

ANALYSING THE USER EXPERIENCE OF SMART CITY MOBILITY
THROUGH APPLICATIONS IN ISTANBUL



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PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Date : 04.07.2023

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ÖZET

Son yıllarda teknolojik gelişmelerle birlikte büyüyen ve değişen üretim ve tüketim ortamında rekabet edebilmek için farklı yollar aranmaya başlanmıştır. Bu nedenle tasarım ve deneyim ve kullanım alanlarının önemi artmaktadır. Aynı şekilde kullanıcıların ihtiyaçları, beklentileri ve günlük alışkanlıkları da değişmekte ve gelişmektedir. Dünyada farklı zamanlarda ortaya çıkan, sosyal ve ekonomik koşullarla şekillenen birçok yerleşim düzeni vardır. Dünyada ve ülkemizde son dönemde en yaygın kullanılan modellerden biri de çevreyi korumayı ve sürdürülebilir kalkınmayı hedefleyen akıllı şehirdir. Akıllı şehir; sınırlı olan dünya kaynakları için zamandan, enerjiden ve iş gücünden tasarruf sağlayarak kaynakları verimli kullanmayı amaçlar. Akıllı şehirler, kentsel yönetimde teknolojinin sunduğu fırsatlardan yararlanarak gerekli yüksek kaliteli kentsel hizmetleri sunmayı amaçlamaktadır. Akıllı şehir teknolojisinin paydaşlarından bazıları; telekomünikasyon ağları, mobil cihazlar, dijital kameralar, kentsel alanlardaki sensörler, halka açık veritabanları, akıllı kartlar ve sosyal medya gibi araçlardır. Akıllı şehir uygulamaları henüz başlangıç aşamasında olan uygulamalardır. Akıllı şehir konseptinde bir paydaş olarak; akıllı ulaşım, akıllı enerji, akıllı altyapı ve akıllı çevre ilk akla gelenlerdir. Akıllı ulaşım sistemi; bilgi ve iletişim teknolojilerinin kaynaştırılması yoluyla, ulaşımın temel unsurları olan insanlar, yollar, trafik işaretleri, toplu taşıma, kişisel ulaşım vb. paydaşlar için etkin iletişim ve etkileşim sağlamayı amaçlar. Kullanıcı beklentilerinin değiştiği günümüzde soyut ve somut ihtiyaçlarını anlamak önem kazanmaktadır. Bu durum kullanıcıların soyut kavramlarla kendilerini ifade etmelerinde zorluk oluşturmaktadır. Olumlu ürün deneyimleri yaratmak ve kullanıcıların yaşamlarına değer katan ürünler tasarlamak için, kullanıcılarda yankı uyandıracak daha fazla araştırmaya ve uygulanabilir araçlara ihtiyaç vardır. Bu doğrultuda tez araştırmasında; kullanıcının ürünle etkileşiminin yarattığı kullanıcı değerine ulaşmayı amaçlayarak, tasarım araştırmacılarının kullanıcı değerini etkileyen buluşlardan yararlanabilecekleri bir çerçeve sunmak, kullanıcı deneyimi ve mevcut ürün etkileşiminde tasarım araştırmacılarının yararlanabileceği bir çerçeve ortaya koymak hedeflenmektedir.

Anahtar Kelimeler: Kent Mobilyası, Akıllı Kent, Etkileşim Tasarımı, Kullanıcı Deneyimi.

ABSTRACT

In recent years, different ways have been sought to compete in the growing and changing production and consumption environment with technological developments. For this reason, the importance of design and experience and usage areas is increasing. In the same way, the needs, expectations and daily habits of users are also changing and developing. There are many settlement patterns that emerged at different times in the world, shaped by social and economic conditions. One of the most widely used models in the world and in our country recently is the smart city, which aims to protect the environment and sustainable development. Smart city aims to use resources efficiently by saving time, energy and labour for limited world resources. Smart cities aim to provide the necessary high quality urban services by utilising the opportunities offered by technology in urban management. Some of the stakeholders of smart city technology are telecommunication networks, mobile devices, digital cameras, sensors in urban areas, public databases, smart cards and social media. Smart city applications are still in their early stages. As a stakeholder in the smart city concept; smart transport, smart energy, smart infrastructure and smart environment are the first ones that come to mind. Smart transportation system aims to provide effective communication and interaction for stakeholders such as people, roads, traffic signs, public transport, personal transport, etc., which are the basic elements of transportation, through the fusion of information and communication technologies. In today's world where user expectations are changing, it is important to understand their abstract and concrete needs. This situation creates difficulty for users to express themselves with abstract concepts. In order to create positive product experiences and design products that add value to users' lives, more research and applicable tools are needed to resonate with users. In this direction, this thesis aims to reach the user value created by the user's interaction with the product, to present a framework that design researchers can benefit from the inventions that affect user value, and to present a framework that design researchers can benefit from in user experience and existing product interaction.

Keywords: Urban Furniture, Smart City, Interaction Design, User Experience.

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ABBREVIATIONS

EIP-SCC	:	European Innovation Partnership for Smart Cities and Communities
EU	:	European Union
Fin tech	:	Financial Technology
HCI	:	Human Computer Interaction
HES	:	Hayat Eve Sığar
ICT	:	Information and Communication Technologies
IOS	:	IPhone Operating System
NFC	:	Near Field Communication
SCW	:	Smart Cities Wheel
UX	:	User experience

I. INTRODUCTION

By nature, human beings are in a constant effort to communicate with their environment. The places where the interaction of people with the living or non-living beings in their environment is felt most strongly can be defined as urban open spaces. The ratio of the time spent by urban people in residential and non-residential areas makes the importance of urban space and the design of urban open spaces understandable.

People have some expectations from the daily life flow and urban space utilisation. Public spaces, which are changing and developing day by day, are expected to have positive effects on the quality of life of the urbanites and thus on the urban space. Many criteria are important in the fast life flow of the urbanites and in meeting their needs. Urban furniture is also an effective element that supports the quality of urban space.

As technology has become a part of human life, some urban furniture has started to keep up with this interaction and turned into smart urban furniture. Since the dissemination of information and access to information has become easier nowadays, information communication technologies are also manifested in smart urban furniture with software and hardware contents.

In cities with high population density, smart urban furniture is more frequently encountered around transportation foci and centres. Especially in urban spaces that host different types of transport together, such as transport transfer centres, there are urban furniture with different features and functions as well as urban furniture supported by smart content. Within the framework of design defined as smart street furniture, the most common products that facilitate the life of the cities we interact with are products such as informative signs showing that the subway arrives in a few minutes, boards telling location, turnstiles, ATMs and traffic Tickets, top-up machines, cash-back machines..

On the other hand, users often encounter various problems when using smart street facilities. The main reason for this is the existence of criteria such as different

user groups due to the international structure of the city, the ergonomic issues that users may encounter, and the technical capabilities of users, which can lead to limitations in the design of such street furniture. Therefore, it is important to determine the limitations of these limitations as part of any research conducted in this field.

1.1. Purpose and Scope of The Research

Interactive urban furniture is designed to facilitate the daily life of people living in cities and to help make cities more sustainable. This furniture is usually equipped with smart sensors, internet connectivity and other technologies. Istanbul is a metropolis with high population density and different user groups where interactive urban furniture is used in various places. The use of interactive urban furniture is more common in areas such as bus stops, touristic areas, parks where the urban population is dense. The subject of the study is to examine the contributions of user experience in the design of interactive urban furniture. . The research problem, "Is the user sufficiently taken into account in the process of designing interactive urban furniture?" reflects the aim of the study.

In this context, it is aimed to examine user experiences through existing interactive urban furniture and to put forward suggestions for improving user experience in urban furniture. The aim of the thesis is to examine the experiences of the users of interactive urban furniture in Istanbul and to reveal how much the user experience contributes to the design process. . Within the scope of the study, it is aimed to reveal the criteria that will form a reference for the designs to be developed in the future of the user experience with examples in Istanbul.

By examining the applications used in Istanbul and in the world, it is aimed to contribute to the literature by determining the successful aspects of the applications in terms of user experience, the areas that need to be developed and the expectations of the users and to contribute to the literature by revealing the findings to improve the designs planned to be made in the future.

1.2. Research Hypothesis and Research Questions

User experience is not sufficiently taken into account in the existing interactive urban furniture used in Istanbul. In this context, answers to the following questions are sought.

- What kind of experience do the users of interactive urban furniture have?
- What kind of problems are experienced in product use?

1.3. Methodology of The Study

Within the scope of the research, user experiences in smart urban furniture in Turkey and in different countries in the world are analysed and the interactive urban furniture "Istanbul card loading kiosk" used in Istanbul is considered as a case study. Case study is a methodological approach that involves an in-depth examination of a limited system using multiple data collection to collect systematic information about how it works and operates (Chmiliar, 2010). The reason why the case study is preferred is that the way of looking at what is actually happening in the environment, collecting data, analysing and presenting the results within the framework of this method is suitable for the scope of the research. According to Davey (1991), it is expressed as a sharp understanding of why the emerging event is the way it is and what to focus on in more detail for future research. Since it has a large structure where such interactive technologies are frequently used, smart urban furniture used in Istanbul has been determined as the universe of this research. Purposive (monographic) sampling technique was determined as the research method since it will be useful in determining the user experience in smart urban furniture with the data to be collected through the characteristics of the research universe.

Yin (1984) stated that the aim of case studies is to generalise and develop theories rather than generalising. He mentions various sources in the data collection process in case studies; documents, archive records, interviews, direct observation, participant observation, physical structures (Yin, 1984). Within the scope of the study, documents, observations and records were handled and cross-case synthesis was selected for data analysis. The main reason for this is that it is aimed to reveal and relate similar and

different aspects by making comparisons between more than one situation since examples both in Istanbul and in the world are compared.

1.4. Research Structure

In the thesis study, firstly, a summary of the literature and the sources that constitute the infrastructure of the study are given. It is stated in detail, from which point of view and in which section the concepts discussed are utilised.

This thesis consists of six chapters in total. In the introduction chapter, the purpose, scope, main questions, hypothesis and method of the study are defined.

In the first chapter, information about the introduction, purpose, scope and method are given. Here, the hypothesis and assumptions formed in the thesis in line with the problem definition are given.

In the second part, the concepts of urban furniture and smart city, which are the main focus of the research, are discussed, and the concepts of urban furniture and smart city are explained by determining the definition of urban furniture and smart city furniture, how the concepts have developed, the factors and dimensions within them.

In the third part, the concept of interactive design and user experience, which is the other focus of the study, is discussed, and the definitions of these concepts, how these concepts have developed, the factors and dimensions of these concepts and their relations with urban furniture are defined.

In the fourth chapter, it is mentioned how the ticketmatik and mobile application used in Istanbul, where the Istanbul card transport card is used, is used and the advantages it offers to people.

In the fifth chapter, the research methodology of the thesis, the research questions and the interview questions that were made for the thesis problems that were determined at the beginning are included. The data obtained in this context are analysed and the findings are presented.

In the sixth chapter, the findings obtained as a result of the research are evaluated in the conclusion section. Possible contributions to future studies are discussed within the framework of this chapter.

2. SMART URBAN FURNITURE

2.1. Urban Furniture Concept

Human beings have created villages, towns and cities in an effort to organise the environment they have lived in since the day they were born. In this man-made environment, urban furniture in the public space appears as an element that meets the simple needs of people. The definition of the city can be made abstractly and conceptually; however, the definition of the city based on concrete measurements for one country may show great differences in another country. Accordingly, in an abstract definition, “the city is an environment where urban life is formed and the man-made environment dominates the natural environment” (Gürel, 1970).

The city is a whole formed by spaces. While the designed and originalised equipment elements within the space organise the space, they should also create a systematic for the equipment areas within the city. Design studies that start at the spatial scale create a variety of activities within the city at the planning stage. The design process, which starts with the concept of equipping the space, ensures the spread of urban areas at the city scale. There are a number of design criteria required for equipping elements. When these are used correctly and appropriately, designs that increase urban comfort and quality of life emerge. The reinforcement elements created in this design process will contain the identity of the cities, their harmony with the architectural structure and their imaginary features (Sakal, 2007).

Within the scope of social science standards, a city is a collection of people and structures that are gathered together in a way that can be called large according to the place and time and have some distinctive features. According to the social scientist Wirth, the city is defined as “a relatively large, densely populated and spatially continuous settlement formed by individuals who are not socially similar” (Allen and Morris, 1968), while Helle described it as “a ball of communication that is formed in the mutual interaction of urbanites and maintains its vitality” (Aydemir, 2003).

In these definitions, urban areas, which are formed by human communities that are constantly changing, developing and communicating, include indoor and outdoor areas.

2.2. Urban Furniture Design

We classify the entry stage of industrial products into our lives as design, production and use. The placement of urban furniture in the space we will add between production and use is a very important point.

Although the concept of street furniture was first defined in the 1960s, street furniture itself is not a modern invention. It appeared with the coming of the city (Bao et al., 2006).

Street furniture existed since the formation of city, it was practical and functional at the early stage: the indication or the separation on the ground (e.g., bollards), seats, public fountains (providing potable water), notice boards, public toilets, etc. Later, there were street lights, commercial notices, decorations, newspaper kiosks, street name plates. Much later, there were rubbish bins, telephone booths, traffic signs, bus stops, etc. (Bao et al, 2006, p. 8).

Functions of street furniture are fundamentally categorised: for practical use and for decoration. “Street furniture is not only for practical use, but also an element of visual pleasure vital to street scenery; Street furniture shows the beauty of design” (Mukoda, 1990, p. 130; see also Warren p. 8). Bao et al. (2006), Wang and Wang (2006) and Yu (2003) pointed out that the functions of street furniture cannot be considered individually and separately. Street furniture is a complex functional system with flexible and extensive considerations. According to this, street furniture can be analysed through four main functions.

According to research, urban furniture plays a crucial role in enhancing the quality of life in cities by improving public spaces, providing comfort and safety to pedestrians, and promoting social interaction. In this essay, we will explore the importance of urban furniture in the city and how it contributes to the well-being of urban dwellers.

Firstly, urban furniture such as benches, tables, and streetlights provides a comfortable and safe environment for pedestrians, cyclists, and motorists. For instance, benches provide a resting place for people to relax and socialize, especially for the elderly or people with mobility issues. Streetlights improve visibility and safety,

reducing the risk of accidents and crime. Therefore, urban furniture contributes to the physical safety and well-being of urban dwellers (Hall, 1998).

Secondly, urban furniture creates a sense of place and identity for a city. It can reflect the cultural and historical heritage of a city, thereby creating a sense of pride and attachment among residents. For example, iconic benches or street art can become landmarks that identify a specific area of the city. This promotes a sense of community and belonging, and in turn, improves the overall quality of life for urban dwellers (Madanipour, 2003).

Thirdly, urban furniture promotes social interaction among residents. Parks, public squares, and other public spaces equipped with urban furniture encourage people to gather and interact. This helps to foster social connections and community cohesion, leading to increased social capital, which is critical in promoting a sense of belonging and a positive urban environment (Whyte, 1980).

In conclusion, urban furniture plays a significant role in creating safe, comfortable, and vibrant public spaces in cities. Its importance cannot be overemphasized as it contributes to the overall well-being and quality of life of urban dwellers. Therefore, city planners and policymakers should prioritize the provision of adequate urban furniture as part of their efforts to create livable cities.

2.2.1. Stages in urban furniture design process

Urban furniture is a product that has many different functions and combines them. A different design process should be applied for each unit. The processes that can be used can be systematised in different ways.

The most simplified and generalised explanation of the design process approach is listed in 5 items: observation, understanding the problem, revealing, comparing, generating alternatives. All of the actions performed during designing constitute the design process. Within the framework following this process, the project is planned, organised and developed (Yaylali, 1998).

It is natural that quite different factors take place in the design of urban furniture. Among these factors, there are various factors such as the social aspect brought about by factors such as traditions, prejudices, historical texture, the psychological aspect

formed as a result of perception, the semantic aspect brought about by the material properties used and the aesthetic aspect brought about by the design dimension (Güzel, 2003). The main thing is to understand and define the product. Whether the product to be designed will be based on invention or whether it will be static is the understanding of the problem, in other words, the determination of the problem. This stage can be regarded as similar to the incubation stage proposed by psychologists. However, incubation is an individual phenomenon. Understanding, on the other hand, involves analytical processes carried out with the group. Elicitation is the finding of alternative solutions. This stage is to some extent similar to what psychologists call enlightenment. Comparison is the stage of comparing the alternatives and obtaining information to select the appropriate one. This is followed by the selection of the policy to be implemented and the decision-making stage. There are non-linear relationships between these stages. As Popper says, we always learn from our mistakes. Therefore, continuous turns between the stages also encourage learning. In the management of product design, there are various benefits of revealing and planning all these stages (Bayazıt, 2001).

If we think of creating a process scheme for a design for urban furniture, it can be a comprehensive scheme that can be adapted to all urban furniture elements in general. In addition, it should be known that a different process is required for each product and the way the processes work will be different (Güzel, 2003).

Professional design methods should be used when designing. New design methods are used in today's reality. Its effect should be carefully considered. In addition, participatory learning and participatory work are necessary for the realisation of design and professional execution. A team of participants and designers is equally important. Being able to work as an employee is equally important.

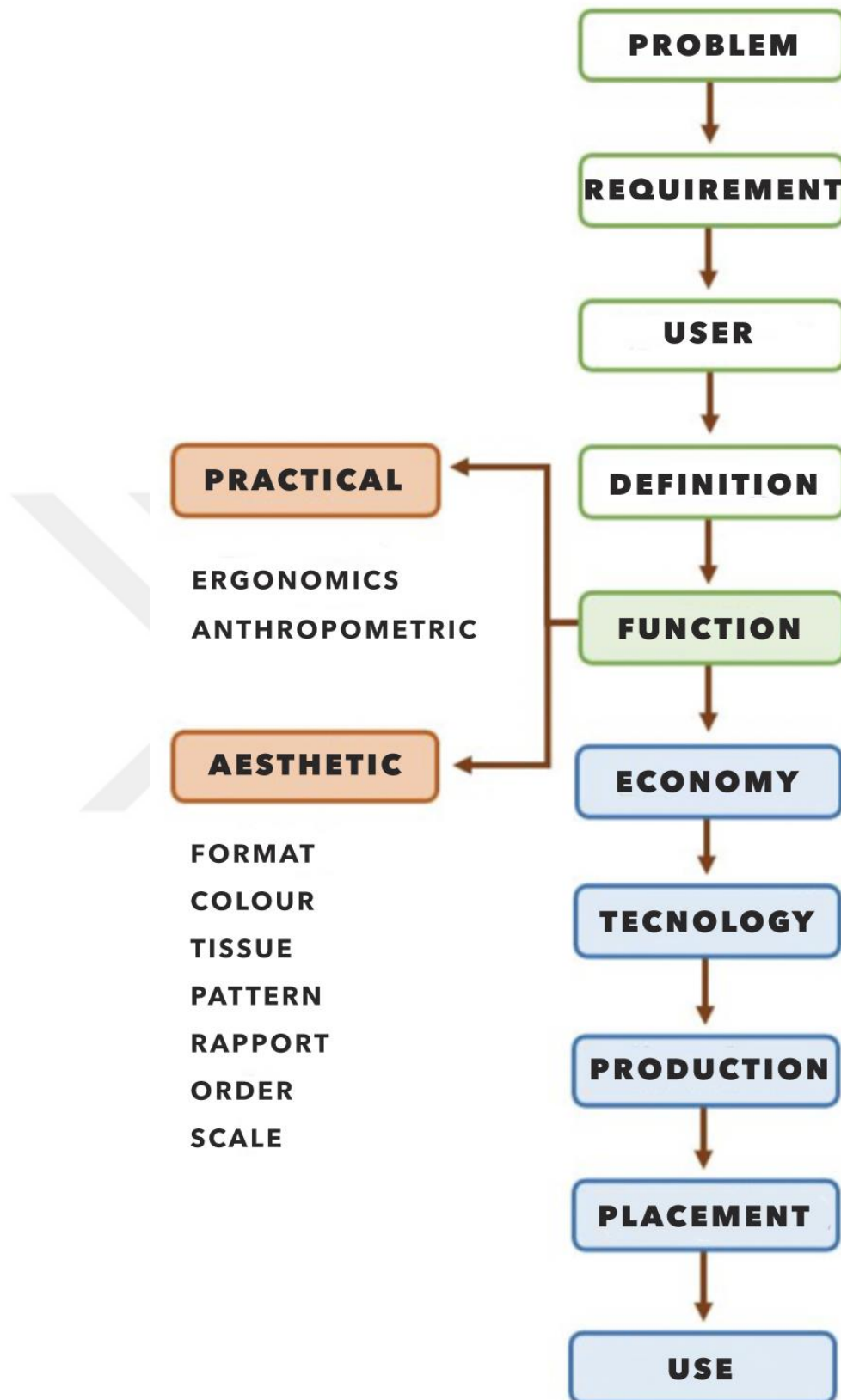


Figure 1. The process of urban furniture from designer to user (URL 1).

2.2.2. Urban furniture design principles

As a result of the gradually developing communication between societies and the mutual influence of various movements on societies, differences in practices related to the use of objects are gradually decreasing. Societies mutually influence each other, and as a natural consequence of this, the design and mass production of equipment elements, as well as their marketing in different countries, lead to similar images in different cities. However, by making arrangements reflecting the unique natural, historical and cultural structure of each city, cities should be given identity or city identities should be kept alive.

Urban furniture should conform to certain standards in terms of ergonomics and various physical properties, functional and aesthetic (line, size, shape, colour, texture, etc.) features should be taken into consideration in their designs, and at the same time they should have original designs as much as possible. Instead of prototypes and standardisation in urban furniture, original designs should be made by taking into account the characteristics and functions of the places where they will be used.

In order for the spaces to have a successful quality, design elements such as size, form, colour and texture should be emphasised and thought in a way to respond to the habits, reactions and instincts of the individual. Thus, the space will gain perceptibility and continuity of usability.

The criteria that can make a difference in the design of urban furniture and affect the level of appreciation of the users are; colour harmony, size / proportion balance, functional suitability, material harmony, being well maintained / clean, being modern, being new, being historical, referring to history, being different, being impressive, being interesting, being flashy, being original / original, having a good location, being compatible with the environment, being in contrast with the environment, being semantic and monumental, being symbolic, creating visual richness.

The product produced in the design process should serve a specific purpose, should be functional as a result of a conscious thought, should be beyond the usual and never done before or should have a very different visuality and a unique feature.

In this research, the concepts of functionality, aesthetics, form, material, colour, texture and perceptibility, which are among the criteria that can be effective in the design of original urban furniture, are discussed.

2.2.2.1. Functionality

Function is defined as “the ability of each part of a whole to fulfil its duty and to help the system above it to do its duty and thus to help the whole to function” (Gür, 1996). Function can also be defined as the conformity of use and functioning to the purpose determined at the beginning. Function in architecture includes the concepts of “purpose, necessity and suitability” (Arcan & Evci, 1999). Designs emerge with the combination of functional and aesthetic elements. Within the design system, as in every other system, it is of great importance what the components of the system are, how the structure of the system is established and what the functions of the system are. When a design is made, the first thing to be planned is the intended use of the design, that is, what its function will be (Ertaş, 2007).

A manufactured product must be functional in order to fulfil its duty. In other words, in order for a product to be functional, it must fulfil a purpose. The function is that each part of the whole fulfils its own tasks and helps the whole function by helping the system on it to complete its work (Aksu, 2012, p. 376). Functionality in urban furniture is that each part that meets different needs fulfils its own task and helps the system above it to complete its work and ensures the functioning of the whole (Akyol, 2006).

If the expected function is determined in the design phase of the space and the equipment elements are used in line with this function, “confusion and object density” will be prevented. Thus, urban area users will receive the service they demand in the best way in a harmonious, original and comfortable space (Sakal, 2007). As in other designs, functionality should be at the forefront when designing urban furniture. The most significant indicator of the functionality of an urban equipment is its suitability for human ergonomics (Hacıhasanoğlu, 1991). A non-functional urban furniture may cause some problems for the place where it is used. In the design of urban furniture, forms suitable for the purpose should be selected from the functional aspect.



Figure 2. Example of an original but questionable functional seating element (URL 2).

Functionality should be prioritised in the design of urban furniture. If an original urban furniture design is not functional, it may cause problems for the place where it is located (Figure 2). In urban furniture design, forms suitable for the purpose should be selected in terms of functionality.

2.2.2.2. *Aesthetics*

The phenomenon of “aesthetics”, which encompasses the human desire to beautify the environment and its elements and all situations related to beauty, has a very important result and effect on both the shaping and evaluation of the built environment and architectural product (Şentürer, 1995). Aesthetics is an important element in the construction of the space and it is a desired concept. A certain dimension of beauty is sought in the spaces, and the aesthetic pleasure and excitement of the space increases the livability of that space. Function, form and aesthetics are in a close relationship (Ayyıldız, 1996).

The lines forming the surfaces of positive and negative elements in urban environments, material, colour, texture characteristics of surfaces, facade proportions of buildings, quality of openings, facade decorations are also important elements in determining the quality of urban environment. In addition to this, floor coverings, urban equipment/urban furniture, lighting elements, elements such as stops, panels, telephone booths and herbal materials and usage patterns are the elements that directly contribute to urban aesthetics. With the combination of all these values, the urban macro form and

urban silhouette are formed for the city as a whole, and when analysed in detail, the concept of urban aesthetics and beautiful/attractive environment at the micro scale emerges. The harmony perceived between all the elements of the object observed when looking at the urban whole reflects its beauty; the aesthetics of the whole depends on the well-analysed relations of the parts with each other (Erdoğan, 2006).

Urban furniture is important not only for functional purposes but also as visual urban elements that complement and define urban spaces. In particular, urban furniture used for visual purposes positively affects the spaces where they are located, while urban furniture that has only functional purposes but does not carry any aesthetic concerns negatively affects the environment. These positive and negative effects show themselves more in places where urban furniture is used intensively and are reflected on the urban identity (Aksu, 1998).

We can say that reflecting the identity of the city in urban furniture design is related to the aesthetically correctness of the designed product. It responds to socio-cultural sustainability by reflecting the city identity in urban furniture. Aesthetics of sustainable urban furniture is as important as functional, economic, durable, ecological materials. The aesthetic concern in the design process, the relationship between the user and the reinforcement element, the urban identity and the increase in perceptibility lead the space to a quality appearance (Karaca Sert, 2022).



Figure 3. “Power Flowers” wind turbines, Netherlands (URL 3).

Designed by NL architects “Power Flowers”, the tree-like structure aims to be located in the city centre with plans to harness wind energy. tree-like design It is both beautiful and practical without affecting the image of the city.

2.2.2.3. *Form*

The structure of a whole is defined as form. A form is not perceived by itself, it is perceived in proportion to its relationship with the forms around it. In this regard, in analysing a form, it is necessary to determine the relationships between the elements that make up this form and the interaction with other forms around it (Ertaş, 2007).



Figure 4. Sustainable urban furniture in Madrid's Mayala neighbourhood (URL 4).

Form is an important design element that makes an object concrete. Form has a great role in creating the character of the design and fulfilling the function. Designers try to provide other concepts such as safety and comfort while shaping the designs. It can be said that one of the most effective aspects in creating the aesthetic value of the design, fulfilling the function, perception, construction and balance of the structure is the geometries that form the form of the design (Ertaş, 2007).

The design shown in Figure 4, which Enorme calls “Mini Hub”, is intended to function as a meeting point for the city and provide a common working space. This urban furniture consists of open and closed areas. The indoor workspace provides the energy needed to charge the devices thanks to USB charging points, lighting and kinetic energy created by the sun and movement. Benches surrounded by greenery have been created where people can sit outside, and thanks to the solar panels on the outside of the product and the increased mobility due to the need to sit, a closed working area has been created by using kinetic energy inside. In this design, it is aimed to create an environmentally friendly public space where people can meet their needs in their daily lives. For these purposes, the correct form has been created by taking into account the identity of the city.

2.2.2.4. Colour

Colour is one of the most effective design elements. Different colour types have different psychological and visual effects on people. In landscape design, colour is an important element that should be evaluated in the design process. Because the colour schemes created have a direct effect on the users and the use of spaces (Altınçekiç, 2000). Whether in terms of living or non-living elements, colour is the design element that affects people the most. Colours have similar psychological effects on people. For example, while warm colours cause excitement and stimulation, cool colours are more restful and relaxing (Korkut et al., 2010).

Colour, as an important stimulus in the context of physical, mental and psychological characteristics of human beings, contributes to human-object-environment harmony. Colour is important in the field of architecture and industrial product design in terms of perception and the psychological effects it creates (Sağocak, 2005).

In the design of industrial products, colour is used as a factor that structures the product-user relationship and reflects the material, construction or functional properties of the product. An object is always visually defined by the integrity of colour and form. Although form stands out as a more effective communication tool than colour, colour is considered as an element that complements this form and contains its expressive qualities (Asatekin, 1997). In addition, colour can also be attributed different meanings

as the conveyor of the designer's aesthetic understanding and identity as a designer, and some special messages he wants to give (Sağocak, 2005).

One of the most important factors affecting visual perception is colour. Colour, which serves aesthetic purposes, determines the quality of the space and is a part of the perception system, adds a different depth and dimension to the space by revealing the material, design and equipment elements used in the arrangements made in urban spaces.(Kıran, 1986).



Figure 5. Camille Walala's bench design (URL 5).

The benches designed by French designer Camille Walala are designed to make South Molton Street, which is closed to traffic, look colourful and fun. In this furniture series designed as a temporary installation, the artist's aesthetic understanding meets design objects in this way. Fun and sculptural urban furniture is designed to add colour and cheer people up in boring and grey urban areas.

2.2.2.5. *Tissue*

The most important aspect of texture is that it is aesthetic, perceptible and tactile. Therefore, texture is a visual design component (Uzun, 1998). The concepts of urban furniture, texture and form are closely related to each other. In design, texture is important for both technical and aesthetic reasons. It creates visually interesting surfaces and hides minor defects (Ashby & Johnson, 2004).

The variety of materials used in creating texture is extremely important (Dascalu, 2011). Texture is one of the important elements that characterise a product and create difference. Considering the strategic importance of design in the competition of manufacturers, it is one of the main objectives of all manufacturers and designers that the product attracts attention and makes a physical difference as well as being functional. In addition to its physical and visual properties, texture has a great contribution to the functionality of the product with both the structure of the product and the material used (Kın, 2007).

Designs have textures that change their surfaces as well as their forms. The perception of objects is done by groping by hand or through the effect of light. By touching by hand, the texturally perceived texture of that object is perceived. The effect of texture on the mind through the eye is the visual texture of objects. As a matter of fact, different textural features such as wet, dry, rough or smooth polished can add different values to the design (Ertaş, 2007).



Figure 6. Examples designed with sample and texture features in urban furniture (URL 6).

2.2.2.6. Material

Urban furniture shows differences and innovations in the design process by being influenced by the variety of materials and fashion trends that develop with technology over time. In the selection of materials in design, the function of the product as well as the visual effect desired to be created in the designed product should be taken into consideration. Material diversity can create different forms, increase the visual quality of the products and enrich the design (Ertaş & Bayazıt, 2004).

Adaptation to climatic differences and durability are important in the use of urban furniture in open spaces. In order for urban furniture to be long-lasting against environmental conditions, factors such as correct material selection and correct positioning should be taken into consideration during the design phase. Climatic factors such as daylight, expansion and contraction, wind stress, humidity, as well as salt, ice or frost should be taken into account in the selection and design of furniture. The best design is to use strong, simple shapes and natural materials (Simonds, 1998).

The properties of the material used are important in terms of the durability of the product and the psychological effects it creates. A concrete seating unit gives a massive and heavy appearance when compared to a wooden one of the same dimensions (Hacıhasanoğlu, 1991). The reasons for material selection in urban furniture can be summarised as suitability for function, suitability for environmental conditions and suitability for shaping (Zülfikar, 1998). Urban furniture should not be selected from

materials with fire risk such as metal, brick, stone and wood where there is a risk of fire. The most commonly used materials in urban furniture are steel and wood, other alternatives are stone, concrete, recycled plastic and glass etc. The choice of material will vary according to the content and limitations in design.

For example, it is important that the furniture is resistant to vandalism, the budget issue and how often the furniture will be used.

- *Steel*: Steel is the most preferred material due to its versatile use, strong and light weight and the ability to be shaped as desired. It is durable, resistant to rust and impacts. It requires little maintenance. Compared to other materials, it is quite cheap as it can be produced by recycling.

- *Wood*: It is one of the most preferred materials. It is a natural material, unlike other materials, it feels warm in cold weather and cold in hot weather. Its disadvantage is that it dries later after rain than metal material and requires more maintenance. They are not resistant to vandalism.

- *Concrete*: Concrete material may not need to be mounted due to its heavy weight. Apart from spray paints, it is also resistant to vandalism. It is a long-lasting and aesthetically attractive material.

- *Stone*: Like concrete, stone is durable and resistant to vandalism. It is difficult to dry after rain and gives limited possibilities in design when aesthetic concerns are considered.

- *Plastic*: Recycled materials are usually made of plastic, which gives a smooth surface and appearance. They are longer lasting, require less maintenance and are cheaper in the long run compared to wood.

In furniture designs, the above-mentioned materials can be used alone or several materials can be used together. In the first stages of the design action, the purpose and function should be determined, as well as the types of materials to be used in the formation of the product. Functionality and visuality should be considered together in design, and it should be designed to meet aesthetic requirements as well as functional requirements. It is possible to achieve the predetermined and desired visual effect with factors such as design and material usage that are revealed within the framework of certain design principles (Ertemli, 2010).

The material, colour, texture chosen in the design of urban furniture will increase the formal value of the design and make the quality of historical areas more prominent. When integrated with well-chosen materials and correct project decisions, the standard and quality of the resulting spaces reaches the highest level. In the determination of urban furniture constructions; in addition to material selection, visual requests, there are functional, physiological, psychological and social reasons, constructional and economic difficulties. The material to be selected must first of all be suitable for the quality and quantity of the place where it is used. First of all, it is necessary to define the material, to determine the conditions of use and construction together with other materials, to know its physical and chemical properties and its processing properties (Dilek & Gürsoy, 2015).

Another important issue in material selection is the attacks and destructions organised against urban furniture. These attacks, also called vandalism, are related to sociocultural deficiencies in society. Urban furniture is the most targeted elements of social violence in the world. No matter what kind of material they are made of, no matter what their dimensions are, no matter the level of development of the countries, urban furniture can be misused. Environmental conditions are another factor to be considered in the design of urban furniture. These elements should be in a material, detail and position that will not be affected by external environmental factors such as heat, light, sound and humidity.



Figure 7. Level up seating unit, Croatia (URL 7).

The example of urban furniture in Figure 7 is a multi-storey seating unit “Level Up” in Rijeka, Croatia, built as an extension of the industrial warehouse building Export Drvo, where people can come together and relax. The roof area has been transformed into terraces and redesigned for the socialisation of the inhabitants of the port city. The design consists of wooden platforms of different heights placed on steel scaffolding. On the terrace you can relax or swing in a hammock.

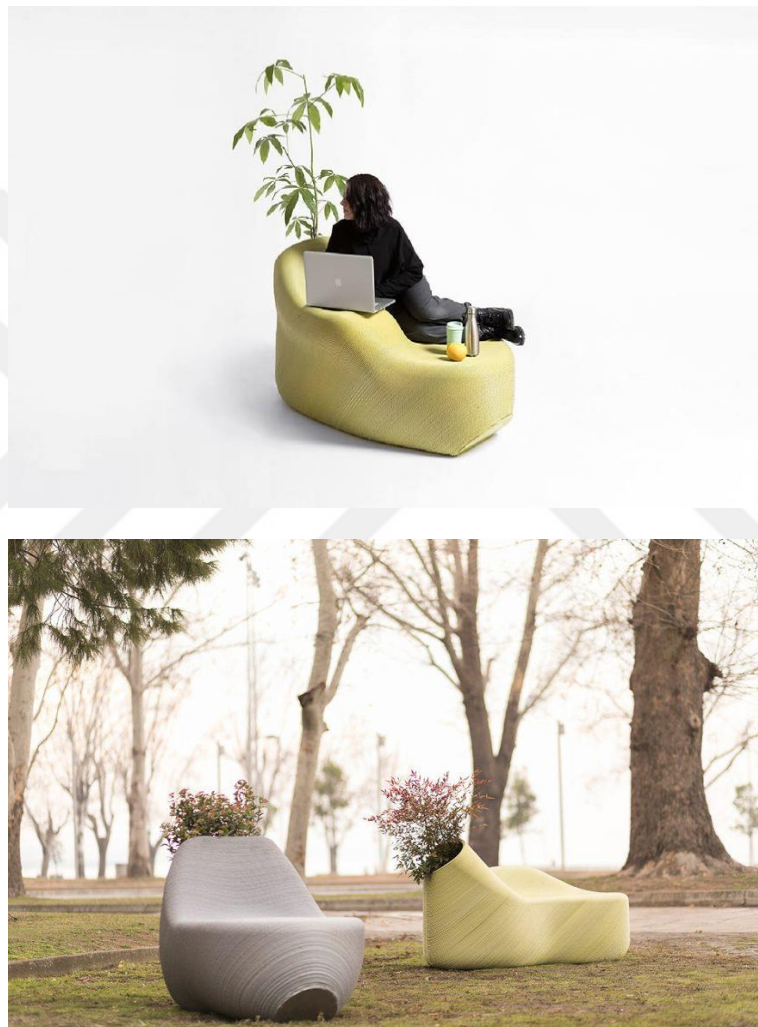


Figure 8. Pots Plus grazing unit (URL 8).

The seating unit used in the urban area in Figure 8 was produced on a 3D printer by recycling thousands of types of plastic waste. The 3D printed ‘XXX Bench’ for Amsterdam is the result of a collaboration with Dutch studio The New Raw and offers a new alternative to the use of recycled plastic waste. This furniture is used both as a seat and as a flower pot.

2.2.2.7. *Perceptibility*

Humans perceive, comprehend and evaluate their immediate environment, the space they live in and the elements that make it up with their feelings and senses. This is a spontaneous event and happens through receiving information from the environment. It is perception that interprets and evaluates this information in a way that helps us to act appropriately and correctly. It is usually easier for us to perceive something we already know about. In order for a reinforcement element to be understood by its user, it is necessary to define what it is. Designs that are made without taking into account factors such as user liking and ease of use and that contain a different understanding of form may sometimes not be perceived (Aksu et al., 2011). However, the concept of perception should be considered and evaluated as a concept that enriches the imagination, improves and diversifies the taste levels of the users, rather than being restrictive in creating original designs.



Figure 9. Examples of original and new urban furniture designed for telephone booth and computer use.

The developing technology, as in the examples in Figure 9, also changes the living conditions. In the periods when mobile phones were not widespread, telephone booths located in urban open spaces and used for communication purposes are replaced by new urban furniture designed for computer and internet use.

2.3. Smart City Concept

The concept of city has been changing from history to the present day; it keeps pace with the development in order for citizens to live a better, more comfortable life. With the adaptation of information technologies to all areas of life, this technology has entered all common areas, services and services of cities and the concept of Smart City has been formed.

The concept of smart city has been frequently used in the international arena in recent years. Smart cities emerged in the late 1990s, mainly in the United States of America (EU), Europe and Japan, and their number is increasing day by day thanks to financial support. Since the early 20th century, the rapid increase in urban population has brought along limited resource and land use problems. Despite the current large urban population, problems in the areas of housing and socialisation continue. For this purpose, alternative solutions are being sought and the growth in population growth is being managed in a smart way.

Smart cities are cities that ensure efficient use of limited resources, save money by investing in information and communication technology, provide maximum efficiency with the quality of life provided by producing smart solutions within the city, reduce environmental damage, and invest in an innovative and sustainable planning process (Ateş & Önder, 2019). In the smart city approach; effective use of technology and resources against problems in the city, production of human-oriented functional solutions, improvement in the living standards of the urbanites, minimising environmental pollution and carbon emissions, smart infrastructures and ensuring network security are at the forefront.

The main purpose of smart cities is to provide maximum energy efficiency and to facilitate the lives of urbanites by producing smart solutions in the city in order to solve the problems caused by the increasing population gathering in cities and to meet the changing human needs with technology.

2.3.1. Basic Principles and building blocks of smart cities

According to the EIP- SCC established by the European Union (EU), which continues to work effectively in the field of smart cities; smart city benefits from

Information and Communication Technology (ICT) in order to increase living conditions, labour force, thus economy and sustainability. As shown in Figure 10, this process consists of 3 main processes: collecting all kinds of information from existing systems, distributing this information through various networks and analysing this information (Smart Cities Council, 2015).

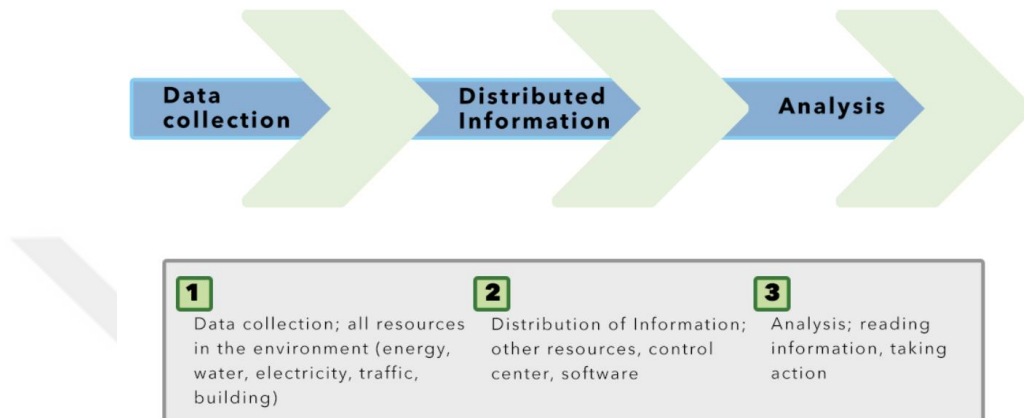


Figure 10. Smart city operation scheme, (modified from Smart Cities Council, 2015).

According to the European Union; smart city building blocks are listed below. Smart cities will determine their road maps and realise their formation in line with these 3 building blocks. The 3 basic factors of the building blocks of smart cities are shown in Table 1 (Mapping Smart Cities in the EU, 2014).

- Technology Factors
- Human Factor
- Institutional Factors

Technology, human and institutional factors are the building blocks that enable the formation of smart cities. These 3 factors provide the formation of the smart city by working in interaction and coordination with each other.

Table 1

3 Key Factors of The Building Blocks of Smart Cities (Mapping Smart Cities in the EU, 2014).

Technology factors	Human factors	Institutional factors
physical infrastructure	Human infrastructure	Governance
Smart technologies	Social capital	Policy
Mobile technologies		Regulations and directives
Virtual technologies		
Digital networks		

Table 1 summarizes the relationship between features and components. The outer ring displays components, and the inner ring displays functions. All attributes are based on a range of technical, human, and institutional factors, rather than assigning specific attributes to each component.

2.3.2. Features of Smart Cities

A smart city should have six basic characteristics (Figure 11). Smart economy, competitiveness; smart mobility, transport and information-communication technologies; smart environment, natural resources; smart people, human and social capital; smart life, quality of life; and smart governance, participation (European Smart Cities, 2015).

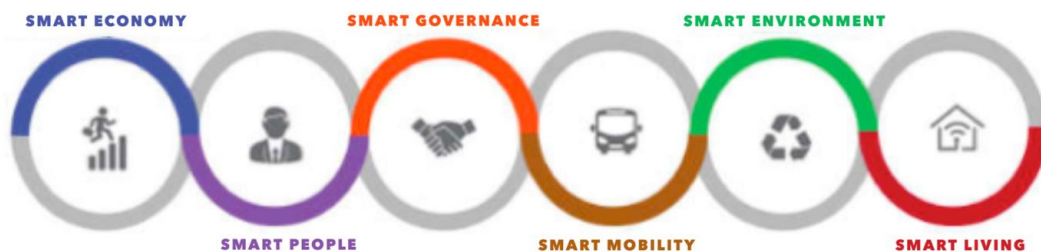


Figure 11. Smart city components (Giffinger et al., 2007).

Smart cities have six characteristics as well as sub-characteristics of these characteristics. Some features that are important for each of these six elements while planning smart cities are shown in Figure 11 (Giffinger et al., 2007).

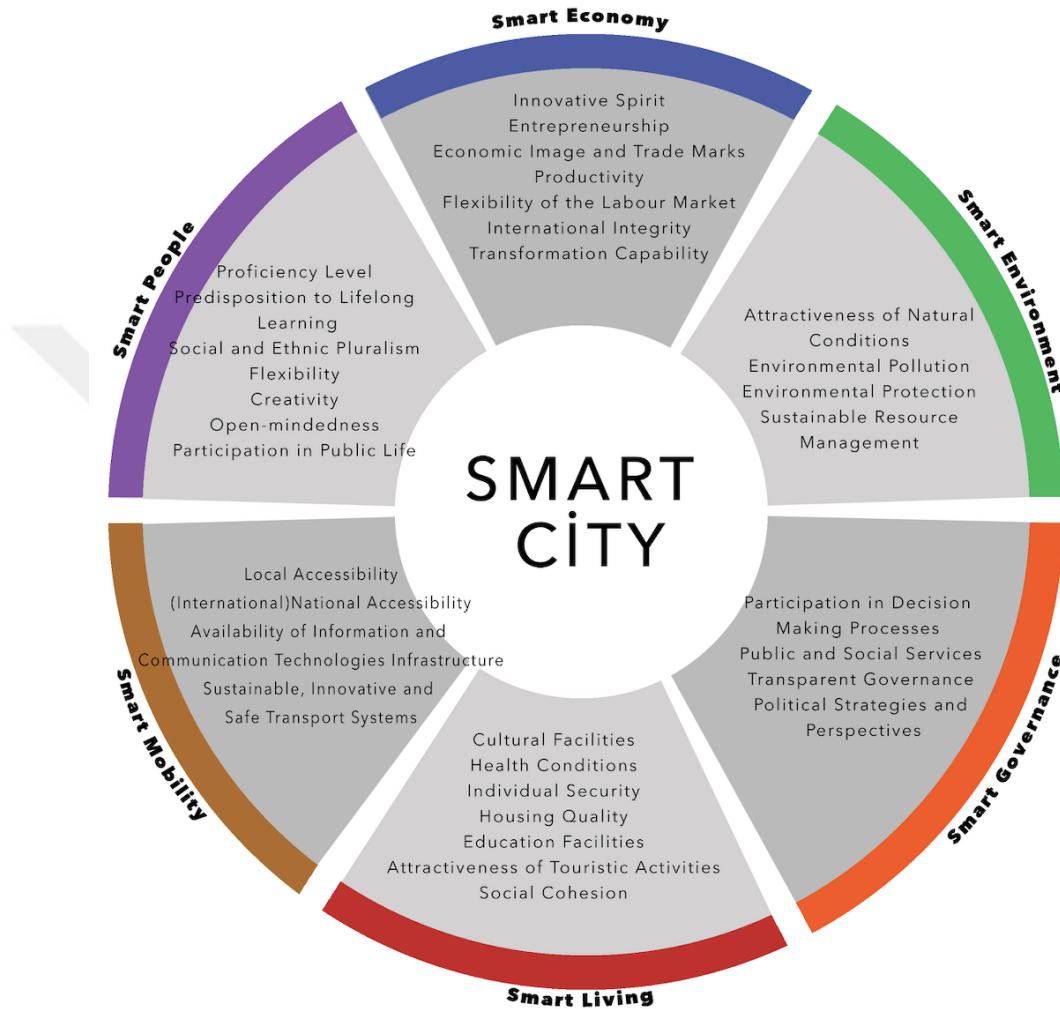


Figure 12. Smart city key features (Çevre Şehir Bakanlığı, 2019'dan değiştirilerek).

Smart Economy: Integrate economy and technology by providing smart solutions for urban economic activities. With the right economic model, it is aimed to use existing resources more effectively, efficiently and innovatively.

Smart Governance: This component provides process management of the city. With the contribution of information and communication technology, it aims to increase trust in public services through effective and efficient communication between

stakeholders at all levels, transparency in public administration and the creation of participatory decision-making mechanisms (Elvan, 2017).

Smart Environment: This component, which is used to reduce the damage caused by population growth to the environment, includes environmentally friendly approaches such as making smart regulations in cities, using natural resources, controlling pollution, ensuring waste management, utilising renewable energy sources, and using smart city furniture.

Smart Life: It aims to provide citizens with a more reliable and healthier environment and to make people's lives easier through information and communication technologies. It addresses issues affecting the lives of citizens such as education, health, public safety, culture and tourism services, housing and energy consumption.

Smart people: Smart cities put people first. Therefore, to create a smart city, we aim to create a society that is open to lifelong learning and innovation, open to participation in social life, open to citizens with high awareness and access to information.

Smart Transport: As the urban population increases, problems such as parking, public transport, road safety and traffic begin to emerge. Therefore, environmentally friendly smart solutions are needed for people using the transport network. These smart solutions include sustainable, safe and innovative systems where transport systems are integrated with technology.

Cohen developed the Smart Cities Wheel (SCW) by bringing a system approach to smart city components. When Cohen created the circle system, he, like Giffinger, considered the components of the smart city under six main headings. This graphic model creates each component by explaining it with three key concepts. Thus, it creates indicators on which cities can plan (Cohen, 2012).

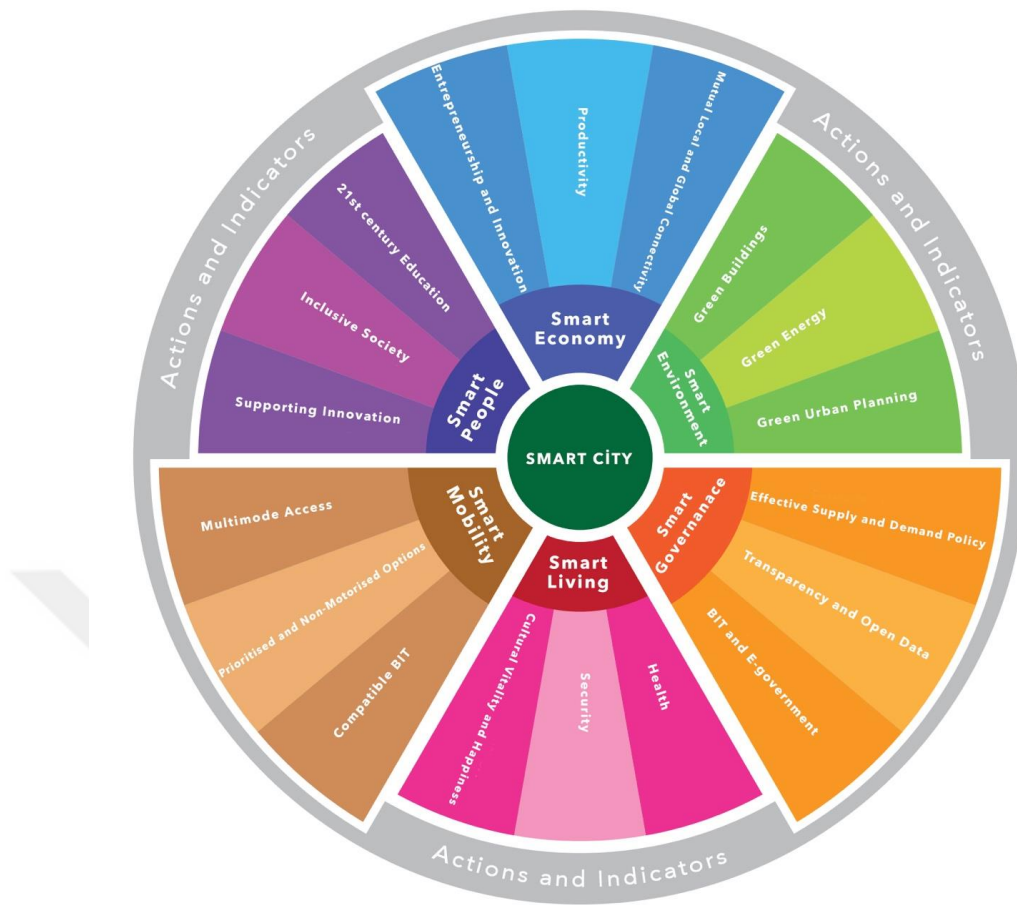


Figure 13. Cohen's smart cities wheel (Çevre Şehir Bakanlığı, 2019'dan değiştirilerek).

Smart cities encourage people to walk, meet, talk and gather in streets, shops and public places. In this way, people can easily communicate with each other and interact with their environment. It is designed to produce more energy than it consumes by maximising energy efficiency. At the same time, smart city furniture is easier to integrate into the city. For example; internet service while travelling, free charging stations, reducing the cost of garbage collection with smart garbage bins, smart street lighting with sensors that allow drivers to find empty car parking spaces, akbil filling units to avoid waiting in line while taking public transport, electronic applications that enable people to do their work in public spaces are some of them.

2.3.3. Smart city facilities

Although there were street lamps and classical benches as urban equipment until the Industrial Revolution, changing lifestyles and needs after the second half of the 19th century required changes in urban equipment (Demir, 2018). Against this background,

the formation of smart cities, which are flooded today, is reflected in urban equipment, which is very important for people in urban space, and reveals smart city equipment.

Smart city equipment are interactive urban furniture that communicate directly with users, can use renewable energy sources, provide easy access for disabled citizens thanks to their technical equipment, include innovative and environmentally friendly solutions, make citizens' lives easier, and define where they are (Doğan, 2015). In short, smart city devices are new generation urban elements that use technology to reduce the problems caused by urbanisation (Ermiş & Karatekin, 2019).

The main purpose of smart city equipment supported by mobile network systems is to produce smart solutions that will meet the needs of modern urban life and social life in the technical context, in accordance with the requirements of the age and to bring its status to the fore. Therefore, unlike urban facilities, smart city facilities can be reconfigured or developed (Özdemir, 2020).

Smart city equipment types used in urban areas are as follows:

- Smart Benches and Charging Units
- Smart Signs and Kiosks
- Smart Bicycle and Car Hire Systems
- Smart Car Charging and Parking Items
- Smart Lighting Elements
- Smart Bus Shelters
- Smart Waste Collection Systems
- Smart Water Fountains
- Smart Toilets (modifying from Iron 2018)

2.4. Smart City Furniture and Applications

2.4.1. Application approaches in existing designs in the world

Smart urban furniture is an important concept that is frequently encountered in the concept of smart city. Although there is no clear definition in many sources, there are some statements in general. For example; Vaida et al. 2014 stated that smart furniture is furniture equipped with technological content that uses environmental information to provide functionality and comfort to its users. In other words, it is furniture integrated with the latest technology. According to Hassanein 2017, smart urban furniture are urban equipment elements that appear in public spaces, which provide the most effective and active interaction with the urbanites in smart city services, using technology to reduce public costs and resource consumption, by putting design at the centre. In short, smart urban furniture are functional urban equipment products supported by a technological infrastructure that enables users to adapt and interact quickly, sometimes fed by natural resources, designed to provide low resource, cost and maintenance.

The smart city is driven by smart city furniture and offers both economic and technological solutions. Examples of such furniture promoting public services are free Wi-Fi internet access, mobile charging trolleys, interactive city maps, notice boards, real-time and up-to-date city information, solar street lights, smart bus stops, separation and warnings. Garbage bins, LED and up-to-date data traffic lights, solar energy parking machine, flower pots with smart irrigation system, smart children's playground. In addition to all these, information can be generated by accessing air quality, sound and noise data and traffic data from sensors on urban furniture for data that can increase urban safety. There are many examples of these smart urban furniture in public spaces.



Figure 14. Umea bus station, Sweden (URL 10).

Research by the Rombout Frieling Lab has shown that in cold and snowy weather people prefer to stand or lean against the bus while waiting, which is why bus stops have wooden partitions instead of seats. The rotating partition is designed to protect passengers from the wind and provide privacy when needed. The bus shelter in Umeå aims to improve the waiting conditions for passengers using public transport in the cold weather conditions of the polar region. By alerting passengers to approaching buses with lights and sounds, the bus shelters allow passengers to rest and shelter from the wind instead of keeping their eyes open while waiting. This bus stop has a “smart ceiling” covered with lighting and speakers to create different ambiances.



Figure 15. Fluid Cube smart bank (URL 11).

An urban device called "Fluid Cube" is designed according to the principles of ergonomics, compatibility with various public spaces, use of renewable resources, durability, ease of transport and installation. Reinforcement is created by drilling holes in cubic blocks in amorphous form. Inside the tempered glass on the upper surface of the design, there are solar panels that power the fixed USB charging socket, Wi-Fi connection and lighting.



Figure 16. Waste Bin with Sensor (URL 12).

An example of a smart bin is the one shown in Figure 16, which facilitates the provision of public services. By placing sensors in these bins, municipalities and public units can instantly receive information such as the percentage of waste collected, where it is located, and temperature data. In this way, the points that need to be visited are determined by the control system, saving time.



Figure 17. Steora smart bench (URL 13).

Steora Smart bench generates energy from solar panels on a smart bench that contains many technologies despite its simple appearance. The bench has two wireless charging zones that support Qi and USB cables and can also charge devices wirelessly. Different versions of the bench design allow charging electric scooters and bicycles.



Figure 18. Smart bus stop, Budapest (URL 14).

The smart bus station in Budapest, designed by Aquis Innovo, provides up-to-date traffic information and allows passengers to perform everyday tasks such as paying

bills, sending parcels, charging mobile phones, renting bicycles and selling tickets. Among other things, the station is equipped with devices that measure air and noise pollution levels.

2.4.2. Application approaches in existing designs in istanbul



Figure 19. ISTON smart bank (URL 15).

Istanbul Municipality, in cooperation with Easton Corporation, has produced smart city equipment for parks identified as earthquake-prone areas in Istanbul. The device was developed for communication, lighting, storage, social and physiological needs, taking into account the basic needs after a possible earthquake. In this context, smart city equipment that uses solar energy, includes charging and lighting units; It has a storage area for disaster-related needs such as tents, blankets and materials with long shelf life. IBB Department of Earthquake Risk Management and Urban Improvement first placed reinforcement materials in Ataşehir Deniz Gezmiş and Topkapı Earthquake Parks to be used before and after disasters.



Figure 20. ISBIKE bicycle rental system (URL 16).

There are bicycle hire stations at 300 points throughout the city. The rented bicycles can be delivered to the same or a different station upon request. Rental and delivery operations can be carried out on the desired day and time without the need for an attendant. Within the scope of the Smart Bicycle Hire System, approximately 3000 bicycles are in service all over Istanbul.



Figure 21. Timtaş recycling container kalemmatik (URL 17).

Smart Recycling Container developed by Timtaş company to prevent environmental pollution. It is designed to bring recyclable packaging waste to the national economy, to explain the importance of recycling and environmental awareness to the society, especially to children, and to leave a more livable environment for future generations. Plastic bottles, glass bottles and metal cans can be thrown as waste. The

maximum waste box size is one litre plastic bottle. It gives 1 pen each time waste is thrown. (It can be adjusted optionally, for example 1 pen for 5 wastes)



3. INTERACTIVE DESIGN and USER EXPERIENCE

3.1. Emergence of Interaction Design

Since its existence, humans have interacted with other humans, nature, tools and later with machines. Interaction as a concept has a wide scope. Interaction design is considered a new discipline, but humans have been designing interaction for centuries. The field has deep roots with other existing disciplines. Therefore, it is often confused with some of these disciplines: interaction design is not website design. It does not have to be a multimedia design or a graphical user interface. It does not have to be focussed on and based on advanced technology.

It has been determined that the emergence of interaction design as a discipline is due to the development of information and communication technologies, especially the emergence of the Internet, the shrinking of hardware sizes, changes in the number and profile of users, changes in products, changes in user-product interaction, changes in software and service development activities and the emergence of graphical user interfaces.

It can be said that interaction design tries to make visible but imperceptible interactions, which are becoming increasingly complex and invisible, understandable, useful and desirable for every user, especially in the field of information and communication technologies. In the traditional sense, it can be said that industrial design focuses on the function and form of objects, while interaction design focuses on how to establish dialogue and exchange information with ICT (information and communication technology) embedded products and software.

There are various opinions about the situations that form the basis for the emergence of interaction design. One of them is that IBM company's first studies on keyboards before World War II (Zanini, 2004). In this approach, there is the idea that interaction design started to emerge with the first analogue electronics and gained importance with the emergence of digital electronics. Another one is the design of cockpits in World War II and the emergence of human factors (Kolko, 2007).

It is possible to say that different dynamics are involved in the emergence and development of interaction design. These dynamics are listed as follows:

- Development of information and communication technologies
- The emergence of the Internet
- Changes in the number and profile of users
- Changes in products
- Changes in user product interaction
- Reduction in hardware size
- Changes in software and service development activities
- Emergence of graphical user interfaces

Cognitive psychology, social psychology, sociology, anthropology, software engineering and computer science have also played important roles in the emergence of interaction design as a discipline (Preece et al., 1994). It has been found that changes in the focus of software and service development activities and in the field of human-computer interaction have played a role in the emergence of this discipline. Although the substructure of this new discipline stems from the dynamics mentioned above, when considered independently of technology, human-computer interaction can be considered as a technical branch of interaction design.

The emergence of the Internet and the distribution of its use created a separate threshold for interaction design (Winograd, 1997). Today, as in the field of computer and communication technologies, continuously falling sales prices have led and will lead to a significant increase in the number of users and user profiles. In this context, it is becoming increasingly important to develop systems that users with different demographic characteristics can easily use, in other words, interact with. For example, the differences and diversity between the user profiles of computer and communication technologies 30 years ago and today's user groups support the need to focus on this issue.

If we think about it not only in terms of using computers or software, but more generally, just as it is an unusual activity for anyone to use electronics, it is an unusual activity for anyone to use a digital computing system or product today. Same as 30

years ago. Probably (Rubin, 1994). Whereas in the 1970s such products were primarily high-priced tools for targeted professionals and hobbyists, today users encounter them in almost every aspect of daily life. From the early 1980s onwards, user portraits began to diversify and from the first half of the 1990s onwards, user portraits increased significantly. It can be said that both socio-economic factors and technical factors influenced by these factors underlie the diversification of user portraits.

3.1.1. Relationship between interaction design and product design

The necessity for interaction design to work in cooperation and collaboration with industrial design from the first step of ICT embedded product development activity becomes clear.

Industrial design and interaction design are both crucial components in the development of ICT embedded products, and they work together to create a successful product.

Industrial design focuses on the physical appearance, usability, and functionality of a product. It deals with the product's aesthetics, ergonomics, and overall user experience. The industrial designer is responsible for creating the product's form, texture, and color, ensuring that it is visually appealing and functional.

Interaction design, on the other hand, deals with the product's user interface and how it interacts with the user. Interaction designers are responsible for designing the product's interface, ensuring that it is intuitive, user-friendly, and easy to use. They focus on the product's usability, user experience, and accessibility.

In ICT embedded product development, industrial design and interaction design work together to create a cohesive and successful product. The industrial designer creates the physical appearance of the product, taking into account the user's needs and preferences. The interaction designer then works to create an interface that complements the industrial design and is easy to use.

The relationship between industrial design and interaction design is critical in ICT embedded product development. The two designs must work together to create a product that is both aesthetically pleasing and easy to use. A well-designed product will

not only be visually appealing, but it will also be intuitive, functional, and easy to use, which will ultimately lead to greater user satisfaction and increased sales.

Table 2

The Relationship Between Industrial Design and Interaction Design in ICT Embedded Product Development Activity (Akoğlu & Er, 2010).

	INTERACTION DESIGN	INDUSTRIAL DESIGN
User	Mental models Perception	Ergonomic factors Anthropometrics
	Need and preference	
	Experience	
Feasibility	Software structure Interaction generation environments Facilities of generation environments Hardware and software relation	Production techniques Production feasibility Material qualities Form
Design Approach	Scenario based approach Complex interaction Graphical user interface Typography, Color factors, Pattern	Form based approach Mechanical interaction Material Color and pattern
	Dimensions of the product Dimensions of the screen Affordances	
	Persona creation	
Problem Solving Approach	Synthetic thinking Text Language Visual Language	Drawing and Synthetic thinking Visual Language
Prototypes	Paper prototypes	Mock-ups
	Virtual prototypes	

Assume that industrial designers and interaction designers work and collaborate together from the very first step in the development process, the planning phase. Reasons for this discrepancy may be the 3-year time lag between interviews and case studies and the rapid development of the field. Another finding in support of the above developments is that in-house interaction designers started working at LUNAR Design, one of the product design consultancies interviewed during this period.

Table 2 shows that there are common factors that both industrial designers and interaction designers focus in terms of design processes. Thus these common factors, which did not come out in literature review but in interviews, constitute the steps that interaction design and industrial design are dependant to each other in ICT embedded product development activities. Although both industrial designers and interaction designers have been considered to propose alternatives about the mentioned common factors in the case study, it is seen that industrial designers' information is still needed. Yet determination of ergonomic factors and form industrial design are dependant to each other in ICT embedded product development activities. Although both industrial designers and interaction designers have been considered to propose alternatives about the mentioned common factors in the case study, it is seen that industrial designers' information is still needed. Yet determination of ergonomic factors and form creation are still in the profession of industrial designers. In the case study although two design professions seem to propose alternatives about the screen dimension of the product, it is believed that interaction designers should be responsible because of designing the information and the functions embedded in that screen. Although both of the design professions seem to propose alternatives for affordances, it should be accepted as a problem to collaborate and cooperate. As a matter of fact, these relationships are being solved by using users' hands instead of other physical controls such as a mouse, handle etc. This situation is gradually shifting interaction design into its individual area from being dependant to industrial design profession. Affordance which is located under the user title also is moving into the profession of industrial design (Author, 2009).

3.1.2. Interactive product design process

The interactive product design process involves a series of iterative steps that are taken to create and refine a product in collaboration with users and stakeholders. This process is typically characterized by a focus on user needs and feedback, as well as a willingness to experiment and iterate until the desired outcome is achieved.

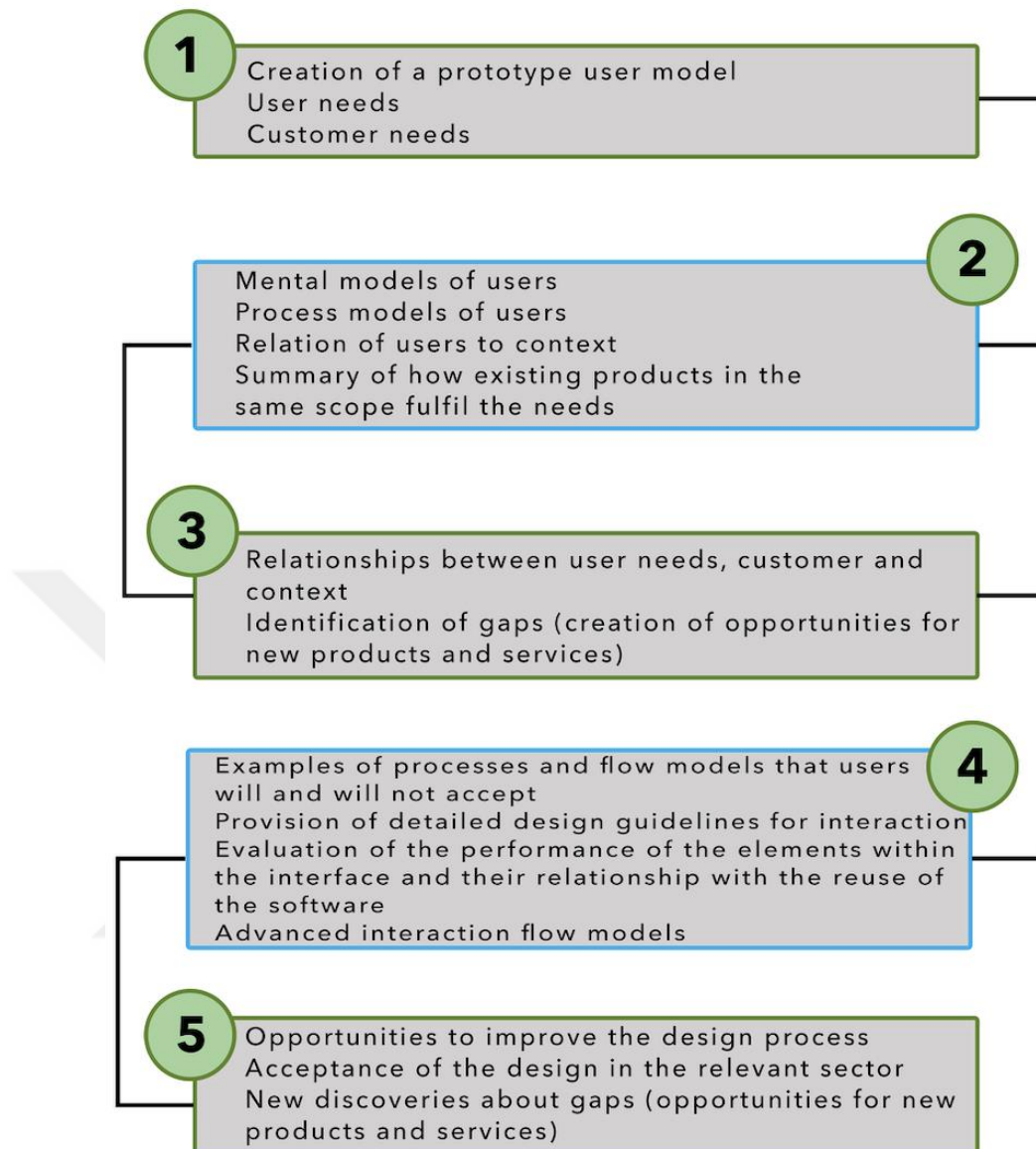


Figure 22. Interaction design process .

Zimmerman et al. (2004) define the interaction design process as a process that starts from defining the design problem and leads this design problem to the final result; they define it as a process that extends to people's reactions to this solution; they classify the stages of this process as follows:

Phase 1

- Creation of a prototype user model
- User needs
- Customer needs

Phase 2

- Mental models of users
- Process models of users
- Relation of users to context
- Summary of how existing products in the same scope fulfil the needs

Phase 3

- Relationships between user needs, customer and context
- Identification of gaps (creation of opportunities for new products and services)

Phase 4

- Examples of processes and flow models that users will and will not accept
- Provision of detailed design guidelines for interaction
- Evaluation of the performance of the elements within the interface and their relationship with the reuse of the software
- Advanced interaction flow models

Phase 5

- Opportunities to improve the design process
- Acceptance of the design in the relevant sector
- New discoveries about gaps (opportunities for new products and services)

In the definition phase of a project, designers create a more general visual model to understand the problem domain and seek input from technical development teams, marketing and business development teams. This phase provides opportunities as these various teams internalise user representations. Although the information gained at this stage cannot be generalised, it can be said to contain useful information that can be used to develop a method of communicating with the observed users and transfer this method to the team. For example, after working on several projects or over a period of time, researchers can use the information gathered in this way to analyse how the target audience has changed and what products might trigger this change.

Overall, the interactive product design process is a dynamic and iterative approach to product development that prioritizes user needs and feedback. By using a combination of frameworks, principles, and techniques, designers can create products that are both effective and engaging for their intended audience.

3.1.3. Principles of interaction design

Many graphical interfaces are designed to be used by only one user at a time. However, as interaction moves beyond the screen and into the space, it is important that the interactive system becomes more humanised, designed to be able to monitor the process and have a passive experience. In any case, it is important that the viewer of the interaction can understand the effects and consequences of causing a change in the environment during the interaction. This is called “interactive readability” (Patten, 2020).

- When the system responds immediately to the user’s actions, it is easier for the user to explore the space and perceive the action-response process. Therefore, designing interactions in a sensitive way while shaping the space can accelerate the user’s communication with the space (Özdemir, 2023).
- Interactions should be visible. Readability increases when interactions are positioned in a way and position that can be read by the active user and other people in the area (Özdemir, 2023).
- Interactions should be tangible. By designing motion and data into physical spatial elements and objects that users can touch, move and manipulate, spatial designers can take interactions that users are already familiar with and adapt them to new systems. Many pre-computer objects have such recognisable tangible properties. For example, a musician knows that he can move his body by looking at the shape of a violin, and he knows that he can touch the strings to produce sound by identifying similar objects. For this reason, referring to past usage methods in the design of interactive spaces and creating forms that users can perceive these methods increase the legibility of the spaces (Özdemir, 2023).

- Interactions need to guide the user. Users move from one point to another on foot. Therefore, users can choose whether or not to interact with the experience. Creating a traceable path between interactive systems in the space provides comfort for users to participate in the experience (Özdemir, 2023).
- Interactions should be kept as simple as possible. The average attention span of a user is 4 seconds. For this, a technical experience should be able to engage the user for these 4 seconds and be understandable. As the interaction becomes more complex, users in the field stop interacting (Özdemir, 2023).

3.2. User Experience

As the conditions of life change day by day and with the development of technology, users have tended towards a consumer rather than a producer attitude. Later, when technology became more different and comprehensive, a closer tendency was shown to the concepts of experience and creativity (Taştan, 2014).

3.2.1. Definition and concept of user experience

The term “user experience” has been a striking concept for researchers and practitioners of multiple disciplines during the last three decades. Due to its content related with a range of disciplines and its multidisciplinary nature, UX becomes an umbrella incorporating many concepts (Roto et al., 2011; Rajeshkumar et al., 2013).

As Hassenzahl and Tractinsky (2006) pointed out, UX was adopted by the human-computer interaction (HCI) and interaction design. It was firstly introduced by Donald Norman to criticize the aspects of human interface research and application at Apple Computer Inc (Rajeshkumar et al., 2013). As technology evolved, users found more interactive products that needed to be useful and usable. These technological developments have led UX designers and HCI researchers to design user interfaces that facilitate the achievement of user goals, and they agree on the importance of UX in user interface design. However, the HCI approach has been criticized for being “vague, transitory and short-term”. Hence, design researchers tried to explain UX by defining its dimensions, elements, frameworks and evaluations (Hassenzahl & Tractinsky, 2006; Rajeshkumar et al., 2013).

There are various models that define how UX is to be understood in the context of design. However, their common point is that UX investigates what experience the system or product incites for the user (Kuru, 2013). Furthermore, this experience can be influenced by an external factor such as a social, cultural or organizational pattern (Arhippainen & Tähti, 2003; Forlizzi & Ford, 2000).

In general, user experience is the result of three main factors (user, product, and environment) and the interaction of these three factors.

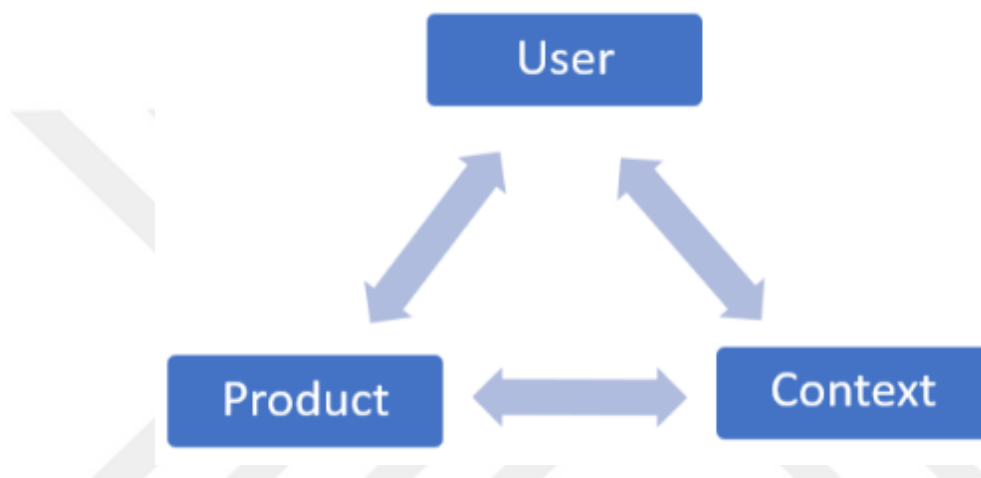


Figure 23. The relationship between the main factors UX.

3.3. Cognitive Factors in User Experience

Focusing on user effectiveness and efficiency is often considered a sufficient design goal for a product or service to succeed. This shows that designers pay attention to usability testing when developing products. Hasenzahl et al. (2008) argued that both utilitarian and hedonic attributes should be evaluated when evaluating the perceived quality of interactive products. Human-computer interaction researchers believe that product design should not only focus on improving effectiveness and efficiency, designers should also consider how users experience products and how they can design things that are enjoyable to use (Korhonen, Montola & Arrasvuori, 2009). The goal is to reconcile the designer's understanding of the role a product plays in a person's life with the person's perception of the product's design. For example, device use is rarely the most important activity in a person's life, but devices are part of a larger flow of needs, desires, and activities. An experience may not be possible without the use of a

specific device, but the device does not constitute the whole experience (Kuniavsky, 2010).

In order to create an experience, it is first important to understand the user's needs. Bonapace (2002) proposed a hierarchy of needs when interacting with a product, referring to the ideas of Jordan and the Ergonomics and Design Working Group of the Italian Society of Ergonomics.



Figure 24. Hierarchy of needs when interacting with products (Bonapace, 2002).

The bottom and fundamental part of the triangle of needs is security and happiness. Second, functionality is the ability to perform work (or play) that resides in computing features and functions outside of the user interface. Third, usability is the practical component of user experience, including the practical aspects of effectiveness, efficiency, productivity, ease of use, learnability, maintainability, and user satisfaction.

At the top of the hierarchy is the need for pleasure, the emotional component of user experience influenced by user feelings. Pleasure has other emotional meanings such as fun, joy of use, aesthetics, desirability, originality, engagement (Hartson & Pyla, 2012). Jordan (1998) asserted that feelings associated with using pleasurable products include security, confidence, pride, excitement, and satisfaction. On the other hand, unpleasant products were associated with feelings of anger, fear, contempt, and

frustration. Product attributes that stood out in terms of influencing satisfaction/dissatisfaction with the product included functionality, ease of use, aesthetics, performance, and reliability. What is Pleasure Concise Oxford Says_A feeling of contentment or pleasure: sensual pleasure as an object of life. Sense enjoyment has received relatively little attention in the design literature. Much has been said about design as a social arbiter, a marketing tool, an aesthetic tool, a bridge between art and technology, and more (Green & Jordan, 2002).

3.4. Usability Criteria for User Experience

UX is confused with usability, which in some ways describes the ease of use of a product, and UX really started out as a discipline with usability - but UX has grown to be more than just usability, it's important to the user experience Every aspect is important to consider in order to bring a successful product to market.(Peter Morville)

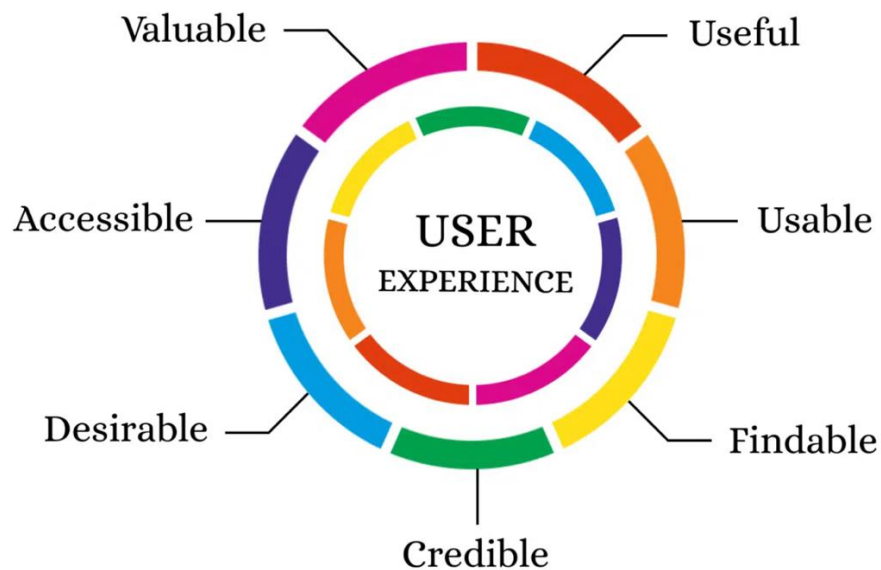


Figure 25. Usability Criteria for User Experience (URL 18).

Usable: Usability remains critical, but interface-centric approaches and perspectives to human-computer interaction do not encompass all dimensions of web design. In short: Ease of use is necessary, but not sufficient. .(Morville,2004)

Useful: As practitioners, we cannot be content to stay within the boundaries drawn by managers. We must have the courage and creativity to question whether our

products and systems are useful, and to apply our knowledge of processes and media to define more useful innovative solutions. .(Morville,2004)

Desirable: Our quest for efficiency must be tempered by an appreciation for the power and value of image, identity, branding and other emotional design elements. .(Morville,2004)

Findable: We must strive to design navigable websites and findable objects so that users can find what they need. .(Morville,2004)

Accessibility: Just as our buildings have elevators and ramps, our websites should be accessible to people with disabilities (more than 10% of the population). These days, that's good business and ethics. At some point, it will become law. .(Morville,2004)

Credible: Thanks to the Web Trustworthiness Project, we're starting to understand the design elements that influence whether users trust what we tell them. .(Morville,2004)

Valuable: Our website must provide value to our sponsors. For a nonprofit, user experience must drive its mission. If you are profit-oriented, you must contribute to profit and increase customer satisfaction. .(Morville,2004)

In conclusion, we discussed seven factors that play a key role in determining the effectiveness of a designed UX.

By focusing on these key factors, designers can take their designs to the next level and ultimately improve user experience. The better the user experience, the more popular the website or application will be among users.

4. RESEARCH METHODOLOGY

Within the scope of user experience in smart urban furniture, a situation analysis was made within the framework of interviews with users in the Söğütlüçeşme region, taking into account the Istanbul card akbil filling device and mobile application.

4.1. Methodology of the Study

Methodology is an important factor for developing the necessary findings for the whole process of the research. Within the scope of this study, qualitative research methodology was used to uncover the underlying reasons for the study. Qualitative research involves collecting and analyzing non-numerical data through various techniques such as interviews, observation and document analysis. One reason why qualitative research is useful in theses is that it provides a detailed understanding of the phenomenon under study by focusing on the experiences and perspectives of individuals or groups in the situation in question (Creswell, 2014).

Within the scope of this study, firstly, the concepts of smart urban furniture and interaction design user experience were examined by conducting a literature research. Afterwards, the importance of smart canteen furniture, which is the focus of the study, in terms of user experience through ticket dispensers and mobile application was examined.

In the next part of the study, the formation and development of smart cities are mentioned and the factors affecting urban furniture design and design processes are examined. Likewise, interaction design and user experience design processes and design principles are examined. Then, case studies and product analyses are included, and the importance of user experience in smart urban furniture is emphasized through criteria.

In another part of the study, Söğütlüçeşme Marmaray and Metrobus stations were analyzed and the process of user experience in urban furniture was examined. In this context, case studies and product analysis were conducted on urban furniture and mobile applications.

Thanks to the data obtained; various interviews and questionnaires were conducted with the users in order to determine the problems experienced by the users using the smart urban furniture and mobile application using the Istanbul card. As a result of the literature research and field research, a product-case study was conducted and these findings were compared and conclusions and recommendations were drawn.

Within the scope of the study, it is aimed to examine the user experiences of people using the biletmatik and mobile application using the Istanbul card.

As discussed in the previous sections of the study, the aim of this study is to identify the problems experienced by the users of the smart urban furniture and mobile application using the Istanbul card and to provide suggestions on product development. In line with this purpose, the following questions are sought to be answered;

- What kind of experience do users of interactive urban furniture have?
- What kind of problems are experienced in product use?

In order to find answers to the research questions, the following questions were asked using in-depth interviews and questionnaire method;

The form consists of six horizontal bars, each with a green label on the left and a grey input field on the right. The questions are as follows:

- First name, surname?
- How old are you?
- What is your occupation? Where do you work?
- Which method do you use to top up Istanbulkart?
- What are the problems with the method you use?
- Where do you use Istanbulkart other than public transport?

4.2. Data collection

Qualitative research method was used in this study as it deals with user experience and individuals' perceptions. Data were collected through in-depth interviews and a questionnaire, which is one of the qualitative research methods. The population of the research consists of individuals using the Istanbulkart Smart card filling station in Istanbul. In this direction, the universe of users was sampled with the purposive sampling selection technique. Therefore, diversity was used among individuals and the sample was formed from individuals using Istanbulkart filling stations in different age groups and educational levels. Purposive sampling allows in-depth research to be conducted by examining information-rich situations depending on the purpose of the study. It is preferred when it is desired to study one or more specific situations that meet certain criteria and have certain characteristics (Büyüköztürk et al., 2016). In this type of sampling, the researcher uses his/her own judgment about who will be selected and samples those who are most suitable for the purpose of the research (Balcı, 2016).

4.3. Data Analysis

The data collected from in-depth interviews and questionnaires were obtained using content analysis technique. The aim of content analysis is to reach concepts and relationships that will help explain the collected data. In content analysis, it is to bring together similar data within the framework of certain concepts and themes and to interpret them by organizing them in a way that the reader can understand. Before examining the stages of content analysis, it is necessary to define the terms used (Yıldırım & Şimşek, 2008: 227; Neuman, 2012: 663). Through content analysis, data are tried to be defined; data that are found to be similar and related to each other are interpreted by bringing them together within the framework of certain concepts and themes. With content analysis, the contents of the participants' opinions are systematically defined (Altunışık et al., 2010: 322). In content analysis, the focus is on the collected data; codes are extracted from the events and phenomena that are frequently repeated in the data set or emphasized by the participant. Codes are grouped into categories and categories into themes. In short, data (codes) that are found to be similar and related to each other are interpreted by bringing them together within the framework of certain concepts (categories) and themes. In content analysis, the content

of the participants' opinions is systematically separated (Bengtsson, 2016; Crabtree & Miller, 1999; Merriam & Grenier, 2019).



5. SMART CITY APPLICATIONS IN SMART CITY FURNITURE

5.1. Istanbul Card

Istanbul card is a contactless smart city card for use in Istanbul. Produced by BELBİM of Istanbul Metropolitan Municipality using NXP's DESFire technology in accordance with ISO/IEC 7816 and ISO/IEC 14443 standards, the card started to replace akbil on 23 March 2009 (Belbim, 2021).

Developed by BELBİM Elektronik Para ve Dağıtım Hizmetleri AŞ using domestic software technology, Istanbul card initially operated as an e-money card in the public transport system, but in 2019 it was purchased as an out-of-town payment option with the vision of "City's Life Card". Istanbul card, which offers options to make life easier for Istanbulites, has 18 million active users (Belbim, 2021).

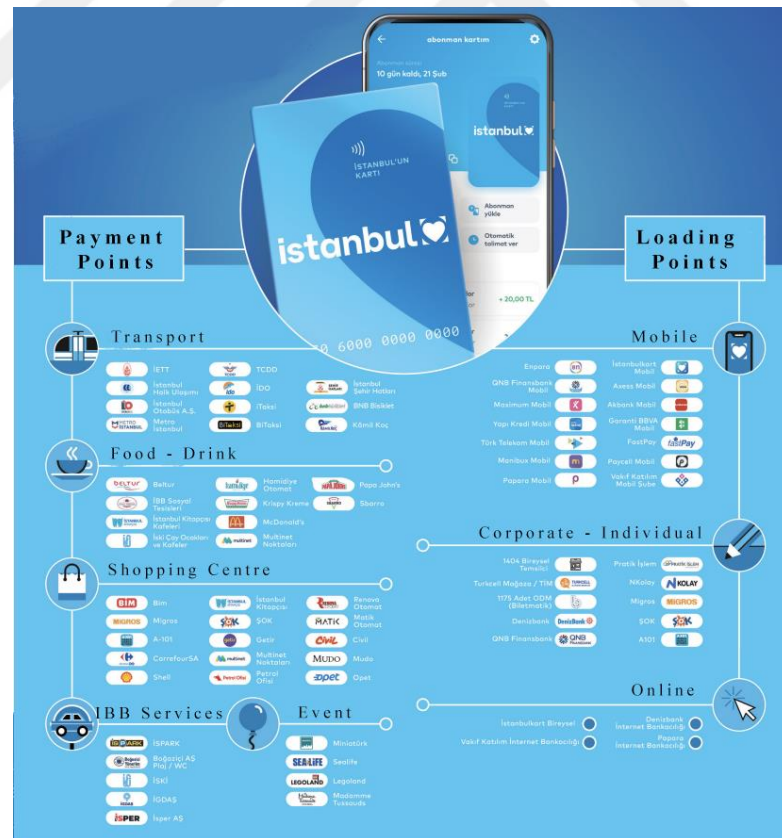


Figure 26. Istanbul Card Loading and Payment Points (Belbim'den değiştirilerek, 2021).

Istanbul Card is a payment tool that can be used in various places and is popularly known as "smart city card". Istanbul Card is valid in markets, online shopping, cafes-restaurants, museums, taxis, entertainment venues, petrol stations, grocery stores, retail stores and many other points.(Figure 26) (Belbim, 2021)

5.2. Istanbul Card Filling Device

Biletmatik is an electronic money filling and sales machine designed by BELBİM AŞ using completely domestic software and hardware, providing card filling and card sales within the scope of the 'Electronic Fare Collection System', using paper and coins. (Belbim, 2021)

It is a vending machine with an electronic money loading and payment system that can sell cards, buy banknotes and coins. It has voice guidance and multilingual options. ATM style buttons and colour LCD display make it quick and easy to use. After the transaction is completed, receipts are provided to check the user's transaction status. (Belbim, 2021)

Thanks to the use of ticket machines; facilitating city life, instant data monitoring, remote access, fault response and prevention of suspicious transactions are provided. (Belbim, 2021)

Two types of machines are used as Istanbul card filling device. The features of these machines are in the collection below.

User Experience



	BM1	BM2
Paying money to Istanbulcart	✓	✓
Anonymous Istanbulkart purchasing	✓	✓
Purchasing a Limited Use Card	✓	✓
Accepting coins	✓	✓
Banknote change giving	X *	✓ **
Making transactions with debit/credit card	✓	✓

Figure 27. Comparison of user experience of Ticketmatikes(Belbim'den değiştirilerek, 2021)

In the picture above, a comparison of certain features offered to people in terms of user experience by two different ticket machines used to load money to the Istanbul card in Istanbul has been made. The features of the two ticket machines are the same and it is seen that they differ only in terms of giving change.

Functions	BM1	BM2
Web monitoring of sales and fillings	✓	✓
WAN and LAN reports generated on the device system to transmit it to the centre securely	✓	✓
Operational alarms by e-mail and SMS to the authorities with	✓	✓
Online-offline working	✓	✓
Operator interface and service activities manage	✓	✓
New banknotes and coins to be able to recognise the system	✓	✓

Figure 28. Comparison of biletmatikes in terms of their functions(Belbim'den değiştirilerek, 2021)

As can be seen in Figure 28, a comparison of the functions related to the operation and interface of two different ticket machines used to load money to the Istanbul card in Istanbul has been made.

Functions	 	
	BM1	BM2
Coins as change be able to use	✓	✓
Secure access to the centre	✓	✓
With an alarm in case of vandalism centre and those concerned via e-mail instantly notification (with the sounding of the alarm lighting leds flash)	✓	✓
24 hour video recording and recordings Storage for 60 days	✓	✓
You can view the stored images in real time monitor and access remotely	✓	✓
Loading generated instructions	✓	✓
Visa discount cards	✓	✓
QR Code reading (optional)	X	✓
Giving paper change	X	✓
24 hours automatic in-cab temperature monitoring cooling fan	X	✓
As a payment point in car parks available	X	✓
Can be used as a bill payment point	X	✓

Figure 29. Comparison of bilematikies in terms of their functions 2 (Belbim'den değiştirilerek, 2021)

In Figure 29 above, two different ticket machines in Istanbul, which are used to load money to the Istanbul card, are compared in terms of their functions. While the one on the right has QR code payment feature, the one on the left does not have this

feature. At the same time, the ticket dispenser on the right has the feature of giving paper change while the one on the left does not. Only the BM2 ticket machine on the right has the feature of using it as a payment option in car parks. It was observed that the BM1 ticket machine on the left has some different features compared to the BM2 ticket machine on the right.

5.3. Istanbul Card Mobile Application

With the transformation of the city from Public Transport Card to Life Card and the use of innovative technologies in transportation, Istanbul Cart mobile application offers the comfort used in all channels of the city. (Belbim, 2021)



Figure 30. Istanbul kart mobile application screen (Belbim, 2021).

With the Istanbul card mobile application specially prepared for user needs, another step has been taken in digital transformation by using Financial Technology (FinTech) infrastructure. Istanbul card mobile application uses completely domestic and national software and financial technology infrastructure to provide users with easy, fast and secure payment opportunities. (Belbim, 2021)



Figure 31. Qr payment service (Belbim, 2021).

Istanbul Card Mobile, which can be easily used on IOS, Android and other operating systems, eliminates physical card dependency with its QR code payment feature and retains all discount rights.

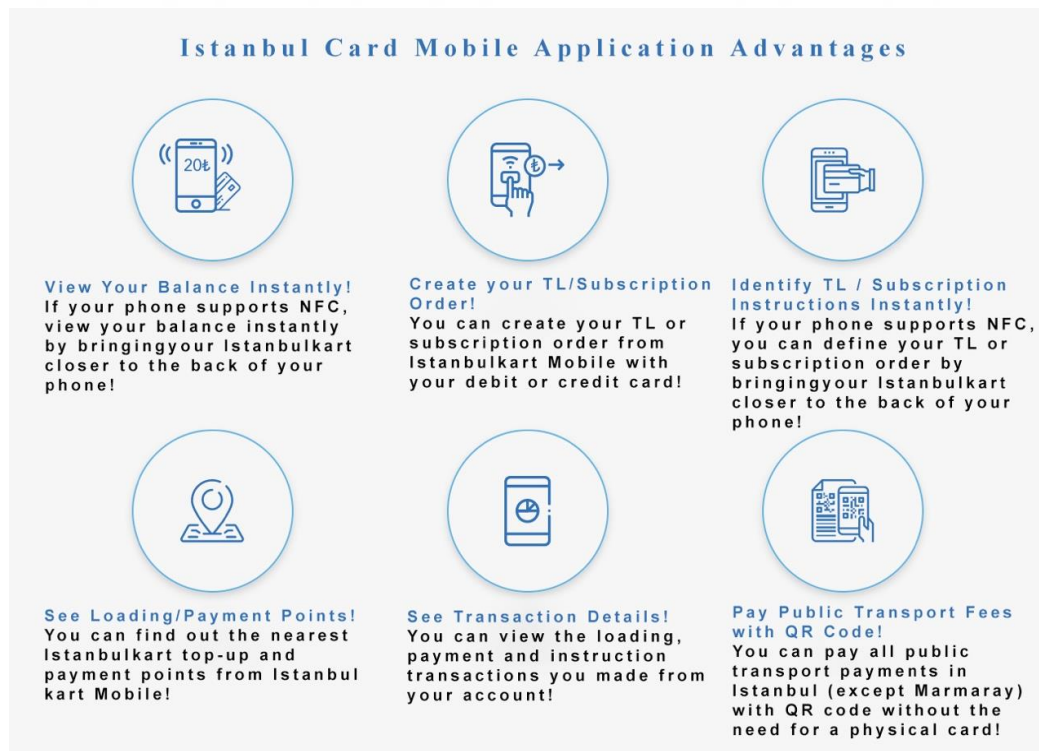


Figure 32. Features offered by mobile application.

In order to facilitate city life, Istanbul kart Mobile also includes balance top-up, subscription top-up and HES code matching features. Istanbul kart Mobile offers special events and opportunities to its users and offers the opportunity to upload instructions from mobile devices with NFC integrated into the IOS operating system. (Belbim, 2021)



6. FINDINGS

6.1. Interview Findings

For this study, interviews were conducted with 32 users between the ages of 20-60. In these interviews, 4 questions were asked to the users.

In line with the answers received from the interviews, it is seen that the answers of the users focus on some criteria. At this stage, various inferences will be made with the user relationship based on the answers given to each question.

The summaries of the answers given to the questions asked in the interviews with 32 users are as follows.

Interviews revealed that users mostly use the mobile application to load money to Istanbulkart. When the comments obtained from 32 users are analyzed, it can be said that the istanbulkart mobile application is preferred because it is easier, more practical and faster. When the users were asked about the problems they experienced in the mobile application, it is seen that they mentioned limitations such as the slowness of the NFC card reading system, problems in generating QR codes and the late response of the system. In addition to these data, it has been determined that users above a certain age prefer ticketmetric instead of the phone application, and it can be said that loading with cash is an important criterion in the preference of this user group. When the problems experienced by the users who prefer ticketmatic are analyzed, the problem that the ticketmatic machine does not accept cash when entering cash comes to the forefront. When asked about the uses of istanbulkart other than transportation, it was determined that the participants mostly do not use istanbulkart other than transportation, and it was analyzed that they do not benefit from the advantages offered by this system sufficiently.

At this stage, it would be useful to analyze the answers given to the questions asked in the in-depth qualitative interviews with 32 users in detail.

Which method do you use to top up Istanbulkart?

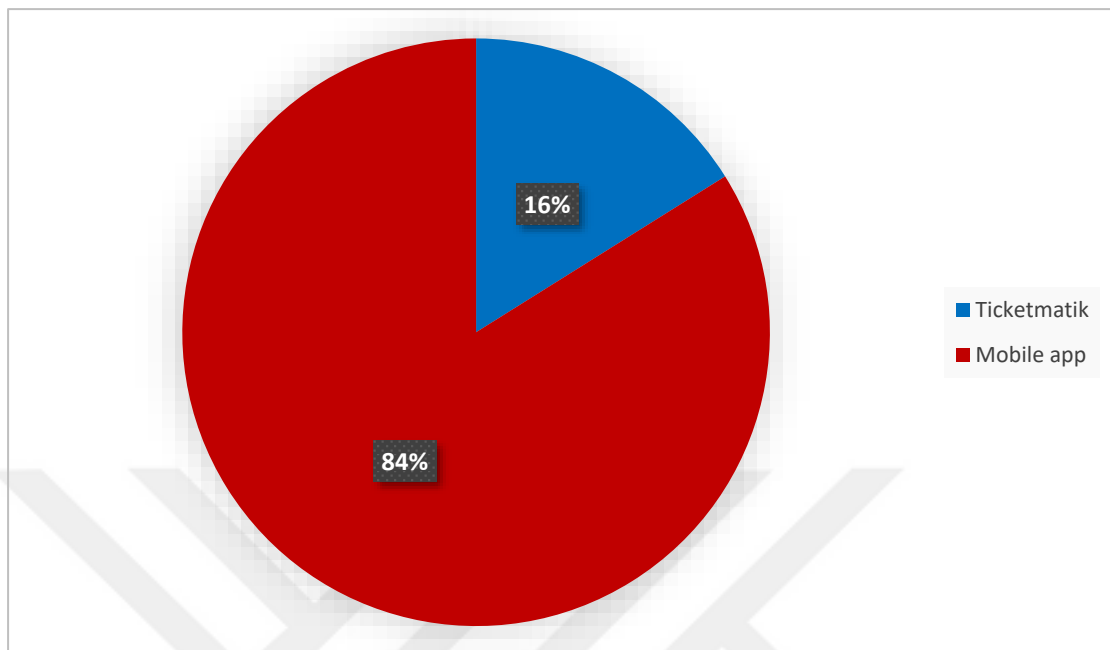


Figure 33. Response analysis of the first interview question.

In the first question asked in the interviews, it was analyzed that 83.9% of the users preferred the mobile application to top up their Istanbulkart, while 16.1% preferred ticket machines.(Figure33)

What are the problems with the method you use?

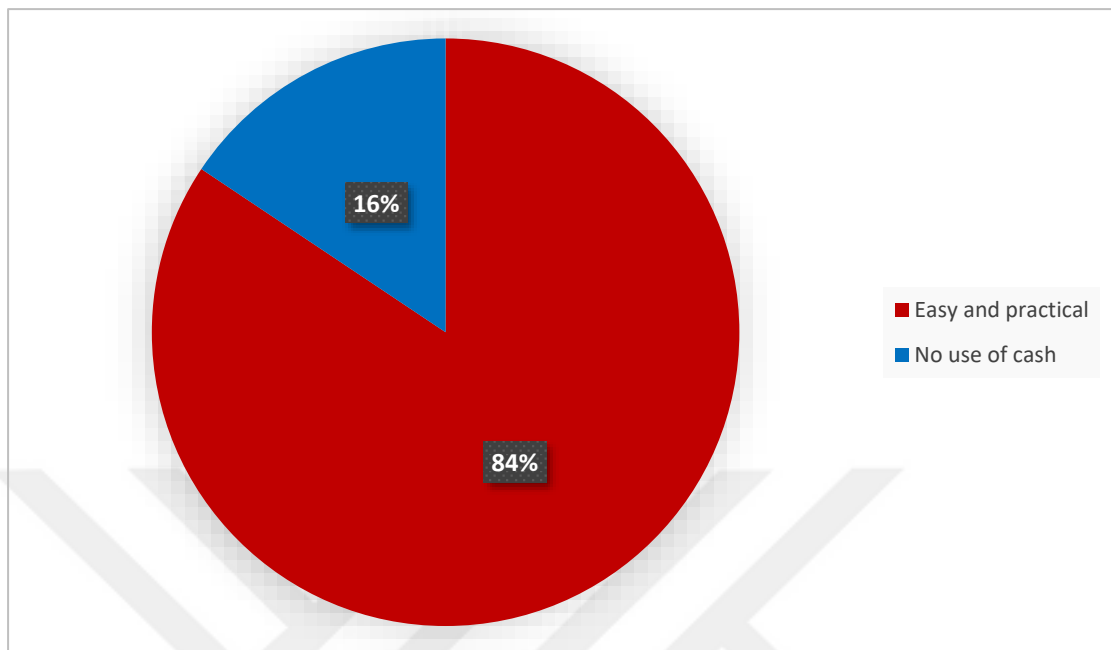


Figure 34. Response analysis of the second interview question.

In the second question of the interview, users were asked why they chose the method they chose to top up their Istanbulkart. As can be seen in the graph above, 84% of the users chose the method they prefer because it is easy and practical. The other 16% of the users prefer ticket machines because they use cash.

What are the problems you experience with the method you use?

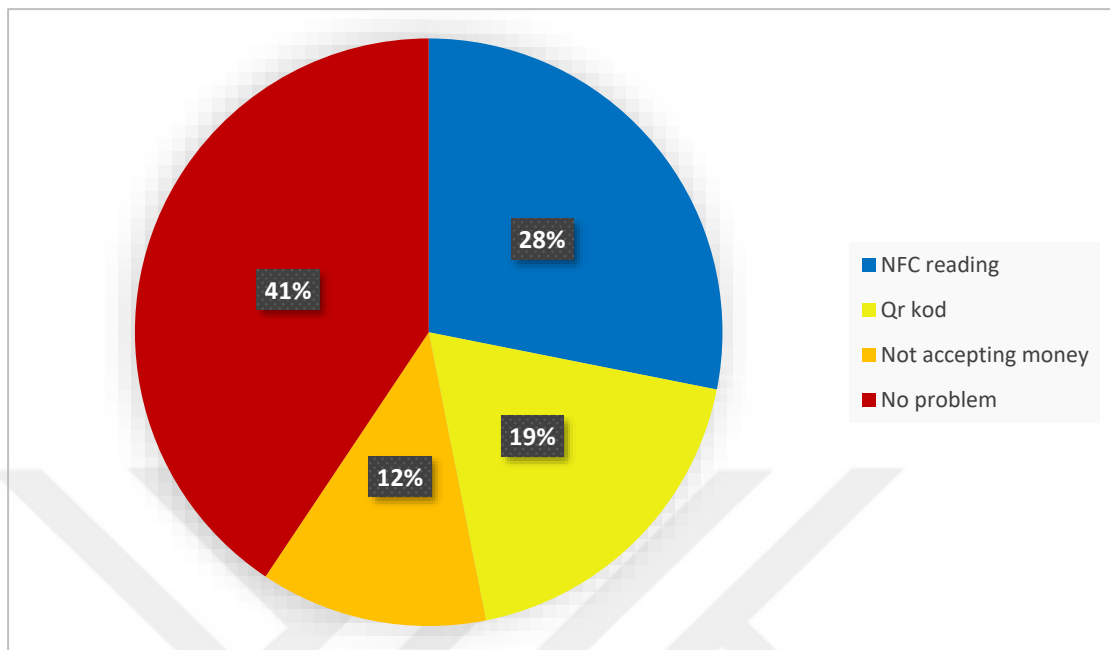


Figure 35. Analysis of the third interview question.

In the third question, users were asked about the problems they experienced with the method they chose to load money to Istanbulkart. As a result of the interviews, when the answers of the users who used the mobile application were analyzed, it was revealed that there were problems such as Qr code reading and loading money to the card with the Nfc system and delays in the system. The only problem experienced by the users of the ticketing system was that the ticketing system returned the money. The majority of users stated that they did not experience any problems with their preferred method.

Where do you use Istanbulkart other than public transport?

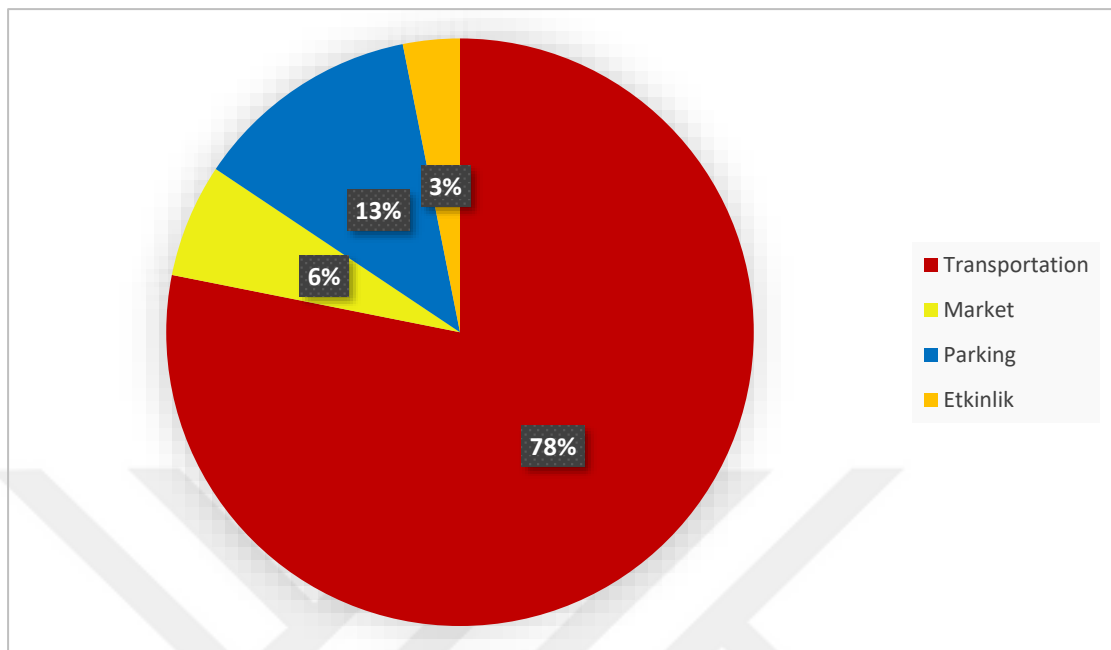


Figure 36. Analysis of the fourth interview question.

In the fourth question, users were asked where they use Istanbulkart. When analyzed according to the answers given, the table above was obtained. According to the table, 27 of the users, i.e. 78%, do not use Istanbulkart except for transportation. Among the users, 4 people say that they use it to pay fees in parking lots, 2 people say that they use it in markets and 1 person says that they use it for events. It has been determined that the majority of users do not use the advantages of Istanbulkart.

7. RESULTS

Throughout history, societies have been in search of an ideal city to solve the problems of their times. Today, one of the most important issues in cities, especially due to population growth, is the environment. In our age, people's unlimited use of natural resources can create problems for the needs of future generations. This question is directly related to sustainability. Sustainability of housing use is one of the most important issues affecting the future. In the world and in our country, smart city applications are being developed by taking advantage of the opportunities offered by information and communication technologies and sustainable urban life aims to realize these initiatives.

"Smart city" is recognized as the living space and ideal city in the information age we live in. The main purpose of creating a smart city is to improve the quality of life of urbanites, to ensure that services are provided effectively and efficiently, and to create livable and sustainable urban areas.

In order to implement the globally accepted and successful smart city model, which has also been adopted in Turkey, and to increase urban welfare, it is necessary to adopt a holistic urbanism approach and to use resources effectively and efficiently without wasting them. One of the first steps to be taken should be to clarify the definition of a smart city, set smart city standards and put an end to disorganized implementation. Smart cities should be people-centered, not technology-oriented, and should approach the use of technology from a perspective that considers the public interest. With this approach, smart city examples should be examined, possible risks and benefits should be investigated, necessary analyses should be made, and after a measurement and evaluation process, the needs of citizens and city-specific features should be implemented.

Smart cities are cities where various technologies are used together to reduce negative environmental impacts due to population growth, especially in large cities, to ensure sustainability by preventing excessive use of natural resources, and to ensure that citizens live in better conditions with improved infrastructure. It will be beneficial to choose technologies and systems that fit the fabric of the city. Targeting

environmental, social and economic sustainability in urban models is an active effort towards the future of cities.

In cities, different expectations of users emerge over time and some urban furniture is transformed into smart urban furniture to adapt to this process. Smart urban furniture, which aims to provide maximum benefit to users by utilizing the opportunities offered by technology, tries to adapt to the conditions of development and change. Such furniture, whose technical infrastructure is supported by software and hardware, is different from urban furniture with these features. It is important to consider all features such as user accessibility to smart urban furniture, perception, visibility or usability of urban furniture, functionality, need-saving features, working / flawless, cleaning, maintenance, scale, shape, color, texture, usability of different users group, size, etc.

In this study, the innovations, possibilities and constraints that Smart Urban Furniture offers to users through examples in Istanbul are examined in terms of user experience principles and interactivity principles. For this purpose, the research topic was determined in the introduction part of the research, hypothesis proposal was made and research questions were determined. With the determination of the scope and limitations of the research, the sampling technique used in the research and how the research method will be processed are mentioned. In the second part of the research, the concepts of Smart Urban Furniture and Urban Furniture are firstly explained and the design principles and methodologies are examined through current examples. In the third part of the research, the concepts of Interaction Design and User Experience, user experience principles and usability criteria for user experience are examined. In the fourth part of the research, Istanbulkart application and biletmatik, which are used for transportation in Istanbul, selected within the scope of smart city applications in Smart Urban Furniture, are selected and examined. In the fifth part, a synthesis of these approaches with all the data obtained in the research was made and various findings were obtained for the principles of the selected existing smart urban furniture. In the conclusion section, based on these findings, which are discussed and interpreted in detail, the interaction of Smart Urban Furniture with the users is analyzed by analyzing the good and bad aspects. The situation was analyzed by examining the good and bad aspects of the interaction.

As a result of the findings obtained in the research, it can be said that usability plays a positive role on the product according to the literature review. Thanks to the data obtained, we can say that the effect of the interviews about the use of Istanbulkart is as follows. According to the findings obtained from the interviews with the users, it is seen that the users prefer the mobile application to a great extent and the most frequently expressed criteria such as "easier" and "faster" are the reasons for preferring the application. Users with a higher age group and fewer users use Ticketmatik for "card loading".

7.1. Elimination of Problems Experienced by Users

As a result of the interviews, it was determined that users using Istanbulkart experienced various problems. One of these problems is the problem with the Nfc card reading system when using the application. In order to solve this problem, we can say that the Nfc system should be developed, this feature should be compatible with the phones used by each user, and more directive and informative notifications should be made to the users through the application.

When the research findings are examined, it is important that smart urban furniture can respond to the needs of users with its functionality, have an infrastructure suitable for technology, be accessible and perceptible, be suitable for user ergonomics, have a design excellence that contributes to the aesthetics of the city, fits the environment and the identity of the city, can become a part and symbol of the city, has features that combine human and functionality by allowing socialization, and provides a sense of security and satisfaction in the space.

In all cases, as the research shows, if the smart urban furniture is given the necessary attention, the right design decisions and the right positioning are made, the quality of space can improve when the user experience is taken into consideration. On the other hand, if the aforementioned design studies are not carried out, negative consequences can be seen in the quality of use and user relationship of these smart urban furniture.

At this stage, it is necessary to briefly answer the research questions determined at the beginning of the study;

- In the process of use in interactive urban furniture, users may encounter various problems such as the lack of physical controls on the comprehensibility of the interface and the fact that the external form of the units does not provide enough information about the use of the product by the user. However, users

- Users may experience adaptation problems in controlling the interface and interacting with the urban furniture due to their low technological literacy.

Based on these answers, it can be said that the hypothesis of this study is correct. It is seen that Smart Urban Furniture in Turkey puts the user in the background in the design process in terms of interface and user experience and for this reason, there are various limitations in terms of interaction in the design of furniture.

The findings of this research will be able to form recommendations for future research. It will be possible to identify the differences in the level of technological literacy of users in different cities in the use of such products and to address the design methodologies to be applied in the design processes of such furniture and to conduct a research on innovative design methods. At the same time, by conducting a research on the designers of these products, approaches to the design processes of smart urban furniture can be examined from the perspective of designers. By conducting such research, it can be said that the product designs to be made in this field in the future will be carried to more advanced points in terms of user experience.

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APPENDIX

Adın Soyadınız nedir?	Kaç yaşındasınız?	Mesleğiniz nedir? Nerede çalışıyorsunuz?	İstanbul karta yükleme yapmak için hangi yöntemi kullanıyorsunuz?	Kullandığımız yöntemi tercih etme sebebiniz nedir?	Kullandığımız yöntemde yaşadığınız sorunlar nelerdir?	İstanbul kartı toplu taşıma dışında nerelerde kullanıyorsunuz?
İrem Ugurlu	20	Öğrenci	Mobil uygulama	Daha pratik	Herhangi bir sorun yaşamıyorum	Sasece toplu taşıma için kullanıyorum
Şakir Mennan Öztürk	21	Memur/ Kültür ve Turizm Bakanlığı	Mobil uygulama	Kolaylık	Sistem gecikmesi , Qr kod okuma	Kullanmıyorum
Buse öner	23	Öğrenci	Mobil uygulama	Kolay olması	Qr kod okuma	Otopark
Hüseyin Yurttepe	24	Zabıta Memuru	Mobil uygulama	Pratik	İnternet hatası vermesi,Qr kod okuma	Kullanmıyorum
Yağmur toprak	24	Reklamcı / reklam ajansı	Mobil uygulama	Kolay olması	Kart NFC okutma	Kullanmıyorum
Atakan ÜRKMEZ	24	Aşçı. Çalışmıyorum	Mobil uygulama	Daha basit ve pratik	Herhangi bir sorun yaşamadım şimdiye kadar.	Kullanmıyorum.
Nil Karakiraz Ugurlu	26	İç mimarım. Fenoks teknik çelik firmasında çalışıyorum.	Biletmatik	Kolay olması	Para kabul etmemesi, geri vermesi, sıra olması	Hiçbir yerde
Ramazan edis	27	Teknik ressam (veldo teknoloji tuzla)	Mobil uygulama	Ödeme kolaylığı	NFC kart okula problemi	kullanmıyorum
Aslı Esi	27	Veri Bilimcisi - Şekerbank	Mobil uygulama	Kullanım kolaylığı	Sorun yaşamıyorum.	Kullanmıyorum.
Gözde Hastoprak	27	Analist - Denetim Şirketi	Mobil uygulama	Kolay	Yaşamadım	Hiçbir yer
Melike Simge Yılmaz	28	Gençlik spor Sanyer İlçe Müdürlüğü Güvenlik	Mobil uygulama	Çünkü biletmatik ile uğraşmak zorunda kalmıyorum ve nakit para kullanmıyorum.	Abonman bittiğinde mobilden yükleyip otobüse binmek zorunda kaldığımda yetersiz bakiye diyor her otobüste yok ne yazık ki talimat yükleme	Aslında birçok avantajı var biliyorum fakat ben bunları takip edemiyorum farklı işlerle de uğraştığım için zamanım olmuyor sadece ulaşım

Adın Soyadınız nedir?	Kaç yaşındasınız?	Mesleğiniz nedir? Nerede çalışıyorsunuz?	İstanbul karta yükleme yapmak için hangi yöntemi kullanıyorsunuz?	Kullandığınız yöntemi tercih etme sebebiniz nedir?	Kullandığınız yöntemde yaşadığınız sorunlar nelerdir?	İstanbul kartı toplu taşıma dışında nerelerde kullanıyorsunuz?
Alper Oralp	30	Kimya Mühendisi	Mobil uygulama	Mobil üzerinden kolaylıkla ve istediğim zaman hem bakiye hem abonman yükleyebildiğim için	Qr kodu oluşturmada sıkıntı yaratıp takılı kalıyor aynı qr kodda cihazlar okuyamıyor, kart bakiyemden, oluşturduğum sanal karta bakiye aktaramıyorum aynı aynı hem sanal karta para yüklemek hem fiziki karta yüklemek sorun teşkil ediyor	İspark larda indirimli otopark ücreti ödemek ve marketlerde alışverişte kullanıyorum
Betül Kuzu	32	Ev hanımı	Mobil uygulama	Kolaylık ulaşılabilirlik	Sorun yaşamıyorum	Kullanmıyorum
Aylin hanım	33	Ev hanımı	Mobil uygulama	Nakit kullanmadığım için.	Sorunsuz.	Sadece toplu taşıma araçları.
Sinan Karadağ	33	Sağlıkçı	Mobil uygulama	Kolay	No	Hiçbir yerde
Begüm Yiğit	33		Mobil uygulama	Kolay olması	Sorun yok	Sadece ulaşımda
MERVE GÜNEĞİ	34	ANTRENÖR	Biletmatik	GÜVENİLİR	BAZEN PARALARI İADE EDİYOR.	HİÇ BİR YERDE
Çağla Yazıcı	37	Mağaza Yöneticisi.	Mobil uygulama	Hızlı ve kolay	NFC'nin kartı okunmaması.	Hayır, kullanamıyorum.
Selime Vural	38	Mali müşavir	Mobil uygulama	Kolaylık	Yok	Getir
Elif Kutluata	40	Asistan-Özel Sektör	Mobil uygulama	Pratik	-	Kullanmadım hiç
Alev aşkın	40	Hemsire haydarpasa numune hastanesi	Mobil uygulama	Kolaylık	Sisteme geç düşmesi ya da onaylama kısmı	kullanmıyorum
Elif Uçar	40	Ev hanımı	Biletmatik	Nakit Para kullanıyorum	Sorun olmuyor	İbb spor unda
Özkan öztürk	40	Askeri personel	Biletmatik	Kolay	Bazen kartı okumuyor	Sadece toplu taşıma
Derya Mordoğan	43	İstanbul üniversitesi tip fakültesi biyolog		Aylik öğrenci dolum yapıyorum aylık dolum yapan bufelerden dolum yapıyorum	Bazen erken saatte gidince kapalı olabiliyor	Otoparklarda
Savaş Sabri ÖZÇELİK	43	İnşaat Mühendisi	Biletmatik	Pratik bir yol	Memnunum	Sadece ulaşımda

Adın Soyadınız nedir?	Kaç yaşındasınız?	Mesleğiniz nedir? Nerede çalışıyorsunuz?	İstanbul karta yükleme yapmak için hangi yöntemi kullanıyorsunuz?	Kullandığınız yöntemi tercih etme sebebiniz nedir?	Kullandığınız yöntemde yaşadığınız sorunlar nelerdir?	İstanbul kartı toplu taşıma dışında nerelerde kullanıyorsunuz?
Kenan Köprülü	45	Tekniker/Emekli	Mobil uygulama	Kredi kartı ile yükleme yapılabilirdi için	Sorun yaşamıyorum	Markette
Özden Kabuk	45	Antrenör, hakem TYF	Mobil uygulama	Hızlı	İnternet erişimi, sistemsel sorunlar	Otoparklarda
Dilek Bakkurt	49	Emekliyim	Mobil uygulama	Kolay olması	Geç entegre olması	Kullanmıyorum
Ayfer Giray	52	Emekli	Mobil uygulama	Kolay	Bazen kitleniyor	kullanmıyorum
GÖNÜL GÖZÜBÜYÜK	53	MEMUR+ (ÖĞRENCİ)	Mobil uygulama	MİGROSTAN YÜKLEME YAPIYORUM. BİLETMATİKTE N ABONMAN YÜKLEMESİ OLMUYOR.	BİLETMATİKTE ÖĞRENCİ ABONMAN ALIMI YOK.	Kullanmıyorum
İsmail YİĞİT	56	Emekli	Mobil uygulama	Pratik	Mobilden talimat verince hemen yükleme yapmamakta, otomatik dolum makinasında tekrar kartı okutmak zaman kaybına neden olmaktadır.	Kullanmıyorum
Ayşe Sak	60	Emekli	Mobil uygulama	Heran daha rahat ve kolay olduğu için	Şu ana kadar sorun yaşamadım	Hiçbir yerde kullanmıyorum