

Complexity versus sustainability in urban space: The case of Taksim Square, Istanbul

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Abstract:

This paper examines the relationship between complexities of urban space against the eco-aesthetic concept of visual sustainability of the environment. It highlights the conceptual challenges in defining urban and architectural sustainability; indicates relations between sustainability and legibility of space and researches negative effects of complexity on a sustainable urban development. The paper identifies two main complexity elements of a city, which are streets and squares and indicates three major subjects to be investigated as 'general legibility easiness level', 'motor complexity elements' and 'general legibility difficulty level' on streets or squares. The survey is carried out in one of the most important city centers of Istanbul: Taksim Square and Istiklal Street. Main findings of our paper are that people learn squares more easily than they do the streets, mobile elements such as vehicles and pedestrians create more complexity than architectural diversity and signs. Complex environments are defined to be less legible as the familiarity decreases.

Introduction

Sustainability is defined as; "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987). Sustainability, within the environmentalist's works, defines the endurance of vital human ecological support systems like agriculture, climatic systems, forestry, fishery and all human communities and related sub-systems underneath the global structure. Global environmental problems in last decades are promoting awareness to sustainable urban development (OECD, 1990). Academic and public discourses lead to this use of the word sustainability in reference to how long human ecological systems can be expected to be usefully productive. Sustainability and notion of being sustainable becomes a phrase to symbolize an unknown rescuer for humanity against a possible self-devastation in the future. The implication is that modern industrial society, which continues to grow in scale and complexity, might collapse as a result of their own growth and associated impacts on ecological support systems. Thus, a possible catastrophe fact increases the importance of urban planning.

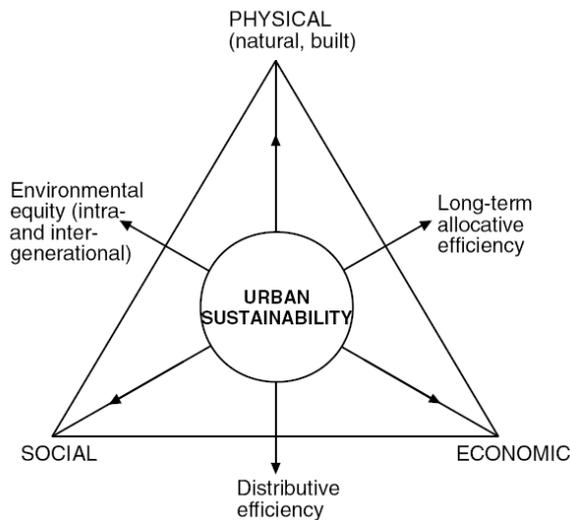


Figure 1. *The urban locus of sustainability principles and policies (Finco & Nijkamp, 2001)*

Today nearly half of the world's population (about 45%) is living in cities. This ratio is estimated to increase up to 60% by the year 2030 (Worldbank, 2007). This fact makes sustainable design an emerging matter in today's contemporary cities as symbols of continually developing urban spaces. Sustainability in urban space is a so-called policy to be developed under conflicting or coordinating objectives for city and its inhabitants (Finco & Nijkamp, 2001). Any sustainable development is evaluated in three sub-systems: physical, social and economic. These systems are sometimes mentioned as "triple bottom line" (Elkington, 1994) by which the viability, development and success of design should be evaluated. They are related to each other within multidimensional complexity (Figure 1).

Cities are always under the pressure of growing and changing complexity that planners cannot ignore. Despite many practical difficulties, firstly planners have to assess the degree of complexity and then to adapt the planning methodology accordingly. The solution for complex problems can be found in so-called integrated analytical communicative or collaborative planning (Diepen & Voogd, 2001). The growing complexity of social life makes the connection between people and places more diffuse than in past periods so that the city can be seen as "a locus of overlapping webs of relations on diverse spatial scales" (Kearns & Paddison, 2000). Elements of social diversity and active differentiation have spatial consequences in two ways. Firstly city of difference, social interaction and shared space make cities intolerable and indifferent with regions of exclusion. This creates excluded people living in excluded regions. Secondly newly emerged urban and building forms create a dissonant image than the older parts of the city.

Agenda 21 (Worldbank, 2007) recommends a series of activities for a sustainable urban design. One of them is to "Promote Sustainable Human Settlement Development" which is directly related to designers' works. As the main actors of design, architects and urban planners focus on the term "sustainable architecture". It is not a prescription, but an attitude as mentioned by Suzan Maxman (1993). This makes sustainable architecture both as a discipline and a product of discipline. It is related to the concept of "green building" (or "green architecture"). Green building is the practice of increasing the efficiency with which buildings use resources - energy, water, and materials - while reducing building impacts on human health and the environment, through better inhabitation, design, construction, operation, maintenance, and removal for the complete building life cycle. Green building concept can be interpreted as a symbol for sustainability but is insufficient to define such a complex subject. Guy and Farmer (2003) analyze sustainable architecture and mention six different kind of competing logic to clear the term: eco-technic, eco-centric, eco-aesthetic, eco-cultural, eco-medical, eco-social (Table 1). These logics are not frozen in time or static but may change in time and space. Through the design process of any particular development, logics may collide, merge, or coinhabit debate about form, design, and specification. Among these six logics, "Eco-aesthetic

logic”, as it differs from the other logic types, shifts sustainability debate from environmental resource use to visual structure of man-made space – especially urban milieu– and emphasizes spirituality in social and environmental relations. This new thinking is bound to New Ageism arguing that the world is undergoing under a new shift of consciousness leading to a new mode of being. Change begins with convergence of eastern and western philosophies. Today merging of these distinct philosophies is creating a new post-modern paradigm on world that can be defined under new sciences of complexity (Jencks, 1996).

Table 1. *The six competing logics of sustainable architecture (Guy & Farmer, 2003)*

Logic	Image of Space	Source of Environmental Knowledge	Building Image	Technologies	Idealized Concept of Place
Eco-technic	global context macro-physical	Techno-rational scientific	commercial modern future oriented	future oriented efficient high- tech intelligent	Integration of global environmental concerns into conventional building design strategies. Urban vision of the compact and dense city.
Eco-centric	fragile micro biotic	systemic ecology metaphysical holism	polluter parasitic consumer	autonomous renewable recycled intermediate	Harmony with nature through decentralized, autonomous buildings with limited ecological footprints. Ensuring the stability, integrity, and “flourishing” of local and global biodiversity.
Eco-aesthetic	alienating anthropocentric	sensual postmodern science	iconic architectural New Age	pragmatic new nonlinear organic	Universally reconstructed in the light of new ecological knowledge and transforming our consciousness of nature.
Eco-cultural	cultural context regional	phenomenology cultural ecology	authentic harmonious typological	local low-tech commonplace vernacular	Learning to “dwell” through buildings adapted to local and bioregional physical and cultural characteristics.
Eco-medical	polluted hazardous	medical clinical ecology	healthy living caring	passive nontoxic natural tactile	A natural and tactile environment which ensures the health, well-being, and quality of life for individuals.
Eco-social	social context hierarchical	sociology social ecology	democratic home individual	flexible participatory appropriate locally managed	Reconciliation of individual and community in socially cohesive manner through decentralized “organic”, nonhierarchical, and participatory communities.

Urban form is the depiction of the built environment based on its composing attributes and its mutual relations. Urban form refers to spatial characteristics like form, width-height proportion, enclosure, type and design that indicate the morphology of area. All these relations are constituted inside the two important elements of the city: streets and squares. Urban street and square sustainability, in the “eco-aesthetic logic” manner, is the fundamental concept to assess the complexity of the mutual relationships between urban form and sustainability (McLaren, 1992, Owens, 1992). More in particular, there is an extended body of literature that attempts to test the hypothesis that some types of urban form and pattern may lead to a reduction of energy consumption during utilization. Most of these researches are focusing on urban size and density, transportation, amount of open space, functions, mixed land use and presence of sidewalks (Diepen & Voogd, 2001). As a result of these studies, a relationship is found between high building density and the per capita fuel consumption for car mobility. Urbanization helps to reduce mobility. The diversity of land use and population as well as walkable

community design promotes inherently the reduction for automobile travel and sustainability. As a result there happens a considerable decrease of fuel consumption within rising urban density as car driving necessity and distance decreases.

Sustainability oriented street design takes an active role in satisfying inhabitants. In planning debates of sustainability and urban rehabilitation, pedestrian needs take significance in planning agendas (Desyllas, 2006). This dictates a new mobility culture which encourages walking by discouraging unnecessary travel with less use of fuel. The execution of regulations and standards for streets and squares can make a space more sustainable to meet the needs of users who live in historical and cultural diversity. This kind of governmental urban space organization can encourage good design that realizes a street and a square culture spaces friendly to all citizens, foreigners and especially tourists. Good design constitutes a legible and simple space with aesthetic influences respecting to all adjacent environmental elements in which one can find his/her way and feel "space enjoyment" to discover and to be inside. Once the space enjoyment is achieved, sustainable space measures will ensure the loyalty of pedestrians indicated by their constant presence not only as passers-by but also as active participants in the given space. In this respect urban and architectural design becomes a strategic tool that encourages a change of urban behavior and can discourage action with an inappropriate design while a good design can have positive and strong effects on people (Mumford, 2000).

A sustainable city with streets and squares oriented for pedestrians and ornamented with a greenery streetscape can be enough for anyone wandering around the streets of a city. Yet a city with a clear and readable "identity" within its minor and macro scale will achieve a higher standard of urban living. There are clear links between the attraction of the city and its quality of life (Rogerson, 1999). This interaction is related to the spatiality of contemporary society. The competitiveness of a city is an important aim in quality and sustainability of a city. A cosmopolite city like Istanbul, having a clear identity and being easily legible despite its complexity becomes important for global competitiveness. The competitiveness of cities reflects not only their current capacity to engage with global capital, but also is a function of their heritage, resulting in a spatially differentiated pattern of uniqueness. With the evidence pointing to the fact that there are clear links between the attraction of city and its quality of life, it is unsurprising that quality of life has become a part of the promotional tools being employed by city agencies to make their location attractive against different global capitals. The quality of a space is emphasized with the increasing abstraction of space. This provides the context for interpreting the place promotion in a complex environment.

The purpose of this paper is to present a conceptual framework on effects of formal of the environment on urban sustainability. A cognitive based indicator system for measuring urban complexity is proposed and applied to an important center of Istanbul: Taksim Square and adjoining Istiklal Street. This study may be a prototype study on which a major complexity element analysis of the whole city may be based.

Sustainability and legibility of urban space

Sustainability concept concerns quality of urban life and an emphasis on equity for the least advantaged sections of present and future generations. The term has been mostly used for social, environmental and economical concerns. Environmental sustainability involves using 'best practice' in the management of energy, transport, waste and pollution. Social sustainability concerns the 'greening' of trade, investment and service industries and the notion of improved 'personal' responsibility for all members of society. Finally, economic sustainability involves self-reliance and the objective of local equity. In the architectural manner urban space sustainability is a resultant of above three factors for a humane space formation. A prerequisite for a sustainable urban environment is that the legible and safe parts can be exploited by current or future users. Haughton (1999) identified four models of sustainable urban development "ranging from deep green to light green"; 'externally dependent cities', 'redesigning cities', 'self-reliant cities' and 'fair share cities' Deep green model attempts to foster self-reliant city where light green model supports an externally dependent city requiring support from governmental sources. The design of a sustainable space necessitates a balance within three major elements that define especially – the walking space – as a node: (1) the economics of space consumption of users as defined by pedestrian needs; (2) the spatial environment as dictated by the relationship of movement and non-movement within a given pedestrian space; (3) the socio-cultural history of the streets as a potential window to discover the pedestrian street culture of the past. They all help architects and urban planners to improve design recommendations on street and node design by utilizing a given space.

Architecture deals with built and natural environment to reduce the threats to personal physiological and psychological health as objectives commonly associated with the idea of sustainable urban environment. This can be managed with a "clearly read" environment that one lives comfortably and tranquilly without any waste of time and health. An environment can only be interpreted as sustainable if the following conditions can be obtained:

- Get rid of sense of loss (Wener and Kaminoff, 1983),
- Have fast movement and ease for way finding,
- Develop group psychology in urban environment,
- Give emotional reliance (Yeung and Savage, 1996),
- Increase potential depth and intensity in human experience,
- Give depth to our daily experience for motional satisfaction, organization and communication,
- Reduce emotional discomfort, chaos, anger and redundant crowd.

In addition to factors mentioned above, unknown environs arouse private desires to discover. Yet even the simplest system should be arranged to prevent cognitive chaos (Pollet ve Haskell, 1991). This can only be developed with environment that stimulates anxiety to discover without complexity. A legible design has positive and powerful influence on behavior of people (Mumford, L., 2000) and can establish urban sustainability in architectural manner. An environment with easier legibility gives people sense of belonging calling on integration of local culture, sense of place, source of pride, historical significance and contextual sensitivity. Especially pedestrians convert natural or man-made space into a social phenomenon, in the process dictating boundaries and attaching meaning to it (Gans, 2002). Sustainable urban spaces should have two interacting elements. First

one is a legible environment that supports psychological or physiological human needs within movement or non-movement spaces to wander and the second is that the reader such as pedestrians who need hierarchy, mobility, protection, ease, enjoyment and identity. According to Nasar (1988), legibility is an environmental factor that lets man to discover his surroundings extensively without getting lost. Lynch (1960) explains it as noticeable parts of the city in an order and in an ease to organize them. As a result, reading in architectural milieu is a quality that enables one to recognize the contents of objects by grouping them meaningfully. Reading is also related to one's personal factors: social, cultural, symbolic, age, gender and intelligence (Erem, 2003). According to Norberg-Schulz (1980) two factors affect reading: the tangible physical existing elements and intangible mental elements. Physical ones belong to environment while the others belong to man. So reading is a variable of man, while legibility is an environmental variable that man use to read around him.

In city scale the advantages of a space against a non-space is its measurability, to be bordered, closed, static and certain. As a Gestalt approach the legibility of a city is affected by the ease to recognize five elements of a city: paths, nodes, landmarks, borders and districts (Lynch, 1960). However, the level of importance for these elements differs. Researches in planned environments show that the most important element is node, and then come landmarks, paths, borders and districts in the order of legibility (Banai, 1999). We can here say that nodes, landmarks and paths play key roles for the legibility of any part of a city. Squares can be defined as nodes and streets as paths.

Urban form is the spatial pattern of human activities at a certain point in time (Anderson et al., 1996). If the number of activities increases at a certain time and place, then the spatial pattern becomes more complex, and this is reflected to urban pattern. This situation unfortunately affects the complexity of the environment. In a general sense, urban form can be classified into three categories: density, diversity and spatial-structure pattern (Tsai, 2005). Density measures the degree of activity intensity. Diversity refers to spatial scale or grain at which different spatial uses interact. The increase in density makes a street or square hard to recognize. Diversity reinforced with density carries the environment to chaos. Spatial-structure pattern is an overall shape of a city. It is the sum of all the density and diversity levels. The legibility of the environment is affected by the geometrical configuration of the physical components. These components either mental or touchable configure the city. This configuration may be simple or complex. So the level of reading is absolutely influenced by the complexity of the environment. The degree of complexity is an important variable for sustainable city design in cognitive manner.

Complexity of urban space

Complexity is described as "a condition of being hard to understand and to be formed of many numbers of related pieces" (Erem, 2003). Complexity is heterogeneity (Godfrey-Smith, 2001). Complexity is variety, diversity, doing a lot of different things or having the capacity to occupy a lot of different states. An environment with a large number of different possible states which come and go over time is a complex environment. Complexity is also assigned variably to unpredictability, irreversibility and ambiguity. There are many different kinds of heterogeneity, hence many kinds of complexity. Any environment will be heterogeneous in some respects, and homogeneous in

others. Environments can be heterogeneous in space and in time, and spatial and temporal heterogeneity exists at many different scales. Sometimes it is used as a synonym for difficulty, or something different (Biggiero, 2001). According to Herbert A. Simon (1956) complex system comprises many number pieces that interact without a simple relationship. Venturi (1977) describes complexity as a mixture of asymmetry, duality, disorientation, lack of hierarchy and chaos. The origins of

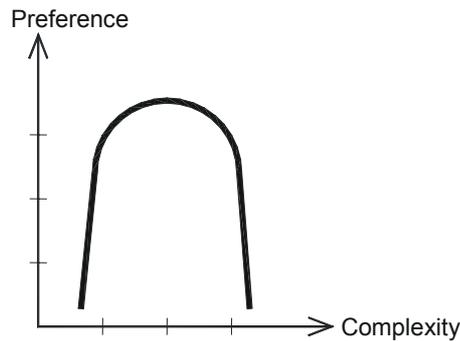


Figure 2. *The relationship between preference and complexity (Fiedeldey, 1995)*

complexity in each type of system, and the relationship of complexity to sustainability, are often very different. There has been, for example, a tradition within ecology to equate complexity with diversity, and diversity with stability or sustainability. Environment is complex according to the quantity of information, our ability to make distinction that is to perceive differences and therefore getting information (Bateson, 1980). Mostly in literature it is usually said that a well ordered system is simple. If the system is ordered then it is easy to understand, predict its behavior and describe it. It is an indicator for difficulty for the legibility of elements of different space layers. The decrease in complexity increases order and decreases cognitive processes and risk for making mistakes. According to Fiedeldey (1995) there is a reverse relationship between environmental preference level and complexity. Preference increases with complexity, but too much increase decreases preference level (Figure 2).

According to Sanoff (1991), reaction to discovery increases with the complexity of stimulating milieu. Also it awakens attention and anxiety. But order, organization, symmetry and repetition holds it in limited and tolerable limits. Geometrical complexity regarding to legibility is determined with the relationship of elements in sight of a vision. The factors affecting complexity in a vision are (Erem, 2003):

- Angle relation: Few straight lines and gentle curves, straight, medium and narrow angles increases complexity.
- Similarity between objects: Decrease in similarity increases complexity.
- The number of words that describes object: Complexity increases with the number of words.
- The symmetry of objects and curves in the vision: Complexity changes according to type of symmetry. As a result of researches radial symmetry is more complex than axial symmetry.
- The dimension of details: The decrease and differentiation in dimension of details increases complexity.
- The differentiation of form and angle in vision: The deformed and recessed forms increases complexity.
- The number of elements in vision: The increase in the number of elements increases complexity.
- The use of color: Increase in variety of colors increases complexity
- Number of edges: Increase in number of edges increases complexity

- Distribution order: Disordered distribution increases complexity, sometimes it is not possible to notice this, because it is not possible to associate the elements of complexity in cognitive level.
- Familiarity: The environment is less complex if they are familiar to observer, but it is too difficult to measure mathematically.

The complexity of the urban structure, the level of differentiation of urban elements and its visual aspect are the main variables influencing legibility in terms of spatial representation. Nevertheless, spatial representation is not only based on Euclidean information, but also on cluster and cognitive processes of categorization and hierarchy. The architectural complexity of contents is in building groups level. Despite the disadvantages of perception, the increase in the level of single building's complexity increases the preference level of its selection as a landmark. If the complexity of a contemporary building increases, it loses its advantage to be selected near historical buildings. The elements of complexity of a building group designate its legibility. So complexity created by pattern and color differentiations, curves, columns, window styles, ornaments hardens preference (Herzog ve Shier, 2000).

The complexity of urban environments involves various aspects, but basically two can be identified. The first is concerned with the evolution of urban structure, i.e. the formation of urban form, and the second is more to do with the social activities of humans within urban environments, for instance, the pattern of pedestrian crowds and traffic flows (Jiang, B., 1999). In urban scale, an environment can be described as complex according to following conditions:

- It is hard to form the cognitive map and find one's way,
- It is hard to select landmarks, paths, borders,
- Only a few sections of a settlement are well-known,
- If we have a lot of information about an object or element, it shows a low degree of complexity.

Uniformity of environmental characteristics and the consequent lack of legibility have both influences on the image of surroundings and on way finding behaviors, because people have difficulties in learning spatial information (Abu-Ghazzeh, 1996). Thus, behavioral legibility depends on environmental information rather than simple physical stimuli. To consider a spatial representation of the urban environment the researcher must not ignore social and cultural characteristics of a person/surrounding relationship. The danger is to build a meaningless environment that affects one's cognitive representation and as a result of his/her behavior. The meanings are important in the elaboration of landmarks and they organize the spatial layout of cognitive maps.

Research objectives

People develop their "cognitive maps" or rich "internal representation" of the environment. Complexity is a factor that interferes with this process mostly in negative manner. The increase in deformation of cognitive map formation is a side effect of complexity. The other effects of complexity are the decrease in legibility, difficulty in way finding and lack of ability to define the environment to third persons. All these negative side effects of complexity can bring discomfort to living in a city. Lack of comfort can threaten the long living life of urban space, so can harm sustainability of that urban space.

Therefore, the objective of our research is to investigate 'complexity of urban space' that is an opposing concept for sustainability. In this study, we basically investigate three main subjects to find out the complexity level of the environment in terms of legibility of urban space:

- 1) *General legibility easiness level*: This analyses the legibility level of streets and square from the mind of citizens. It is questioned in under two easiness levels of legibility and definition:
 - a) *Ease of legibility*: Legibility analysis is a cognitive representation of a person's information about a street. It indicates the percentage of environment that a person can define to know. This is related to self-confidence of a man on knowing the environment. If a person thinks he knows a street much better than another one, then theoretically this street can be assumed to be more legible than the other one. As the ease of legibility for a street decreases complexity increases.
 - b) *Ease of definition*: Definition analysis is about the cognitive ability of one person to define elements on a street to another one. As ease of definition decreases, complexity degree increases.
- 2) *Motor complexity elements*: Motor complexity elements are the environmental components (i.e. vehicles, pedestrians, signs, furniture, trees and etc.) that increase the overall complexity degree of a street.
- 3) *General legibility difficulty level*: Difficulty level analysis for each street retrieves the most unreadable parts of urban space.

The study area

The notion of complexity is difficult to grasp in practical life, and even more difficult to handle theoretically. Today information theory and "chaos" theory has a general understanding and definition of complexity (Grönlund, B., 2006). Complexity is neither simple order nor a complete mess. It is something between order and chaos, and it grows at the edge of chaos. From the point of view of information theory, complexity is the result of information that has been discarded. Only in special cases is it possible to figure out the kind and amount of discarded information. This is why there is no general way to measure or compute complexity in practical life. Information theory has been taken as the basis of urban complexity theories to help to develop sustainable environments. The question of complexity of urban design certainly has to be broken down into groups of detailed and specific aspects, which cannot be totally searched here. They have to be further elaborated through research programs. Here, only some starting points for an urban design of complexity will be discussed.

The eye level of man in urban space is the main observing point for the complexity of the environment. Streets and squares are the main surrounding space development elements of city. The complexity of city can be investigated by analyzing both of these elements (Erem & Şener 2006):

1. **Streets**: Streets are the kind of space where urban encounters can take place on a wide scale in everyday life. Physically complex urban space in the form of urban streets increases extraversion: private services as well as out-ward oriented do-it-yourself activities, the meeting of strangers, coincidence of trajectories, etc. Streets define the urban landscape acting as a generative urban element in conjunction with the building block (Lillibye, 1996). Streets consist of the combination of these relations: the relationship between mass and volume, the continuity of experience and simultaneous continuity. So the legibility of

streets is man's perception of volume and spaces by continuous experience in the street. This continuity is possible with the continuous perception of space. But perception interrupts when too much information is given to the observer. This interruption is triggered negatively by the complexity of the surrounding street space.

2. Squares: Squares are nodes that one can enter. Squares define the junctions of streets. They are both movement and non-movement spaces. The legibility of the node increases when closure as a square is formed (Alexander et.al., 1977). The closure of the square, openings, functions and formal properties such as the form of the square, ground pattern, symmetry and asymmetry and the form of the buildings effect the legibility of squares. Theoretically, complexity increases with lack of legibility of squares.

The greenhouse effect and ozone depletion are consequences of the processes of urbanization and industrialization which use up raw materials and energy, and produce damaging as a result of energy loss. Furthermore, cities can be environmentally unfriendly places. By discharging pollutants and other activities such as resource exploitation and land development, urban society interferes with these environment processes and systems. In addition, local problems such as public safety, litter and high crime rates also affect the quality of urban life. In addition to the above problem a city is under the danger of uncontrollable complexity of urbanization. Mostly urbanization results in a mixture of buildings with a diversity of architectural styles. Istanbul is a good example with most of its streets and squares made up of mixture of modern and historical buildings. This diversity seems to be interesting for many people. But in such a complex environment one can hardly find his way, read the environment and describe it to another person. In our study we try to find out the effect of complex environment on legibility of an environment. The sample of environment is one of the most important centers of Istanbul: Taksim Square and Istiklal Street end (Figure 3).

Taksim Square is situated in the European part of Istanbul. It's a major shopping, tourist and leisure district famed with its restaurants, shops and hotels. It is considered to be the downtown center of contemporary Istanbul, and is the location of the Cumhuriyet Aniti (Republic Monument), which was built in 1928 and that commemorates the formation of the Turkish Republic. Taksim was originally the point in Istanbul, where the main water line from north of Istanbul collected, and branched off to other parts of the city. This use for the area was established by an Ottoman Sultan: Mahmut I. The Square takes its name from the stone reservoir that is located on the side of the square. Taksim is a popular and historical destination for both tourists and citizens of Istanbul. It is surrounded by a water reserve tank stone building on the east side, by Ataturk Cultural Center on the west, Inonu Park on the north and The Marmara Hotel with twenty six storeys on the south side. There are important major streets joining to the square such as Istiklal Street and Siraselviler Street on the southwest side, Cumhuriyet Street and Tarlabasi Street on the northwest side and other minor streets such as Mete Street on the northeast side and Ismet Inonu Street on the northeast side.

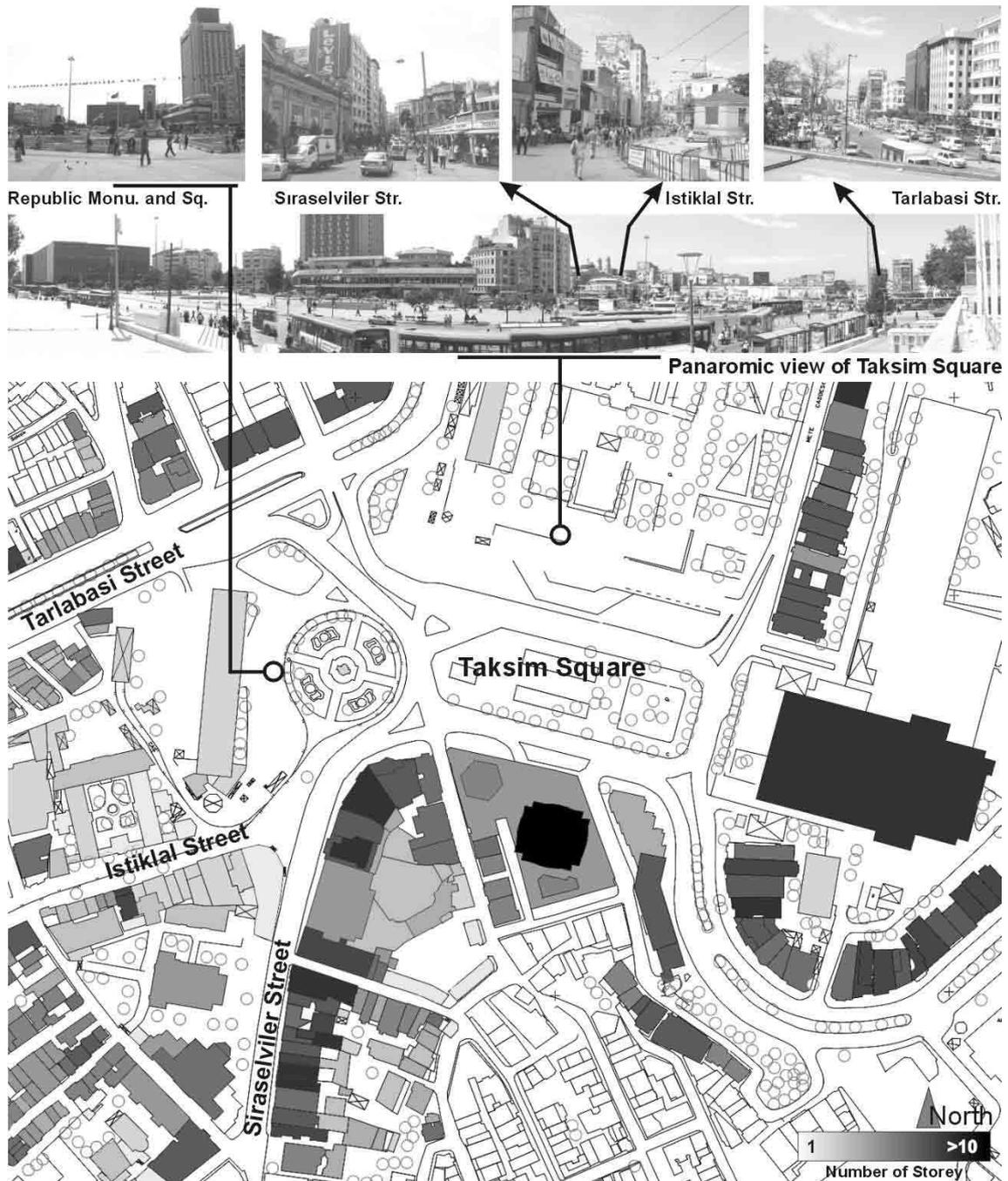


Figure 3. Pictures from Taksim square, Siraselviler, Istiklal and Tarlabasi streets. Differentiation in number of storey analysis for square and joining streets.

Analysis method

This study is based on a structured questionnaire survey with a visit to the site. Survey was carried out in May 2006 in Taksim Square and Istiklal Street junction. Sixty-two respondents were interviewed in the survey. All the respondents were citizens of Istanbul and they were chosen randomly, but were living more than five years in the city. The respondents were chosen from people between ages of twenty and thirty. The structured survey aimed

at ascertaining the data about the elements that determine the complexity of the streets with related questions and the visit to the site aimed to archive photos of those elements.

Findings

The findings of the structured questionnaire applied to sixty two respondents to examine “complexity issues” defined above are as the following:

General Legibility Easiness Level:

Ease of legibility: 58% of respondents mentioned Taksim Square to know nearly 100%. This is probably because of its being a major node. The reading of the surrounding buildings is easier in a square. 52% of respondents answered to know Istiklal Street nearly 100%. This is possibly because it is the most used street joining to Taksim Square. 6% of respondents mentioned to know 100% of Siraselviler Street and this finding is only 3% for Tarlabasi Street. %23 of respondents mentioned to know 0% to 20% for Siraselviler Street. This ratio is %29 for Tarlabasi Street. From the most to the least level the order for maximum (between 80%-100%) legibility easiness for streets and square is: Taksim Square, Istiklal Street, Siraselviler Street and Tarlabasi Street (Figure 4).

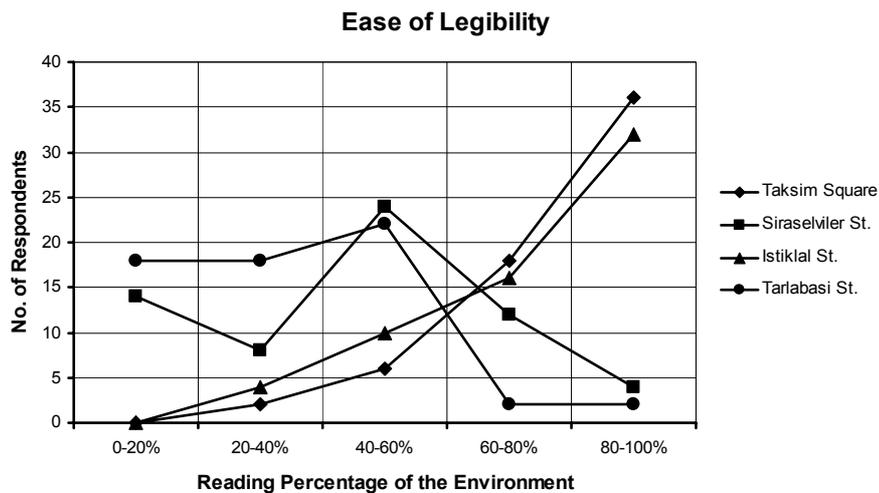


Figure 4. Legibility easiness of Taksim Square and the streets

Ease of definition: “Is it hard for you to describe an address to another person within Taksim Square and environs?” is the question for this issue. The definition easiness has been investigated with a five incremental degree from easiest to hardest: always, mostly, sometimes, rarely, never. 48% of respondents mentioned to describe an address to another person “mostly”. This ratio decreases much for “always” with %10 and a little for “sometimes” with 35%. Generally, Taksim Square and its adjoining streets have been found as “mostly” easy to define to another person. From our point of view, this shows that for this spaces one can read this environment and is mostly sure about his or her knowledge on his/her cognitive representation. So this decreases the complexity level of this milieu (Figure 5).

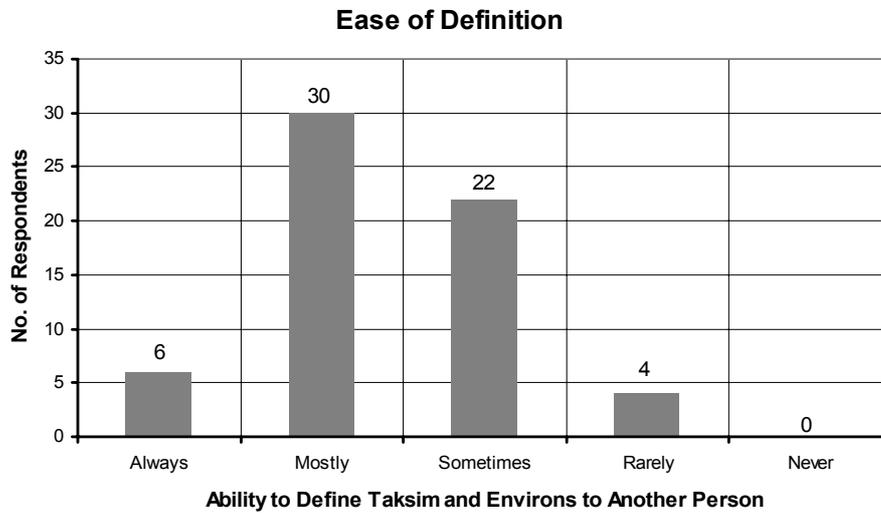


Figure 5. Definition easiness level of Taksim square and the streets

Motor complexity elements:

Taksim Square: 39% of respondents mentioned that the major complexity element for Taksim Square is “pedestrians”. 37% of respondents choose “vehicles” to be second major complexity element. We can easily say that both of these environmental urban mobile elements; “pedestrians” and “vehicles” are motor complexity elements for Taksim Square. Architectural diversity with 10%, signs with 7%, differentiations in number of storey with 5% are affecting the total complexity level of the square in minor level. Trees in the square are the least affecting elements with 2% of selection.

Siraselviler Street: 35% of respondents mentioned that the major complexity element for Siraselviler Street is “vehicles”. There is too much traffic in every hour of the day. So it is natural for vehicles to be taken as the main complexity element. 28% of respondents choose “architectural diversity” to be second major complexity element. Maybe architecture was chosen as complexity element, because when you look from Taksim Square you see different kind of buildings with changing number of storey. Ayatriada church at the back side of one storey fast-food restaurants on west side, where a uniform row of buildings with eight to ten floors on the east side are the enclosing facades for Siraselviler Street. So the motor complexity elements are “vehicles” and “architectural diversity” for Siraselviler Street. %13 or respondents choose signs, pedestrians and differentiations of storey equally. So in the architectural manner complexity of the street comes from different heights of buildings on each side of the street plus signs on buildings as non-movement elements and pedestrians and vehicles as movement elements.

Istiklal Street: There is no motor vehicle transport allowed on the street. Only police cars and service vehicles are allowed to get in the street. Also, a tram is working from the Taksim Square end to the other end of the street: The Tunnel. 15% of respondents choose “vehicles” to be third major complexity element. This may be because of these allowed cars and other vehicles. They penetrate the pedestrian side walks on the street and increases chaos on the pedestrian jam times especially in the evenings after six o'clock. We can say that elements as “pedestrians”, “signs” and “vehicles” to be motor

complexity elements for Istiklal Street. Architectural diversity with 10%, differentiations in number of storey with 5% are affecting the total complexity level of the square in minor level. Trees in the square are the least affecting elements with 3% of selection.

Tarlabasi Street: 34% of respondents mentioned that the major complexity element for Tarlabasi Street is “vehicles”. This is because of this road’s being a major one for Istanbul traffic system. The traffic flows faster than the other streets and Taksim Square. So pedestrian sidewalks are not as comfortable as the other spaces mentioned above. 18% of respondents mentioned pedestrians and architectural diversity to be complexity elements for the street. 16% of respondents choose “differentiation in number of storey” and 14% for “signs”. We can say that elements as “vehicles”, “pedestrians”, “architectural diversity”, “differentiation in number of storey” and “signs” to be motor complexity elements for Tarlabasi Street. As five of motor complexity elements have been chosen we can comment as this street to be “too complex”. This may be result of low percentage in familiarity for this street, because respondents have chosen this street as the least known space around Taksim Square (Figure 6).

Generally, complexity is affected by the density of vehicle and pedestrian traffic on the ground level. The other elements are signs on the buildings. Architectural diversity whether old, historic, contemporary or new and etc. is another complexity element for a street or a square. Also different buildings increase complexity level with different number of storey on the same street or square. May because there is not too much number of trees, or may be people need to see plantation trees are not chosen as complexity elements.

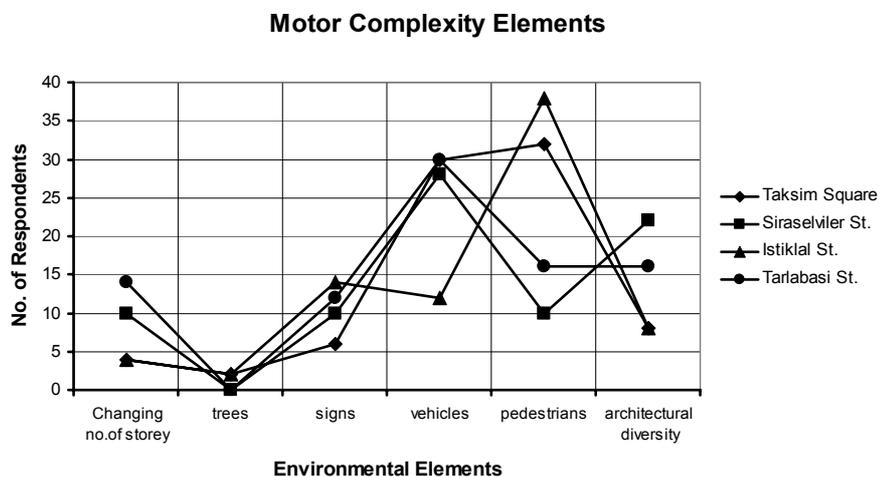


Figure 6. Complexity elements of Taksim square and the streets

General Legibility Difficulty Level: For this question, respondents gave score for “legibility difficulty” of each street and Taksim Square. They gave one point for the easiest and gave more points for harder ones. The score changes from one point to five points. The top point for the hardest one is five. For the evaluation of questionnaire, we add all the points taken from respondents. As the result for this “street test” Siraselviler has taken the highest score with 230. Then came Tarlabasi Street with 212, Istiklal Street with 144 and Taksim Square with 112. These scores are mostly related to

familiarity. Also for complexity level; architectural diversity, difference in number of storey and usage of signs has been found high for both Siraselviler and Tarlabasi Streets. The motor complexity element of “architectural diversity” has the highest percentage for the Siraselviler Street which has difficulty for legibility (Figure 7).

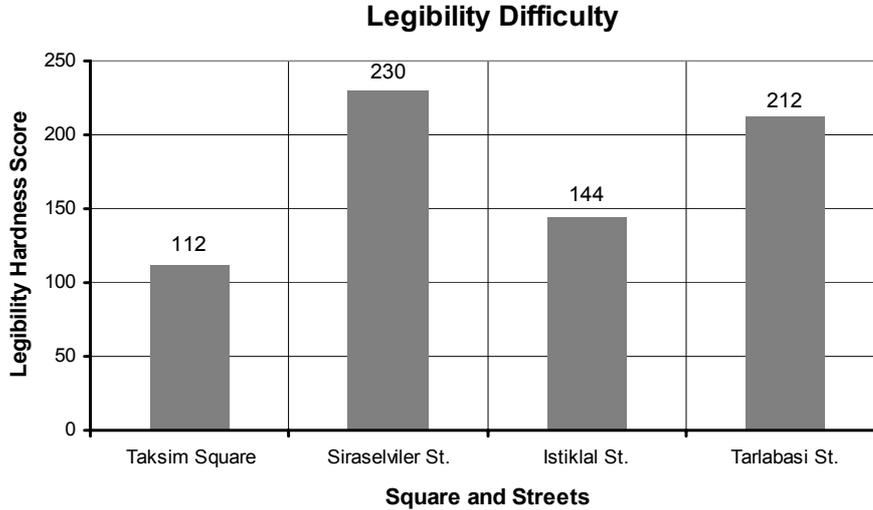


Figure 7. Legibility difficulty level of Taksim square and the streets

Discussion and conclusion

General complexity level of urban space can be interpreted as a result of difficulty in the reading, living and having access to the environment. General complexity level of square and streets is the difficulty of way finding and constituting the cognitive map of environment, lack of selection for landmarks on streets and nodes. This study gives important clues on the “complexity formation of urban street and a square” according to its legibility:

People learn about squares more than streets. Nodes seem to be more legible than streets. This is because of easiness in reading the environment. One can read a square from his standing point without any extra movement or effort. But streets are to be discovered by walking in it. Some elements may be omitted in reading. So one finds street to be more complex than a square.

Mobile elements such as vehicles and pedestrians are the most selected complexity elements for urban squares and streets. This is probably because of making chaos in vision, increasing noise and interrupting pedestrian flows. Architectural diversity and signs are the other complexity elements for urban spaces. Architectural diversity increases complexity. This has been proofed by findings of “General Legibility Easiness Level” in Siraselviler Street. As “architectural diversity” becomes to be a motor complexity element, the difficulty of legibility increases, because the maximum ratio for architectural diversity is seen in the least legible environments. The difference in building form, height and type, the position of the building to the street increases the street’s complexity level. Other most effective elements of complexity are differentiation of storey and signs. These findings support the earlier findings that the increase of signs in urban space increases complexity (Nasar and Hong, 1999).

Complex environments are defined to be less legible. As the familiarity decreases for streets then “general legibility easiness level” decreases. As the number of different motor complexity elements in a street or a square increase and the ratio of their effect on complexity become to be similar as the legibility easiness decreases. Architectural diversity increases complexity as found in Siraselviler Street.

Taksim Square and adjoining streets are major parts of an important tourist center for Istanbul. For a sustainable city development legible urban environment is a necessity. Obtaining a legible environment is possible by eliminating elements that increase complexity such as traffic jam, uncontrolled pedestrian movement and visually complex signs. The other elements such as architectural diversity and differentiation in number of storey are uncontrollable factors. But governments can regulate them for further developments.

Complex environments can give advantages to a city as creating a living urban environment with its inhabitants. Sometimes a street or a square with many pedestrians but without vehicles can be more attractive than a lonely place. This study gives some tips for a better street or square design and the effects of complexity on such a space. Based on this prototype study, further studies may be carried out on different parts of the city. These efforts may contribute to changing the negative and chaotic image of special environments through user participation and take designers to a more balanced environmental design in the middle of complexity and sustainability. This work may be used as a part of tourist, governmental regulation and advertisement purposes concerning Istanbul.

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Kentsel mekânda karmaşıklık sürdürülebilirliğe karşı: Taksim meydanı örneği, İstanbul

Günümüzde sürdürülebilirlik kavramı gerek akademik çevrede, gerekse halk tarafından ekolojik sistemin ne kadar süre ile üretken olabileceğine bağlı olarak değerlendirilmektedir. Bu bağlamda, 20 yıl içinde kentlerde yaşayan insanların toplam nüfusa oranının %45' den %60 oranına çıkacağı tahmin edilmesi nedeniyle gittikçe karmaşılaşan kentsel mekânın sürdürülebilirliği önem kazanmaktadır. Konu ile ilgilenen mimarlar "sürdürülebilir mimari" terimi üzerinde yoğunlaşmaktadır. Bu kavram eş anlamlısı olarak kullanılan "yeşil mimari" kavramının ötesinde birbiriyle yarışan farklı mantıksal konular ile anlatılmaktadır: eko-teknik, eko-merkezli, eko-estetik, eko-kültürel, eko-medikal ve eko-sosyal. Eko-estetik mantık bağlamında kent meydanı ve sokağının sürdürülebilirliği bu bildirinin kapsamında kent formu ile sürdürülebilirlik arasındaki karşılıklı ilişki karmaşasının temel çıkış noktasını oluşturmaktadır.

Kentleşmenin karmaşası ile sürdürülebilirlik arasındaki ilişkiyi anlamaya yönelik araştırmalardan, genellikle kentleşmedeki yoğunluk artışının yakıt tüketiminin azalması nedeniyle ekolojiye katkıda bulunduğu anlaşılmaktadır. Ancak kentsel gelişme "mekândan hoşlanma" duyguları içinde, insanı kaybolmadan keşfetmeye yönlendirecek "iyi tasarım" la destekli ve okunabilir "kimlik" içinde gerçekleşmelidir. Bu durum, bir kenti diğer dünya kentleri ile yarışabilir kaliteli yaşama sahip bir konuma getirmektedir. Bu makalenin amacı kentsel karmaşıklığın kentsel sürdürülebilirlik üzerindeki olası etkilerini araştırmaktır. Bunun için kentsel karmaşıklığı ölçen bilişsel tabanlı bir gösterge sistemi önerilmiş ve bu sistem İstanbul'un önemli bir kent merkezi olan Taksim Meydanı ve ona bağlanan İstiklal Caddesi'nde uygulanmıştır.

Kentsel mekânın sürdürülebilirliği ilk olarak okunabilmesi ile başlar. Kentsel çevre; kaybolma hissinde kurtulma, kolay ve hızlı hareket etmeyi ve yön bulmayı

kolaylaştırma, sosyal açıdan toplumsal ortak grup psikolojisinin gelişmesini sağlama, duygusal güven verme, insan deneyiminde potansiyel derinlik ve yoğunluğu artırma, duygusal tatmin, organizasyon ve iletişim için bir altyapı, günlük deneyimize bir derinlik verme, karmaşa, kızgınlık, gereksiz kalabalıklaşma ve duygusal rahatsızlığı azaltma, işlevlerini yerine getirebiliyorsa sürdürülebilir olarak nitelendirilebilir. Kentsel form insan aktivitelerinin zaman içinde belirli bir noktada gerçekleştiği mekân dokusudur. Aktivitelerin artması durumunda mekân karmaşıklaşır ve bu durum mekân dokusuna yansır. Mekânda yoğunluk ile güçlendirilmiş çeşitlilik çevreyi kaosa sürüklemeye başlar. Kaosla beslenerek bilişsel anlamda okumayı sınırlayan karmaşıklık yaşam sürekliliğini tehdit etmeye başlayacaktır.

Karmaşıklık anlaşılması güç olma ve birbiriyle ilişkili çok sayıda parçadan oluşma durumu, heterojenlik, çeşitlilik, değişkenlik, çok şey yapma ve pek çok durumu kapsama olarak tanımlanabilir. Çevre bilginin miktarı, farkları ayırt edebilme yeteneğimiz ve bilgiyi alabilmemize göre karmaşıktır. Karmaşıklıkta azalma düzeni artırır ve bilişsel süreçleri azaltarak hata yapma olasılığını düşürmektedir. Tercih ise karmaşıklık ile artmakta, ancak çok fazla karmaşa tercih düzeyini de azaltmaktadır. Geometrik karmaşıklık ise, görüntüdeki elemanların ilişkisi ile belirlenmektedir: açı ilişkileri, benzerlik, tarif etmedeki sözcük sayısı, simetri, detay boyutları, forma farkları, eleman sayıları, renk çeşitliliği, kenar sayısı, dağılım düzeni ve aşinalık. Kentsel mekândaki karmaşıklık, kentsel formun gelişimi ve sosyal aktivitelerin yoğunluğu ile ilgilidir. Kentsel ölçekte bir çevrenin karmaşık olarak tanımlanması, bilişsel haritanın oluşması ve yön bulmadaki zorluklar, çevre işaretleri, yollar ve sınırların belirlenmesi güçlüğü, az bilgi veya çok bilgi sahibi olabilme ile ilişkili olarak değişmektedir. Kentsel bilginin temsil edilmesi, araştırmacıların karmaşıklığın ortaya çıkarılmasında en önemli araçlarıdır ve bu çalışmalarda insanın sosyal ve kültürel karakteristikleri göz ardı edilmemelidir. Buna göre, çevreye yüklenen anlamlar da okumayı ve karmaşık bulma düzeyini etkileyebilecektir.

Karmaşıklık pratik hayatta anlaşılması zor, ne basit ne de kaotik bir oluşumu temsil etmektedir. Bilgi teorisine göre karmaşıklık göz ardı edilen bilginin sonucudur. Bu nedenle karmaşıklığı kesin olarak hesaplamamızın bir yöntemi yoktur. Ancak bilgi teorisi bu çalışmada da olduğu gibi kentsel karmaşıklık ile ilgili araştırmaların temelini oluşturmaktadır.

Çalışmada araştırma alanı insanın göz seviyesinde algıladığı kentsel mekânın karmaşıklığı üzerine yoğunlaşmıştır. Sokaklar ve meydanlar kentsel çevrenin gelişmesinde ana elemanları oluşturur. Karmaşık sokaklar dışa dönüklüğü artırır. Sokaklar bina blokları ile bağlantılı kentsel peyzajı tanımlar ve kütle-hacim ilişkisini, deneyimin sürekliliğini ve devamını sağlarlar. Süreklilik kentsel mekânın sürekli algılanması ile sağlanabilir. Ancak karmaşıklık sürekliliği kesintiye uğratabilmektedir. Meydanlar sokakların birleşim noktalarıdır. Meydanın okunması ancak meydan olarak kapalılığın oluşması ile sağlanabilir. Meydanın kapalılığı, açılmalar, işlevler ile meydanın formu, zemin dokusu, simetri, asimetri ve bina formları meydanın okunmasını etkiler. Teorik olarak meydandaki karmaşıklık okumayı etkiler.

Araştırma alanı seçilen Taksim Meydanı İstanbul'un Avrupa yakasında yer almaktadır. Kentin büyük alışveriş, turizm ve rekreasyon merkezlerinden bir tanesidir. İçinde 1928 yılında yapılmış Cumhuriyet Anıtı'nı barındırır. Bölge Osmanlı padişahlarında 1. Mahmut zamanında kurulmuş popüler bir turizm merkezidir. Doğuda büyük su deposu, batıda AKM, kuzeyde İnönü Gezi Parkı ile güneyde yirmi altı katlı otel ile sınırlanmaktadır. Taksim Meydanı güney doğu tarafından İstiklal caddesine açılmaktadır. Taksim Meydanı'na bağlanan diğer caddeler ise güney yönünden Sıraselviler Caddesi ile kuzeydoğu yönünden Tarlaşısı Caddeleri'dir.

Araştırmanın amacı kentsel sürdürülebilirliğe etki eden sokak ve meydan karmaşıklığını ortaya çıkarmaktır. Yaşları yirmi ile otuz arasında değişen 62 adet deneğe soru sorma yöntemi ile anket uygulanarak bir analiz yapılmıştır. Denekler rastgele ve İstanbul'da beş yıldan fazla yaşayanlar arasından seçilmiştir. Sokaklar ve meydan içinde karmaşıklığı etkileyen faktörler için bulunan sonuçlar üç konu başlığı altında gruplandırılabilir:

1. Genel okunabilirlik düzeyi: Okunabilirlik kolaylığı en fazladan en aza doğru Taksim Meydanı, İstiklal, Sıraselviler ve Tarlabası Caddeleridir. Taksim Meydanı ve çevresinin tarif edilebilme kolaylığı en fazla "genellikle" cevabı üzerine yoğunlaşmış ve bu durum karmaşıklık düzeyinin çok fazla olmadığı şeklinde yorumlanmıştır.
2. Ana karmaşıklık elemanları: Karmaşıklığı oluşturan çevresel elemanlar meydan ve caddelere göre farklılık göstermektedir. Bulgulara göre, Taksim meydanının en önemli elemanları taşıtlar, yayalar ve mimari farklılıklardır. Sıraselviler caddesindeki elemanlar ise mimari farklılıklar, taşıtlar ve levhalar olarak karşımıza çıkmaktadır. İstiklal caddesinde yayalar, levhalar ve taşıt trafiğine kapalı fakat acil girişlere açık olmasına rağmen taşıtlar olarak kendini gösterirken, Tarlabası caddesinde ise taşıtlar, mimari farklılıklar ve levhalar ön plana çıkmaktadır.
3. Genel okuma zorluğu düzeyi: Okunması en zor mekânlar en zordan kolayca doğru Sıraselviler, Tarlabası ve İstiklal Caddeleri ve Taksim Meydanı'dır.

Yukarıda ortaya çıkan sonuçlar sokakların ve meydanların karmaşıklığı ile ilgili olarak bazı ipuçları vermektedir:

1. İnsanlar meydanlar hakkında sokaklardan daha fazla bilgi edinmektedir. Bağlantı noktaları daha okunabilir olmaktadır. Bunun nedeni insanın bir meydan içinde çevresini ekstra hareket etmeden okuyabilmesidir. Ancak sokaklar yürüyerek keşfedilebilmekte ve bazı elemanlar atlanabilmektedir.
2. Bu nedenle insan sokağı meydana daha karmaşık bulmaktadır. Taşıtlar ve yayalar gibi hareketli elemanlar başlıca karmaşıklık elemanları olarak seçilmektedir. Bunun nedeni kargaşa yaratmaları, gürültüyü artırmaları ve yaya akışını kesmeleridir. Bina formu, yüksekliği, tipi ve pozisyonlarından kaynaklanan mimari farklılıklar da karmaşayı artırmaktadır. Diğer karmaşıklık artırıcılar kat farklılıkları ve levhalar olmaktadır.
3. Karmaşık çevreler daha az okunabilmektedir. Ana karmaşıklık elemanları arttıkça okunabilirliğin azalması ile karmaşıklığın artışı kaçınılmaz olmaktadır. Mimari çeşitlilik karmaşıklığı Sıraselviler Caddesinde olduğu gibi artırmaktadır.

Sürdürülebilir bir çevrenin oluşması ancak karmaşıklığı oluşturan trafik sıkışıklığı ve kontrolsüz yaya trafiğinin düzenlenmesi ve görsel olarak karmaşık levhaların düzenlenmesi ile sağlanabilir. Bunların yanında mimari farklılıklar ve kat farklılıkları, ancak yönetimlerin düzenlemeleri ile kontrol edilebilir. Bu çalışma prototip olarak kabul edilirse İstanbul'u içeren turizm, tanıtım ve yönetsel amaçlar için kentin önemli meydan ve sokaklarına uygulanabilir.