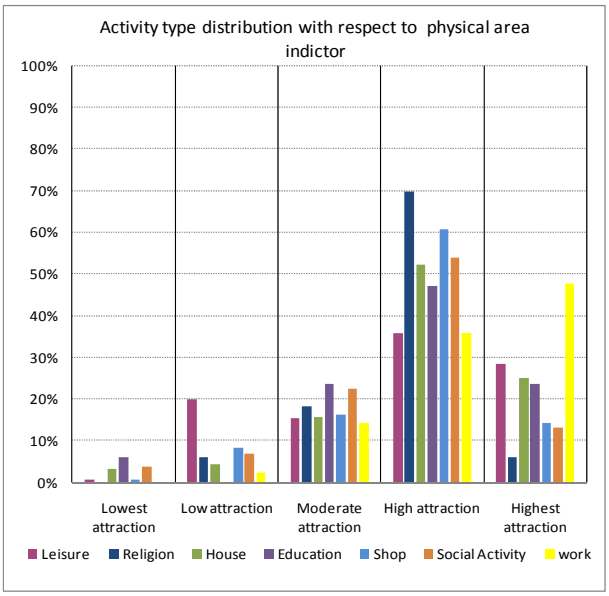

Figure 6-8: activity type distribution in respect with physical area indicator.

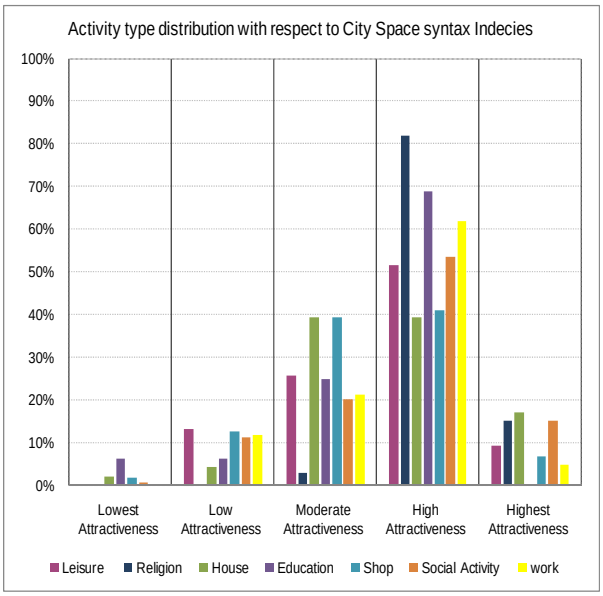

Figure 6-7: activity type distribution in respect with City space syntax indices

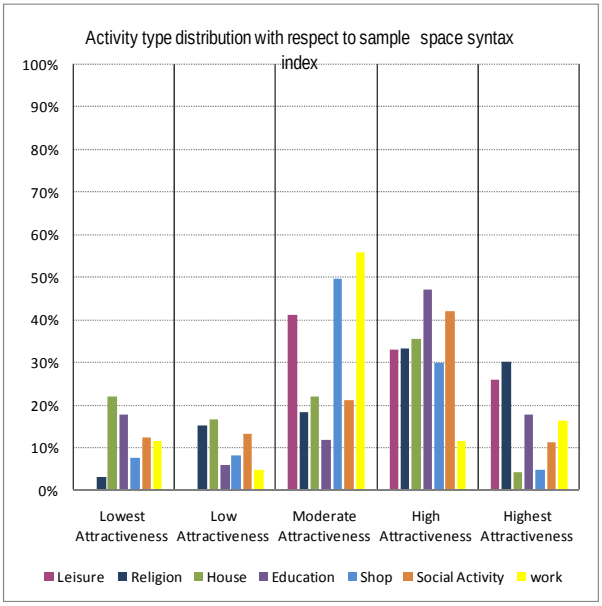

Figure 6-10: activity type distribution in respect with Sample space syntax indices

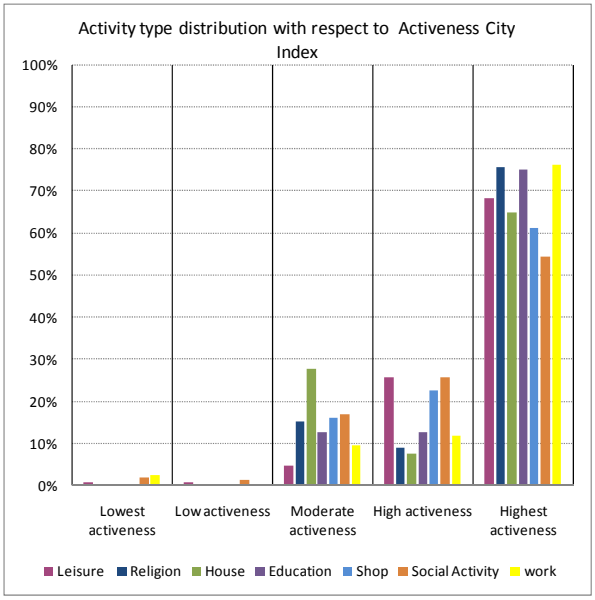

Figure 6-9: activity type distribution in respect with Activeness City indices

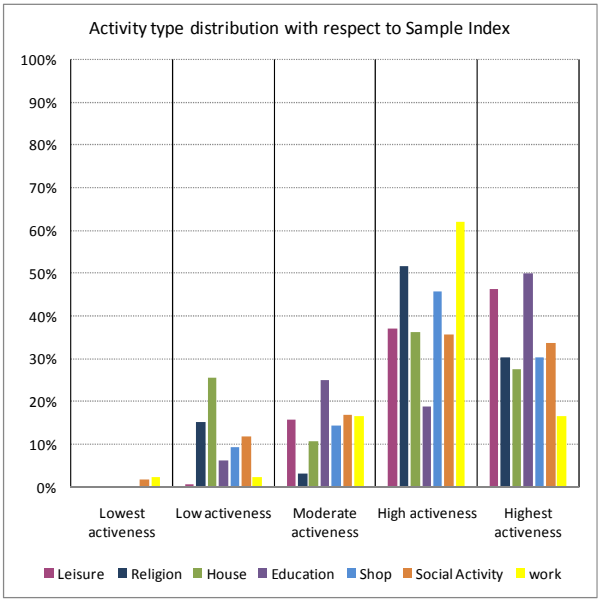

Figure 6-11: activity type distribution in respect with Sample Activeness Sample indices

Women physical and social obstacles that and urban morphology elements

To address this issue the researcher addressed direct questions to the women about the obstacles that they face within their daily trips and the location that they avoid to approach in the city (appendix 1: Questionnaire). The interviewed women highlighted the locations of fear as a part of the survey. Those areas were defined by names of transport stations, district or neighbourhood name such as industrial districts and street name like Istiklal backstreets. The discussion will focus on first addressing the social barrier in terms of safety, dealing with two categorize of safety that are women perception of personal security and road service and safety.

Second the research would link the highlighted obstacles with the areas been avoid in GIS. Further analysis will be done by overlaying those areas of fear with urban morphology indicators and finally conclude on physical and social by justifying the reasons using urban mobility indicators.

Within the collected sample, there was a variation in the responses. 51 % of the women respond that they are not facing any obstacles. However, 46% of the samples highlight the obstacles they face in terms of time of the day (see figure 6-12), obstacles in terms of perception of personal security (see figure 6-13) and in terms of road service and safety (see figure 6-14).

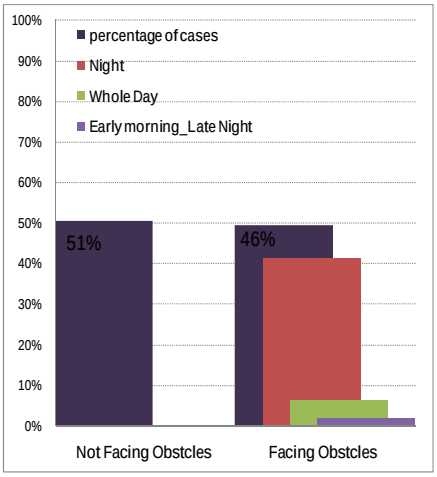

Figure 6-12: % women who faced obstacles vs. not facing

Women in Istanbul highlighted four main issues concerning their perception of personal security. Some samples highlight one or two obstacles within these main groups while some others highlight all of them together. Perception of personal security in Istanbul is addressed as follows,

First, fear of safety like dark area, seashores and empty transport stations. Second, timing and daily schedule, which was mainly addressed by employed women.

Third, cultural and social aspects in terms of socio-economic variation as well as education and ethnicity focusing on Gypsies issue. Crowdedness and children occupation difficulties are shown in (Figure 6-13).

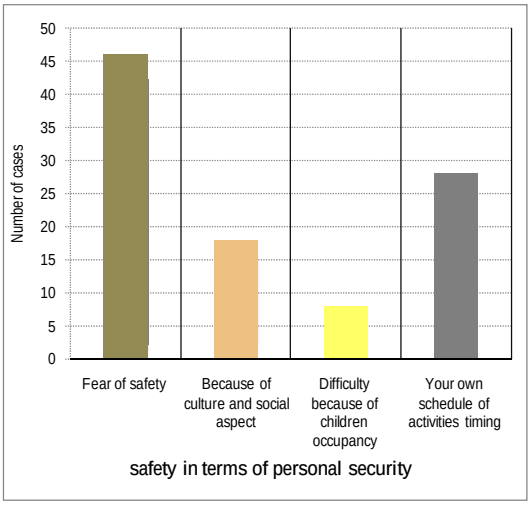

Figure 6-13: women and safety in terms of own perception of personal security

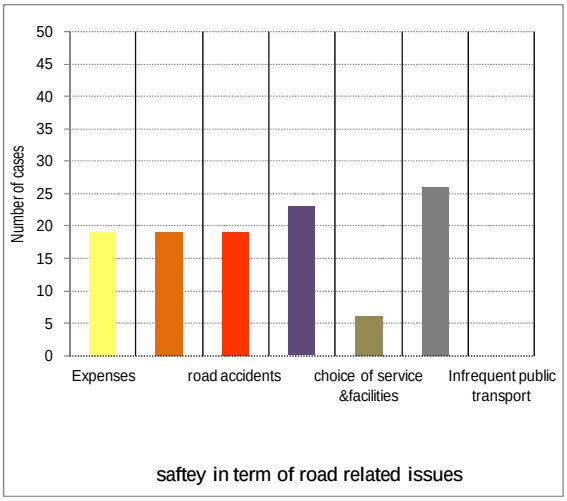

Figure 6-14: Women and Safety, in terms of Road service and safety

In terms of road service and safety, obstacles are divided into two groups. Group 1 include high risk of road accidents and high exposure to noise, linked through driving force behind them. As, Istanbul is

considered a metropolitan city crowded by vehicle and cars. However, group 2 include high risk of road accidents, high exposure to noise, street condition (damaged, polluted), public transport expenses, limited choice of service and facilities, operating hours of buses and infrequent public transport (Figure 6-14).

Concerning the perception of personal security, the research got 54 responses while concerning the road service and safety the research got 112 responses. The number of the responses is higher than the samples number that is because some of the samples highlighted more than one or two obstacles. In conclusion, women in the collected sample face more obstacles and suffer from unsafe feelings in term of road service more than the personal perception of security.

In the figures listed below, figure 6-18 to figure 6-26 shows fear areas with respect to the whole study area as well as to activities distribution and daily trips distribution. figure 6-16shows the area of fear highlighted by women in Istanbul. Areas as mentioned before vary in type and use i.e. Industrial district, transport station, busy commercial backstreets and street edges like seashores. However, figure 6-17 shows women activities distribution with respect to fear area. It is found that, out of 813 activities location there are only 23 locations within those areas.

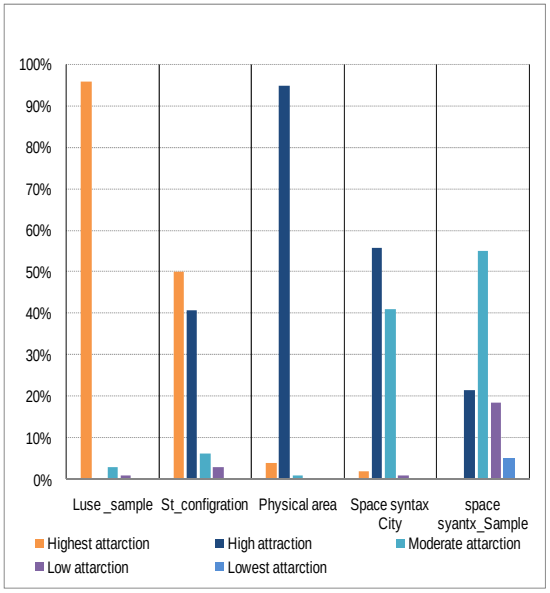

Figure 6-15: Average % of trips passes by Attractiveness categories _sample

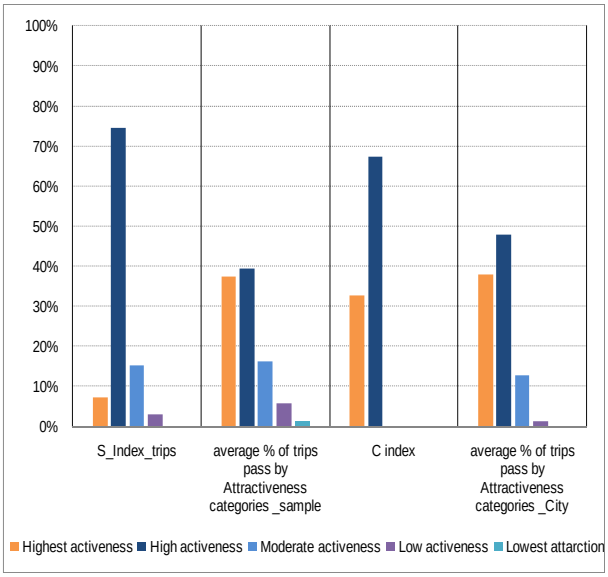

Figure 6-16: comparison % of trips passes by attractiveness sample, city indices and average of Individuals indicator

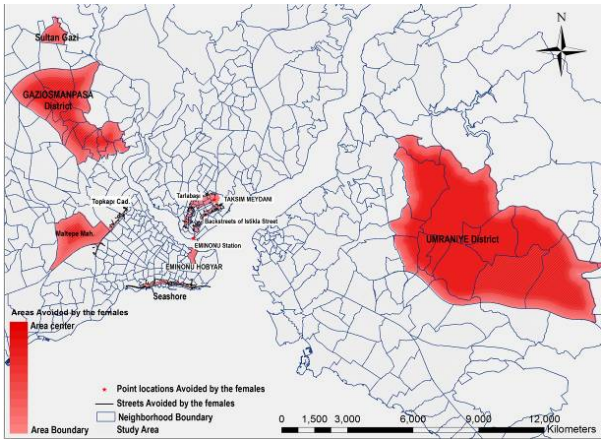

Figure 6-18: fear area highlighted by the women in Istanbul

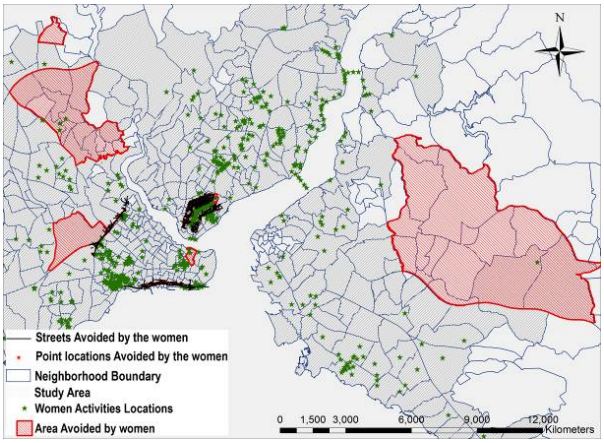

Figure 6-17: fear area overlaid by women activities location

In addition, Figure 6-20 shows the distribution of the daily trips with respect to the fear area, it shows that majority of trips avoids passing by the highlighted area (see figure 6-20 to figure 6-24). Comparing urban morphology indicator it observes that (see figure 6-22) location use indictor shows highest effect on the area as it is the only indicator which have red lowest value categories which mean lowest attraction.

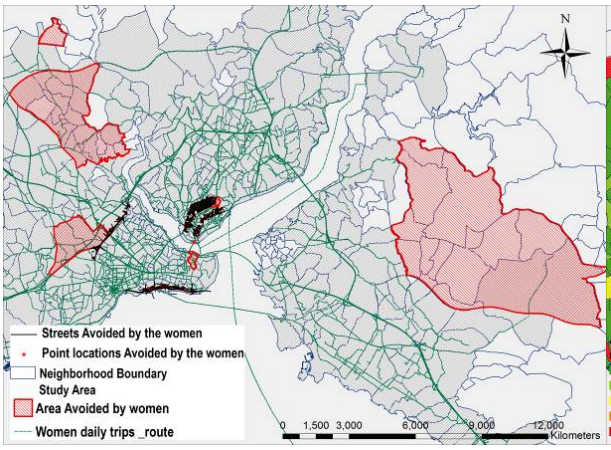

Figure 6-20: fear area in respect with Trip distribution.

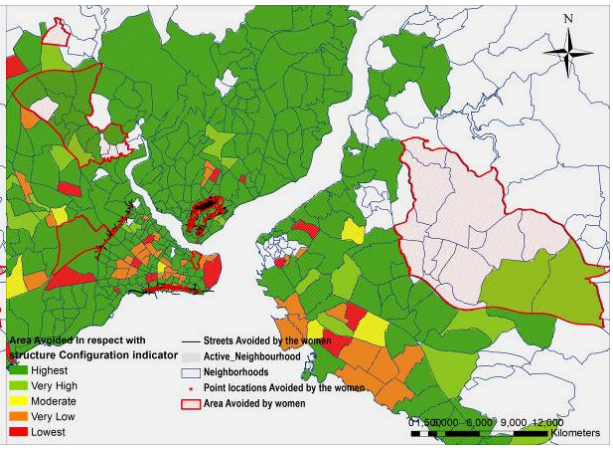

Figure 6-19: Fear area in respect with Structure configuration indictor.

However, Figure shows lowest effect of the fear area where it covers in general highest and high attraction area only.

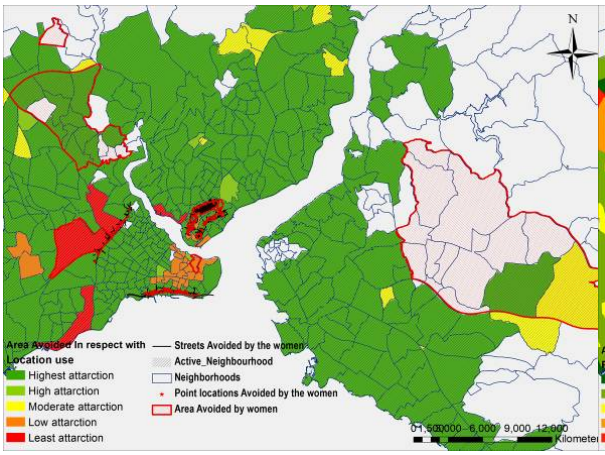

Figure 6-22: Fear area in respect with Location use Indicator.

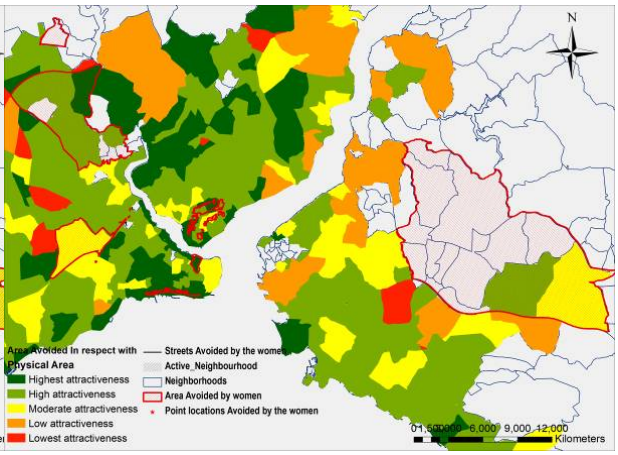

Figure 6-21: Fear area in respect with physical area indicator.

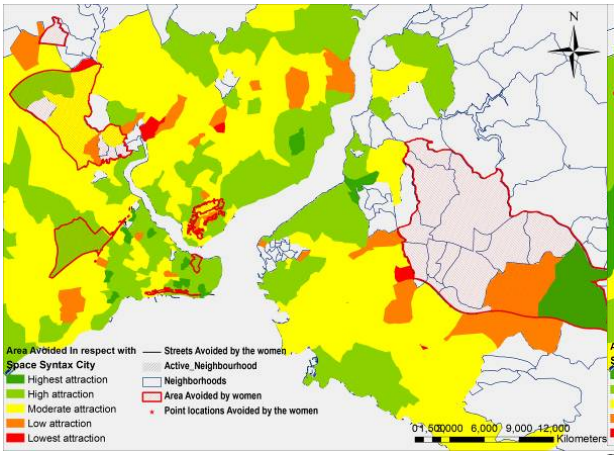

Figure 6-24: Fear area in respect with Space syntax of the sample.

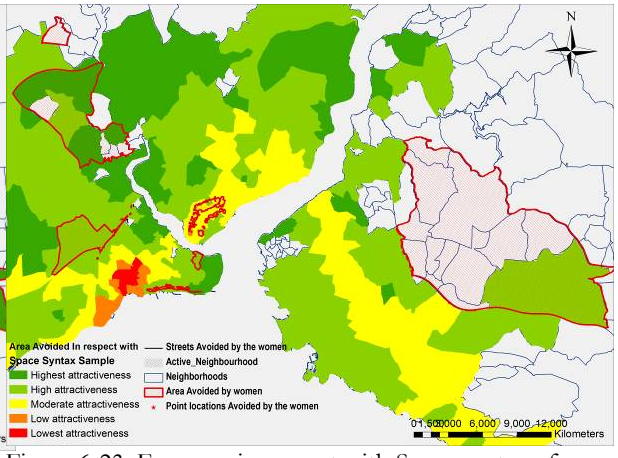

Figure 6-23: Fear area in respect with Space syntax of the City.

Figure 6-25 and figure 6-26 shows fear area covering Activeness Index for both the sample and the city. It observed that comparing effect of the cumulative Activeness Index of urban morphology to the Individuals Indicator overlay, that the Index have a moderate effect on the fear area where the converge is between low to highest Activeness categories in respect to the sample index and low ,high and highest categories. To conclude the obstacles that women in Istanbul facing obstacles in terms of safety

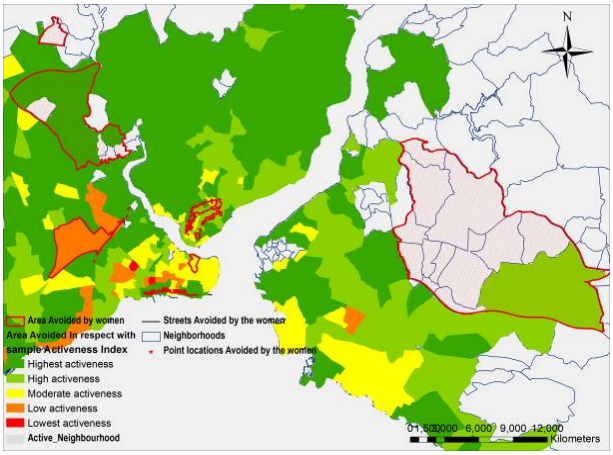

Figure 6-25: Fear area in respect with Sample Activeness Index

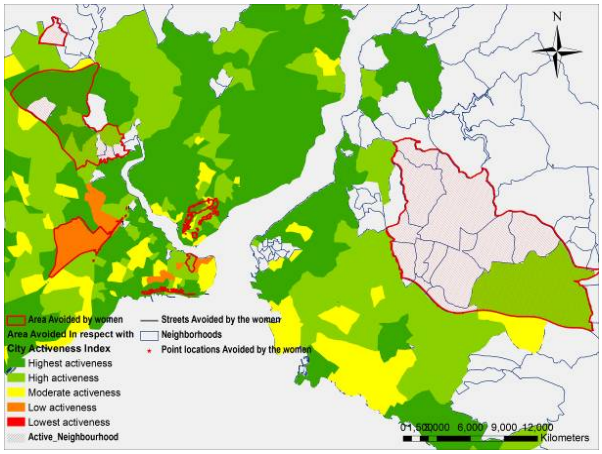

Figure 6-26: Fear area in respect with City Activeness Index.

Street network and the movement in city:

Figure 6-27 to figure 6-32 shows space syntax measurements in terms of network connectivity's, local integration, global integration where the graduated colours from dark red to light green shows the high road connection, high global Integration, low local integration (dark red). Connectivity indicator is showing the density of access to an area, local integration index shows the concentration of the activities near, the patterns of movements from outside the city towards an urban unit centre i.e. city centre, neighbourhood centre while global integration shows movement patterns from inside the city towards out side to city limits or towards the edges i.e. high ways, walls, neighbourhood or districts boundary.

Figure 6-27 shows connectivity index for the complete network within the study area, where it shows five dark red areas. Representing "*Bogaz bridge*" in 1, the most busiest street in the city "Istiklal Street" in 2,in 3 on the European "Eminonu Hobyar" and "Kadilkoy station" on the Asian side, where both consider as a main gate to the contained (station for bus train and ferry)as well as Market area. In five, the area shows. While, in Figure 6-28 it is shows the dark red lines are concentrated only in Faith district. Were majority of samples has been collected.

Figure 6-29 represent city network global integration index. That shows irregular red rings around the city centre as well some area where historical and modern city parts are met i.e. in the historical peninsula and Topkapi old wall .while in the sample network it observe it has lighter effect as the physical structure of the network changed. However the parameter shows similar behaviour of movement as in the city network parameter. To conclude, space syntax parameter gives insight to movement pattern from to the city. However, space syntax is not sufficient in explaining the driving forces behind the resulted pattern.

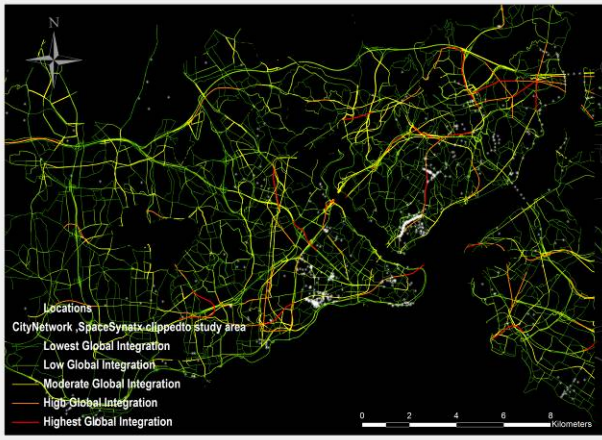

Figure 6-27: space syntax city network connectivity and activities locations

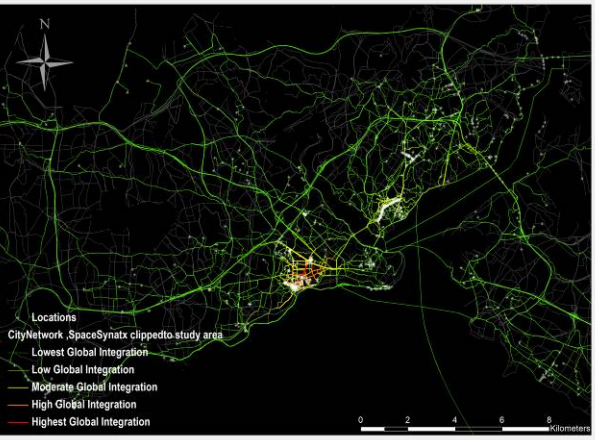

Figure 6-28: space syntax sample network connectivity and activities locations

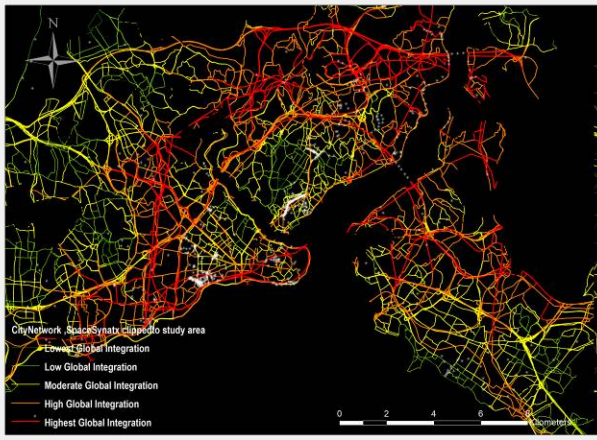

Figure 6-29: space syntax city network global Integration and activity locations

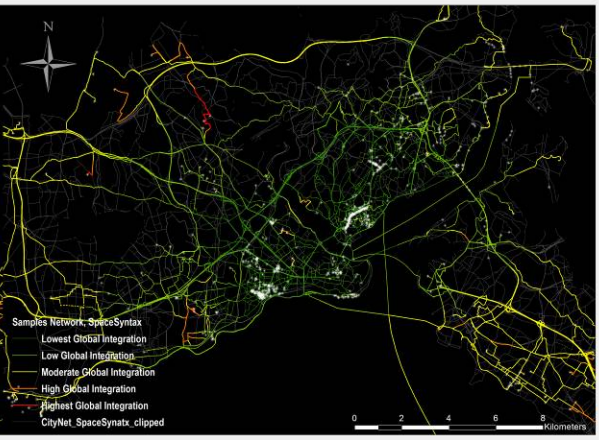

Figure 6-30: space syntax sample network global integration and activity locations

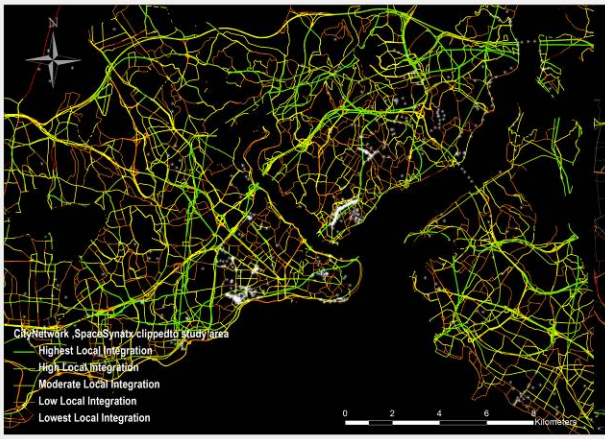

Figure 6-32: space syntax city network local integration and activity locations.

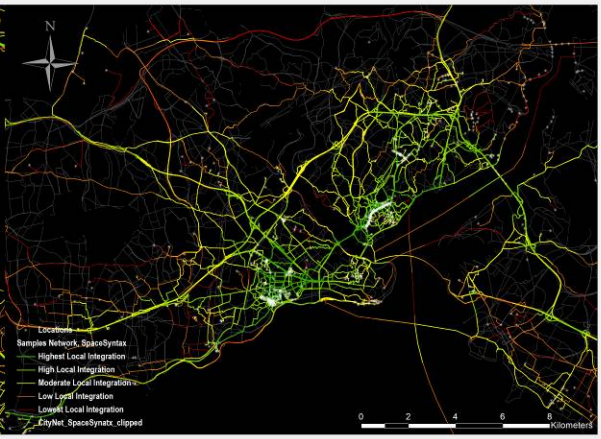

Figure 6-31: space syntax sample network local integration and activity locations.

7. DISCUSSION

This chapter discusses the results and analysis from the previous chapters. The discussion is built on the researcher's observations. To structure the discussion, the research questions are showed here.

How to trace women movement in the city?

Women movement in relation with physical elements in the city is traced using questionnaires, participatory mapping, time-use survey and GIS based spatial analysis techniques. A combination of these tools and techniques have been used and tested in this research.

How locations and accessibility of activities affect travel patterns of women in Istanbul?

Spatial distribution of activities is related to a city's physical structure in terms of neighbourhood location use, structure configuration, percentage of built up–street area, surrounding streets connectivity's and the spatial local integration of the activities. Location use is highly connected to the spatial distribution of the activities as it occupies the same location that the activity takes. Structure configuration is seen to control visual permeability, which increases pedestrian attraction to the neighbourhood. While the percentage of built up-street area increases the interaction in the area in terms of jobs, opportunity, and investment as people are attracted to the areas that have developed infrastructure and the built-up area. Considering the connectivity of a neighbourhood this applies to the natural movement theory showing that an area with attractive activities works as a magnet that attract activities and people, which affect positively the local integration of an area. Locations and accessibility of activities were seen to affect the travel patterns of women in Istanbul. Where women travel patterns is affected by activity locations and accessibility. The more accessible location, the more attraction to that location. Richness in activity attracts more travel pattern.

How socio-cultural variances and urban structure affect activity patterns and travel behaviour for women in Istanbul?

Socio-cultural variances and urban structure affect activity patterns and travel behaviour for women in Istanbul, in terms of spatial distribution of activities locations as well as the physical spatial configuration and its' use i.e. location use, physical area, physical area percentage and street network spatial arrangement. However, this physical spatial characteristic of the activities location has different socio-cultural characteristics. It is shown that an area with a variety of use in terms of activities i.e. residential, commercial, institutional, educational and leisure activities, and with a high visual permeability in terms of physical structure configuration i.e. grid or grid and squares and well planned physical area that have good distribution percentage of infrastructure and built-up structure, is attracting more trips to pass by and will support more activities than other areas do. The researcher observed that women travel behaviour is affected by the socio-cultural variance in terms of activities locations and trip purpose where social activities are the most dominate motivation to carry out a trip.

How can urban form be defined and quantified?

Urban form main feature are buildings, streets and location use, these feature are defined by its physical characterises. The physical characteristic of urban form is defined by the geometrical measurement like area (length, width), volume (area, high) and the physical shape of its feature like linear, curved, etc. and its function i.e. residential, commercial, industrial, etc. In this study all these have been combined by the spatial arrangement of the physical fabric of the area. Buildings can be defined and quantified by its area, area percentage, layout and its physical arrangement within the urban fabric in addition the building usage

can by counted and added as measurement of location use. Streets can be defined by its layout and spatial network arrangements and be quantified by counting the number of connection and the spatial relationships between its segments. However, location use is connected with buildings usage, it can be defined by it counting buildings with the same use and finding the percentage of that use per study unit. In conclusion urban from is definable by its geometrical characteristics and quantified by developing Activeness index.

How does women activity and cultural aspects affect urban structure in the city?

Although, the sample collected for this study was not random which make answering the part about "cultural aspects" uncertain. However, women activities and culture aspect have a spatial local connection. Proved by the local integration measurement, where activities are more concentrated i.e. Istiklal Street where commercial activities is been carried out and the cultural ties are stronger i.e. dressing style of the interviewed women in the Beyoglu was different than dressing style in Fatih.

How street network shape movement in cities?

Street network shapes the city in terms of accessibility, connectivity and spatial Integration of the network. It was observed that shaping the movement in the city follows two theoretical concepts which are natural movement and movement economy. Streets accessibility and connectivity define area attractiveness. However, accessibility and connectivity is not the only driving force that attracts visitors. Spatial network arrangement, beside its connectivity is explaining place attraction. Concepts of gravity applies to its spatial distribution of activities, thus attracting more movement to the place when it is highly integrated locally while expelling the movement from the place will be taking part when it is highly integrated globally.

What are social barriers that woman face in their daily trips?

Social barriers that women face in their daily trips are relative. This depends on their own perception to the environment surrounding them; women generally face two types of barriers. The first type is related to a woman's perception of personal security related to dressing up, physical and verbal harassment and physical strength. The second type is related to road service and safety. The second seems to be more effective for describing women's travel in Istanbul. In addition, urban morphology Elements Street, buildings and functions seems to have effect on that feeling and perception. The researcher observed that women social barriers are relative and related to the spatial physical local environment.

8. CONCLUSION ,RECOMMENDATION

The research faced some limitations. Limitation in fieldwork as mentioned in the summary of fieldwork (see chapter 4). It prevents the researcher from collecting random samples that might improve the bias in the sample.

In addition, there were limitations in research time that have two consequences. First, time limitation in data preparation for analysis that prevents the researcher from considering the multi mode of transport within women movement. Thus, the researcher considered only pedestrians mode of women movement. Second, time limitation prevents from further simulation for women movement using advanced simulation tools i.e. MATSim.

Conclusion

Urban morphology is defined by its geometrical characteristics. It is quantified by applying SMCE analysis and developing "Activeness index". However, urban mobility defined by human activates and travel patterns. Addressing gender differentiation issues is essential to achieve social equity and equality. Women needs differ than men need as well as their behaviour and perception. In addition, women social barrier is relative and related to the physical spatial arrangement the place. In the current research, although sampling methods was not random still it was possible to trace women movement by a combination of tools and techniques of questionnaires, participatory mapping, time-use survey and GIS based spatial analysis techniques are used.

Women travel patterns is affected by activity locations and accessibility. Accessible location attracts trips more. Besides, richness of activity types mean richness in trips attracted to the location. However, travel behaviour is affected by the socio-cultural variance of women, trip purpose where it found that the most motivated trips are social trips. Women activities and cultural aspect is connected to the spatial local characteristic of the place, where space syntax local integration parameters succeed to prove that the area with high concentration of activities is locally highly integrated. Women construct society while streets network shape the movement of women, connectivity of place explains its accessibility, local integration of roads explain its local richness. While global integration explains urban unit's boundary.

In conclusion, urban morphology is highly linked to urban mobility, urban mobility is carried out by women activates and movements in Istanbul. Women perception in perceiving city problem is applicable where it has been tested by women fear area.

Recommendation:

For further study, the researcher would like to recommend the following:

1. Further development of survey framework and tools is advisable. Application of new technology i.e. digital pen and electronic tablet might improve and reduce data preparation.
2. Collecting a random sample, that contained a gender variation i.e. men and women in order to be able to compare the results validity in terms of gender mobility and travel needs.
3. Using the same data set that been developed to develop a Multi-Agent Transport Simulation MATSim, in order to be able to see activities schedule effect on travel patterns. As well as it will

be helpful in developing alternative scenarios that can be applied by decision maker who will to consider gender human interaction in city development.

4. Extended the research to consider the multi mode and Movement analysis

List of references

Algers, S., Eliasson, J., & Mattsson, L.-G. (2005). Is it time to use activity-based urban transport models? A discussion of planning needs and modelling possibilities. *The Annals of Regional Science, 39*(4), 767-789.

Balmer, M., Meister, K., Rieser, M., K.W., A., & Nagel, K. (2009). MATSim-T: Architecture and Simulation Times. [Information Science Reference]. *Multi-Agent Systems for Traffic and Transportation Engineering,*, 57–78.

Batty, M. (2004). A new theory of space syntax. London, UK: Centre for Advanced Spatial Analysis (UCL).

Beall, J. (1996) Urban Governance: Why Gender Matters. *Vol. Series No. 1. Gender in Development Monograph* New York: United Nations Development Programme.

Bentley, I. e. a. (1985). *Responsive environments: a manual for designers*: The McGraw-Hill Companies.

Bhat, C., & Koppelman, F. (2003). Activity-Based Modeling of Travel Demand. In R. Hall (Ed.), *Handbook of Transportation Science* (Vol. 56, pp. 39-65): Springer New York.

Chang, R., Wessel, G., Kosara, R., Sauda, E., Ribarsk, W., & UNC Charlotte, C. (2007). Legible Cities: Focus-Dependent Multi-Resolution Visualization of Urban Relationships. [Visualization and Computer Graphics]. *IEEE Transactions, 13* (6), 1169-1175.

Conroy Dalton, R., & Bafna, S. (2003). *The syntactical image of the city: a reciprocal definition of spatial elements and spatial syntaxes*. Paper presented at the 4th International Space Syntax Symposium. Retrieved from http://eprints.ucl.ac.uk/1104/

Conzen, M. (1960). *Alnwick, Northumberland: A Study in Town Plan Analysis* (Vol. 2nd revised edition). London: Institute of British Geographers.

de Smith, M. J., Goodchild, M. F., & P.A., L. (2009). *Geospatial Analysis - a comprehensive guide* (3rd edition ed.).

Fox, M. (1995). Transport planning and the human activity approach. *Journal of Transport Geography, 3*(2), 105-116.

Frey, H. (1999). *Designing the city: towards a more sustainable urban form*

Fülöp, J. (2005). Introduction to Decision Making Methods *Laboratory of Operations Research and Decision Systems: Computer and Automation Institute, Hungarian Academy of Sciences 1*.

Gerçek, H., & Demir, O. (2008). *Urban Mobility in Istanbul* (No. Final report). Istanbul Istanbul Technical University Civil Engineering Faculty.

GÖKARIKSEL, B., & MITCHELL, K. (2005). Veiling, secularism, and the neoliberal subject:national narratives and supranational desires in Turkey and France. *Global Networks, 5*(2), 147–165.

Golledge, R. G. (1992). Place recognition and wayfinding: Making sense of space. *Geoforum, 23*(2), 199-214.

Hillier, B. (1999). The common language of space: a way of looking at the social, economic and environmental functioning of cities on a common basis. *Space Syntax Laboratory, 11*(3).

Hillier, B., & Iida, S. (2005). Network and Psychological Effects in Urban Movement. In A. G. Cohn & D. M. Mark (Eds.), *Spatial Information Theory* (Vol. 3693, pp. 475-490): Springer Berlin / Heidelberg.

Johnson, J. H. (1967). *Urban geography : an introductory analysis*. Oxford etc.: Pergamon Press.

Kim, Y. O., & Penn, A. (2004). Linking the Spatial Syntax of Cognitive Maps to the Spatial Syntax of the Environment. *Environment and Behavior, 36*(4), 483-504.

Kunieda, M., & Gauthier, A. (2007). *Gender and Urban Transport. Fashionable and Affordable*. Eschborn, Germany: GTZ

Lapucci, A., Lombardo, S., Petri, M., & Rotonda, M. (2009). A Participative Multi Agent System for Urban Sustainable Mobility *Geocomputation and Urban Planning* (Vol. 176/2009, pp. pp.255-279). Heidelberg: Springer Berlin

Latham, A., McCORMACK, D., McNAMARA, K., & McNEILL, D. (2009). *Key concepts in urban geography*. Los Angeles: Sage.

Long, Y., Baran, P. K., & Moore, R. (2007). *THE ROLE OF SPACE SYNTAX IN SPATIAL COGNITION: evidence from urban China*. Paper presented at the 6th International Space syntax symposium, Istanbul.

Lynch, K. (1960). *The image of the city* Untied State of America: The Joint Center for urabn studies

Mauch, M., & Taylor, B. (1997). Gender, Race, and Travel Behavior: Analysis of Household-Serving Travel and Commuting in San Francisco Bay Area. [10.3141/1607-20]. *Transportation Research Record: Journal of the Transportation Research Board, 1607*(-1), 147-153.

McGuckin, N., & Murakami, E. (1998). Examining Trip-Chaining Behavior: Comparison of Travel by Men and Women *TRANSPORTATION RESEARCH RECORD*

Meyer, M. D., & Miller, E. J. (2001). *Urban transportation planning : a decision-oriented approach*. Boston ; Bogotá: McGraw-Hill.

Miller, E. J., Douglas Hunt, J., Abraham, J. E., & Salvini, P. A. (2004). Microsimulating urban systems. [doi: DOI: 10.1016/S0198-9715(02)00044-3]. *Computers, Environment and Urban Systems, 28*(1-2), 9-44.

Montello, D. (1997). The perception and cognition of environmental distance: Direct sources of information. In S. Hirtle & A. Frank (Eds.), *Spatial Information Theory A Theoretical Basis for GIS* (Vol. 1329, pp. 297-311): Springer Berlin / Heidelberg.

Moughtin , C. (2003). *urban design: street and square* (Third ed.). Oxford.

Munda, G. (2003). Measuring Sustainability,A Multi-Criterion Framework. *Manuscript forthcoming in Environment, Development and Sustainability, November 2003*.

Nagel, K., & Flötteröd, G. (2009). *Agent-based traffic assignment: going from trips to behavioral travelers*. Paper presented at the 12th International Conference on Travel Behaviour Research (IATBR).

Pacione, M. (2005). *Urban geography : a global perspective* (Second edition ed.). London etc.: Routledge.

Patton, M. Q. (2002). *Qualitative Research and Evaluation Methods* (3rd edition ed.).

Penn, A. (2003). Space Syntax And Spatial Cognition Or Why the Axial Line? *Environment and Behavior, 35*(1), 30-65.

Ritchie, j., & Lewis, j. (Eds.). (2003). *Qualitative research practice*. London SAGE Publications.

SECOR, A. J. (2002). The veil and urban space in Istanbul: women's dress,mobility and Islamic knowledge. *Gender, Place and Culture, Vol. 9*(No. 1), 5–22.

Sharifi, M. A., van Herwijnen, M., & van den Toorn, W. H. (2007). *Spatial decision support systems*. Enschede: ITC.

UN-HABITAT. (2008). *Gender mainstreaming in local authorities*.

van Nes, A., & Nguyen, T. M. (2009). *Gender Differences in the Urban Environment:The flâneur and flâneuse of the 21st Centur*. Paper presented at the The 7th International Space Syntax Symposium.

Vance, J. E. (1977). *This scene of man : the role and structure of the city in the geography of western civilization*. New York etc.: Harper's College Press.

Wachs, M. (1996). *The automobile and gender:an historical perspective*. Paper presented at the Women's Travel Issues, the Second National Conference, Baltimore

APPENDIX 1:

8.1. Appendix :

8.1.1. English questionnaire

Sample number: ☐☐☐
Date: / /2010

Interviewer team ☐

This questioner had been designed to help in studying women travel pattern in Istanbul. Your answers will help in improving the quality of life related to urban mobility. The answer you will give will be used only for scientific purpose. your privacy is guaranteed

Thank you in advance for you kind and voluntary participation.

A. Personal information:

1.	Gender		Age					
	☐Female	☐Male	☐18 to 24	☐25 to 30	☐31to 37	☐38 to 44	☐45 to 51	☐52+
2.	Marital status		☐Single	☐Married	☐Widowed	☐Divorced	☐Others	

3.	Does your family own any of the following?				
	☐Car	☐Bicycle	☐ Motorcycle	☐ None of these	☐ Others
4.	Which of the following ranges includes your monthly household income?				
	☐less than745 TL		☐745 – 1,000 TL	☐1,000-1,400 TL	
	☐1,400-1,750 TL		☐1,750-2,000 TL	☐2,000-6,500 TL	

**this information will be used to understand if monthly income affects your choice of travel option.*

5. For how long you have been resided in Istanbul where you now live?

…… Days …… Months …… Years

- Please locate your **house** on the map.

7.	What is the highest level of school you have completed?		
	☐Grade school or less	☐High school graduate	☐Some college
	☐College graduate	☐Graduate degree	

8 .	Which of the following best describes your proficiently status?	
	☐Self-employed	☐Employed by someone else
	☐Student	☐Currently unemployed or laid off
	☐On leave, including maternity leave	☐Retired
	☐Homemaker	☐Other.....

Children under 12:

9.	Do you have any children in home (kids/brother/sister) below 12 years?

9.	Do you have any children in home (kids/brother/sister) below 12 years?			
	□Yes	□No	If (No) please Go to B	
10.	Do you take the children to and back from school?			
	□Yes	□No	if (NO) please go to question (B)	
11.	Are the children attending :			
	□Nursery	□kindergarten	□primary school	□none of them

- Please locate your **children school/kindergarten/nursery** on the map.
- When do you take then in the morning? …….....
- At which time do you pick them in the afternoon? …….....
- Is the ***school/daycare*** far away from you home? ……..... .minutes.

B. Daily activities:

12. What is the most daily activity that you spend your time on?

If you are NOT working please go to part C.

a) Professional:

13	Are you currently employed?									
	□Yes	□No	If (NO) go to question (23)							
14	How much do you spend in				hours per day		days per week		Times per month	
	□work									
15	How do you normally travel to and from work (travel options)? (Check all that apply)									
	□Car	□Tram	□Bu	□Bicycl	□Tax	□Motorcycl	□walkin	□ferr	□Trai	□other
No /										

16 What is your exact job title?

. ……... .

17	What time do you leave home to work?	
	Betwee	

- Please locate your ***work place*** on the map.

18.	How long do you take to go from home to work?		
	□ Less than15 minutes	□ 15 to 30 minutes	□ 30 to 45 minutes
	□ 45 to 60 minutes	□ 60 to 75 minutes	□ 75 to 90 minutes
	□ More than 90 minutes, around ……..		

20.	Does transport access and availability affect your choice of employment (choosing		
	□yes	□No	if (NO) then go to question (22)

20.	Does transport access and availability affect your choice of employment (choosing		
	How Does transport access and availability affect your choice of employment?		
	□ Low	□ Moderated	□ High
21.	Can you explain why?		

22.	What time do you ***leave work*** to					What is the time that you suppose to ***spend*** in				
	Between					Between				
23.	How long do you take to go from work to home?									
	□ Less than15 minutes		□ 15 to 30 minutes			□ 30 to 45 minutes				
	□ 45 to 60 minutes		□ 60 to 75 minutes			□ 75 to 90 minutes				
	□ More than 90 minutes, around ……..									
24.	How do you normally travel to and from work (travel options)? (Check all that apply)									
	□Car	□Tram	□Bus	□Bicycle	□Taxi	□Motorcycle	□walking	□ferry	□Train	□others
No/line										

b) House keeping

25.	How much do you spend in house	hours per day	days per week

c) Free time

What is the attraction area that you like to ***spend your time there***? Locate on map.

26.	How do you spend you free time?	hours per	days per week	days per months
	□shopping			
	□voluntary work			
	□visiting friends and family			
	□Religious			
	□ Others like:			

- ***Shopping:***

27.	In which day(s) you like to go for shopping?			
Day of the	Daily	General	How much time it take you	How do you normally travel to
□Saturday				
□Sunday				
□Monday				
□Tuesday				
□Wednesday				
□Thursday				
□Friday				

- Can you please locate the **shops** that you visit on the map?

- ***voluntary work***

28.	Do you have any voluntary activities?	When?

28.	How much do you spend in that	hours per day	days per week	Times per month

➢ Can you please locate the **place** on the map?

- ***Social visits***

➢ What about your family and friends?

30.	Where do you meet them normally?		
a.	□	At home	➢ Please locate their house on the map.

Or

b.	□	Outside home						
	□	Cinema	□	Mosque	□	Coffee shops	□	Parks
	□	Cultural and historical	□	Market	□	Bars	□	others

31.	How do you normally travel to and from work (travel options)? (Check all that apply)									
	□Car	□Tram	□Bus	□Bicycle	□Taxi	□Motorcycle	□walking	□ferry	□Train	□others
No/line										

- ***Religious:***

32.	➢ Where do you go for practicing your Religious duty? Please locate on the map.
	When?

33.	How long do you take to go from home to there?		
	□ Less than15 minutes	□ 15 to 30 minutes	□ 30 to 45 minutes
	□ 45 to 60 minutes	□ 60 to 75 minutes	□ 75 to 90 minutes
	□ More than 90 minutes, around ……..		

35. What are the attraction places that you pass by every day?

.....

.....

.....

.....

.....

....

- Why?.....

  .....

  .....

  .....

- Please locate on the map?

36. Which type of activities you normally combine?

.....

.....

.....

.....

.....

.....

- Please locate each one on the map.

C. Safety and obstacles :

37.	Is there any place you trying to avoid passing by when you are					What time of the day?
	□	Yes	□	No	If (YES) why?	□Morning
						□Afternoon
						□Night

39.	*Is one of the following reasons effect your daily trips?*		
	□*Yes*	□*No*	*If (YES) check all that applied.*
□	*Infrequent public transport*		
□	*Operating hours of buses*		
□	*Your own schedule of activities timing*		
□	*Expenses*		
□	*Fear of safety*		
□	*Street condition(damaged ,polluted)*		
□	*High risk of road accidents*		
□	*High exposure to noise*		
□	*Limited choice of service and facilities*		
□	*Difficulty because of children occupancy (very crowded you cannot move with the children)*		

39.	*Is one of the following reasons effect your daily trips?*
□	*Because of culture and social aspect (specify?)*

- Please locate it on the map.

Thank you so much for your cooperation!!!

8.2. Appendix 2:

8.2.1. Turkish questionnaire

Anket no:

Tarih: / /2010

Anket Ekibi

Bu anket, çalışan kadınların ulaşım eğilimlerinin belirlenmesine yardımcı olması amacıyla hazırlanmıştır. Cevaplarınız kent içi hareketliliğe bağlı yaşam kalitesini artırmaya yardımcı olacaktır. Vereceğiniz cevaplar sadece bilimsel amaçlarla kullanılacaktır. Kişisel bilgileriniz gizli tutulacaktır. Nazik ve gönüllü katılımınız için şimdiden teşekkürler.

D. Kişisel Bilgiler:

1.	Cinsiyet		yaş					
	□ Kadın	□ Erkek	□18 - 24	□25 - 30	□31- 37	□38 - 44	□45 - 51	□52+
2.	Evlilik Durumu		□ Bekar	□ Evli	□ Dul	□	□ Diğer	

3.	Ailenizin ulaşım için kullanması açısından aşağıdaki araçlardan hangisine sahipsiniz?				
	□Araba	□Bisiklet	□ Motorsiklet	□ Hiçbiri	□ Diğer

4.	Aylık geliriniz hangi aralıklardadır?		
	□745 TL'den az	□745 – 1,000 TL	□1,000-1,400 TL
	□1,400-1,750 TL	□1,750-2,000 TL	□2,000-6,500 TL

**Bu soru aylık gelirinizin ulaşım tercihinizi etkileyip etkilemediğini ölçmek için hazırlanmıştır.*

5. Ne zamandır İstanbul' da oturuyorsunuz ve şu an nerede yaşıyorsunuz?

   …….....

   …… Gün …… Ay …… Yıl

   - Evinizin yerini haritadan işaretler misiniz.
   -

7.	Mezuniyet derecesi?		
	□İlkokul /Okula gitmedim.	□İlköğretim	□Lise
	□Lisans	□Lisans üstü	

8 .	Aşağıdakilerden hangisi mesleğinizi daha iyi tanımlıyor?	
	□İş sahibi	□Maaşlı çalışan
	□Öğrenci	□İşsiz ya da işten atılmış
	□İzinli, annelik izni	□Emekli
	□Ev hanımı	□Diğer

12 yaş altı çocuklar:

9.	Evinizde 12 yaş altı çocuk var mı? (çocuk/ kardeş)			
	□Evet	□Hayır	Eğer cevabınız (Hayır) ise lütfen B bölümüne geçiniz.	
10.	Çocuklarınızı okula götürüp getiriyor musunuz?			
	□ Evet	□ Hayır	Eğer cevabınız (Hayır) ise lütfen B bölümüne geçiniz.	
11.	Çocuklarınız aşağıdakilerden birine devam ediyor mu?			
	□Kreş	□Ana okulu	□İlkokul	□Hiçbiri

- Lütfen çocuğunuzun devam ettiği **Kreş/Anaokulu /İlkokul** 'u haritada işaretler misiniz?
- Sabah kaçta götürüyorsunuz ?…….

- Ve akşam kaçta geri almaya gidiyorsunuz ?……
- Kurum evinizden uzakta mı?…… .....minutes.

E. Günlük Aktiviteler:

12. Gündelik yaşamda hangi faaliyete daha çok zaman harcıyorsunuz?

Çalışmıyorsanız lütfen (**C)** bölümüne geçiniz.

d) Mesleki Sorular:

13.	Şu an çalışıyor musunuz?									
	□Evet	□Hayır	Eğer cevabınız (Hayır) ise lütfen (23). soruya geçiniz.							
14.	Ne kadar zaman harcıyorsunuz?			Günde kaç saat		Haftada kaç gün		Ayda kaç hafta		
	□iş için									
15.	İşe nasıl ulaşıyorsunuz ?(seyahat türlerinden seçiminiz)? (Birden fazla seçenek									
	□Araba	□Tramway	□Otobüs	□Bisiklet	□Taksi	□Motorsiklet	□Yaya	□Vapur	□Tren	□Diğer
No/Hat										

16. İşinizin tam tanımı nedir?…….. .

17.	İşe gitmek için evden kaçta ayrılıyorsunuz?	
	saatleri arası	

- Lütfen **işyerinizi** haritada işaretler misiniz?

18.	Evle iş arası ne kadar sürüyor?		
	□ 15 dakikadan az	□ 15- 30 dakika arası	□ 30-45 dakika arası
	□ 45-60 dakika arası	□ 60-75 dakika arası	□ 75-90 dakika arası
	□ 90 dakikadan daha fazla, yaşlaşık		

20.	İş tercihinizde ulaşım seçeneklerinin etkisi var mı?		
	□Evet	□Hayır	Eğer cevabınız (Hayır) ise lütfen 22 bölümüne geçiniz.
	Ulaşım bağlantısı ve kolaylığı iş seçiminizde ne kadar etkili oldu ?		
	□ Az	□ Orta	□ Çok
21.	Nedenini açıklar mısınız?		

22.	Eve dönmek için, işten kaçta		İş yerinde harcadığınız süre nedir?	
	Saatleri Arası		Saatleri	
23.	İşten eve dönmek ne kadar zamanınızı alıyor?			
	□ 15 dakikadan az	□ 15- 30 dakika arası	□ 30-45 dakika arası	
	□ 45-60 dakika arası	□ 60-75 dakika arası	□ 75-90 dakika arası	
	□ 90 dakikadan daha fazla, yaşlaşık			

24.	İşten nasıl dönüyorsunuz? (seyahat türlerinden seçiminiz)? (Birden fazla seçenek									
	□Arab	□Tramwa	□Otobü	□Bisikle	□Taks	□Motorsikl	□Yaya	□Vapu	□Tre	□Diğe
No/H										

e) Ev işleri

25.	Ev işi için ne kadar zaman	Günde kaç saat	Haftada kaç gün

f) Boş Zaman

Zamanınızı geçirmekten hoşlandığınız size çeken alanlar nerelerdir? Haritada gösteriniz.

26.	Boş zamanınızı nasıl	günde kaç	haftada kaç gün	ayda kaç gün
	□alışveriş			
	□gönüllü işler			
	□arkadaş ve akrabaları ziyaret			
	□ibadet			
	□ diğer:			

- ***Alışveriş:***

27.	Hangi gün/günler alışveriş yapmaktan hoşlanırsınız?			
Haftanın	Günlük	Genel	Evden alışveriş	Alışveriş mekanına nasıl
□Cumartesi				
□Pazar				
□Pazartesi				
□Salı				
□Çarşamba				
□Perşembe				
□Cuma				

- Gittiğiniz **alışveriş mekanlarını** haritada işaretler misiniz?

- ***Gönüllülük İşleri***

28.	Gönüllü olarak yaptığınız aktiviteler var mı?	Ne zaman yapıyorsunuz?

28.	Bu aktivite için ne kadar zaman	Günde kaç	Haftada kaç gün	Ayda kaç defa

- Gönüllü çalışma yerinizi haritada işaretler misiniz?

- ***Sosyal Faaliyetler***

- What about your family and friends?

30.	Nerede buluşuyorsunuz?		
a.	□	Ev	➢ Arkadaş/aile fertleri ile buluştuğunuz evleri haritada işaretler

Ya da

b.	□	Ev dışında						
	□	Sinema	□	Cami	□	Kafe	□	Park
	□	Kültürel ve Tarihi	□	Market	□	Bar	□	Diğer

31.	Buluşma yerine nasıl ulaşıyorsunuz (seyahat seçenekleri)? (Birden fazla seçenek işaretleyebilirsiniz)									
	□Araba	□Tramvay	□Otobüs	□Bisiklet	□Taksi	□Motorsiklet	□Yaya	□Vapur	□Tren	□Diğer
No/at										

- ***Inanc:***

32.	➢ İbadet için nereye gidersiniz? Lütfen har,itada yerlerini işaretleyiniz.
Ne zaman gidersiniz?	

33.	Ne kadar sürüyor?		
	□ 15 dakikadan az	□ 15- 30 dakika arası	□ 30-45 dakika arası
	□ 45-60 dakika arası	□ 60-75 dakika arası	□ 75-90 dakika arası
	□ 90 dakikadan daha fazla, yaşlaşık		

35. Hergün geçtiğiniz size çeken mekanlar nerelerdir?

.....

.....

.....

.....

.....

....

- ➢ Neden buradan

geçiyorsunuz?.....

- Haritada işaretlermisiniz?

.....

37. Hangi aktiviteleri birarada gerçekleştiriyorsunuz?

.....

.....

.....

.....

.....

- Lütfen herbirini haritada işaretleyiniz.

F. Güvenlik ve engeller

37.	Kentte seyahat ederken geçmekten sakındığınız yerler var mı?					Günün hangi zamanı?
	□	Evet	□	Hayır	Evet cevabınız (EVET) ise neden?	□Sabah
						□Öğle
						□Akşam

39.	Aşağıdakilerden biri/birkaçı günlük seyahat modunuzu değiştiriyor mu?		
	□Evet	□*Hayır*	*Eğer cevabınız (EVET) ise aşağıdaki seçeneklerden hangi/ hangileri?*
□	Seyrek toplu taşıma		
□	Otobüs saatlerinin uyumsuzluğu		
□	Günlük programın uymaması		
□	Fiyatlar		
□	Güvenlik korkusu		
□	Sokağın durumu(yolu bozuk, kirli)		
□	Yüksek kaza riski		
□	*Gürültü*		
□	*Limitli servis ve araç çeşitliliği*		
□	*Çocuk sebebiyle hareket kısıtlılığı*		
□	*Kültürel ve sosyal farklılık sebebiyle yaşanılan sıkıntı (Neden?)*		

- Lütfen haritadan yerini işaretleyin.

İşbirliğiniz için çok teşekkürler!!!