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Contents

Editorial

Aliye Ahu AKGÜN • *Editor*

Do you believe in coincidences? I don't. This year, unconsciously each cover's colour became a tone of green. We didn't make it on purpose but actually our subconscious made the choice. Green means environment, nature and peace. It is the colour of what we need most in these days.

Environment always plays a crucial role. Not only in individuals' life cycle but also for successful planning, implementation and design. Korkaz and Madani, in their article, "Informal settlements' urban recognition process: A case study of the Essadikia Quarter in Laghouat, Algeria", provides different urban transformation strategies implied by actors in informal settlements of Algeria. They conclude that the success of urban transformation relies not only on strategies but also, and more, on geographical location and natural characteristics of the place.

Zain and his colleagues in their paper entitled "Traditional concepts of Dayaks in the Longhouse of Nek Bindang Village of West Kalimantan" examine the importance that traditional architecture gave to environmental risks, based on Longhouse construction in Nek Bindang Village of West Kalimantan. Their evaluation proves that the traditional architectural concepts have given priority to the balance and harmony with the environment, hand in hand with the local capabilities.

The neglectful behaviour of humans towards the environment appeared first as urbanisation. The negative impact of urbanisation is realized today and there is a call for challenging urbanisation. Each individual depending on their experience provides solutions. Oluwatayo et al., in their paper entitled, "Walking experience in mixed use developments in Lagos, Nigeria", provide one architectural solution to urbanization – mixed-use development. Depending on the pedestrian's experience, if mixed-use development is designed without blocking the shortest path and with non-slip surfaces and lighting features, it increases the satisfaction of pedestrians. Therefore, urbanisation can be a better experience for its citizens.

The beginning of technological advancement was the winner of the fight with environmental issues. Yet, the following years have shown that as it was in traditions, the humans and the environment need to be in harmony, not in war. But the perception of youth has already formed as if it is a fight and the severe consequences call for better environmental attitudes. It is important to think on when and how we can break and change environmental attitudes of the youth. Professional education and universities are the main tools to touch youth to increase their awareness towards environment. In the article, "Determination of the difference between environmental attitudes of 1st and 4th year students of landscape architecture", Tarakçı Eren and Düzenli, show that the education plays a significant role to improve environmental attitudes of youth.

Everybody has the right to experience environment. But the experience is often limited. Özgür and Eşbah Tunçay, in their article "The using of urban park as perceived by visually impaired", discuss how sensory design in urban space can increase individual experience of visually impaired and others. They stress a better understanding of the different types of sensory perception in order to design urban spaces for all.

Fallah and Hojat, in their article entitled "Mental images and congruence strategies: An investigation of congruence between residents and private open spaces in three dominant housing patterns of Yazd" investigate how congruence is established between residents and open spaces in tree dominant housing patterns of Yazd, a traditional city in Iran. According to their results, the similarity between the ideal and desired open space and actual one identifies the behavioural adaptation of residents.

Kozikoğlu and her colleagues, in their article entitled "Mapping relations as a design strategy, physical attraction forces correlation for design thinking", offer how scientific data can be transferred into the design process and convert the subjective process of design to a more objective process. They conclude that the use of dynamic tools and thinking provide and evidence-based environment for the design processes of landscape architects and urban designers.

Ristanto and his colleagues, in their article "User behaviour and circulation in an Indonesian student communal housing facility: Combining space syntax and Actor Network Theory", analyse to better explain socio-spatial phenomena to help architects design a more strategic and efficient space arrangement.

Molaei and his colleagues, in their article, "Principles of flexibility in design process, with the approach to creativity in design", introduce six general principles of flexibility. According to Molaei et al., these principles can be turned into a wide variety of flexible design processes. Therefore, the design and its process can be adaptable to unpredictable conditions and time changes.

Each day, environment reminds its importance to us and adaptation becomes crucial. Dabanlı et al., in their article entitled, "In Situ dynamic system identification of historic masonry monuments based on non-destructive testing", offer a system to understand how to protect cultural heritage towards environmental challenges especially natural disaster risks. Each monument depending on its period asks for a special treatment and protection method. According to their evaluation, for Nur-u Osmaniye mosque, the FE model to update it structure is the relevant one.

Future of cities asks for green construction. Tuz and Sertyeşilışık in their article "Integration of the management theories for enhancing green marketing implementation in the construction industry", focus on the response of green marketing to environmental concerns. They investigate management theories to enhance green marketing implementations. They provide a guideline for the conceptual changes to adopt green marketing in the construction industry.

Not only the construction industry but architectural design firms also must fulfil the adaptation requirements in order to increase their competitive advantage. Ibem and his colleagues, in their article "Critical success factors (CSFs) for e-Business technologies adoption in architectural practice in Nigeria", provide a successful path for architectural firms to adopt e-business technologies. By adopting successful e-business technologies in improving professional service delivery efficiency, architectural firms will gain competitive advantage.

On its own, neither adaptation nor giving the environment its deserved value is not enough as we are living in communities. The history and literary texts have a great power to explain this to us clearly.

Aydın and her colleagues, in "Reading 19th century architectural and interior space reflections of modernization through the literary space: Émile Zola's Nana", offer insights into 19th century's architecture and interior space from Emile Zola's novel Nana, depicting the social problems of the times. They conclude that class discrimination and gender issues have a conflicting reflection on the architectural and interior space.

Çil and Şenel Fidangenç, in their article, "Outside the house but not in the city: Promenades in Istanbul as negotiated public spaces for women in 19th-century Ottoman novels", offer insights into women at the beginning of modernization in Istanbul of Ottoman Empire. They evaluate that especially the promenades are the places reflecting safety but also tools to keep Muslim women away from the westernized and cosmopolitan side of Istanbul.

Today, this closeness is changing and especially the youth prefer more openness not only outside but also inside. Ammar, in the article entitled "Housing arrangement transformation and the cultural revolution" shows that traditions and cultural change provides a transformation in housing arrangements. Ammar evaluates that the youth of Gaza has a tendency towards openness especially by isolating guest's spaces by moveable barriers.

But privacy still keep its importance The main objective for architects is to improve building quality for occupants. Şan Özbilen and Bayazıt in their article entitled "Decision-making method for choosing best alternatives for internal walls based on cost and sound insulation performance", aims to find the optimum internal wall that complies with the Acoustic Regulation of Turkey and maximizes the airborne sound insulation performance while minimizing other parameters (cost, weight, thickness). By the help of TOPSIS Method, they demonstrate that the combined method is a convenient method for decision making.

Enjoy our November 2021 issue!
Happy New Year!!!

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Informal settlements' urban recognition process: A case study of the Essadikia Quarter in Laghouat, Algeria

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Abstract

The main topic of this article is about the dealing with the informal settlements in the city.This paper aims to identify urban transformations in Essadikia, an informal settlement known for its high density, in the city of Laghouat in the south of Algeria.

Its history explains the paradoxes of the algerian city,and more precisely, in Saharan cities where quarters grew rapidly after the Algerian independence in 1962.

This study examines the urban recognition process through the strategies of different actors. Our study based on fieldwork, questionnaires and interviews with local residents and public actors involved in the regularization process.

From the state to the residents of Essadikia, the transfer of land ownership is ensured, by the municipality. This local authority is the main actor in this regularization project of retrocession.

Despite the different strategies adopted by actors, The results obtained show that the urban recognition process of this quarter is partially successful due to the multiple challenges of the urban integration especially geographical position and the presence of the mountain.

Keywords
Essadikia Quarter, Informal settlements, Laghouat city, Regularization process, Urban recognition.

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1. Introduction

The number of cities and metropolitan areas has increased recently. The world is becoming increasingly urban, and the urbanization phenomenon and urban transformation are usually accompanied by significant growth due to the corresponding massive rural exodus.

The urban transformation is an important concept to clarify; the different urban issues are taken for granted under this general term. The urban transformation concept changes in each period (Gülersoy, 2011) and within the different political, social, economic and cultural context.

Depending on planning theory strategies, urban transformation could be reconsidered with three major categories:

- Heritage conservation-based urban transformation, which concerns the most valuable urban areas and historic places preservation.
- Regeneration-based urban transformation: in the areas with economical potentials, intervention in the abandoned industrial spaces.
- (Re) Development based urban transformation: which focuses on urban upgrading and social and economic restructuring on squatter settlements and deteriorated spaces.
- The urban management has become an enormous challenge, especially concerning informal settlements around the world. Due to rising populations, mainly in urban areas, the number of people living in unplanned neighbourhoods is growing (Syagga, 2011).

Informal settlement is the clearest manifestation of the uncontrolled urban process of a city's urban development. Its emergence is due to multiple causes: urban migration, concentration of services and resources within a few large cities, and inadequate housing policies (UN Habitat, 2015). These housing policies have failed to address major issues including the lack of housing, poverty, or even mobility due to conflicts or various disasters, such as climate change, which are forcing many people to endure poor housing and difficult living conditions.

Algeria is not immune to this urban phenomenon. Informal settlements are increasingly common and part of the city landscape. The country is facing a critical housing shortage, and the disfigurement of Algerian urban spaces is easily noticeable.

2. Research methodology

The first part of our research presents the topic and several definitions of informal settlements with special highlight for the Arab urban context and the overall upgrading project strategies adopted in each context.

The second part then it focuses on the Algerian context taking the case of the city of Laghouat city as an example in order to study the effectiveness of the whole process and its details, particularly the role of all the actors in this outline recognition strategy. A mixed research approach used, Primary data were collected through several qualitative and quantitative techniques, observations and interviews with decision-makers, local authorities and inhabitants. Survey was conducted to clarify the most important information and resident opinions about this quarter.

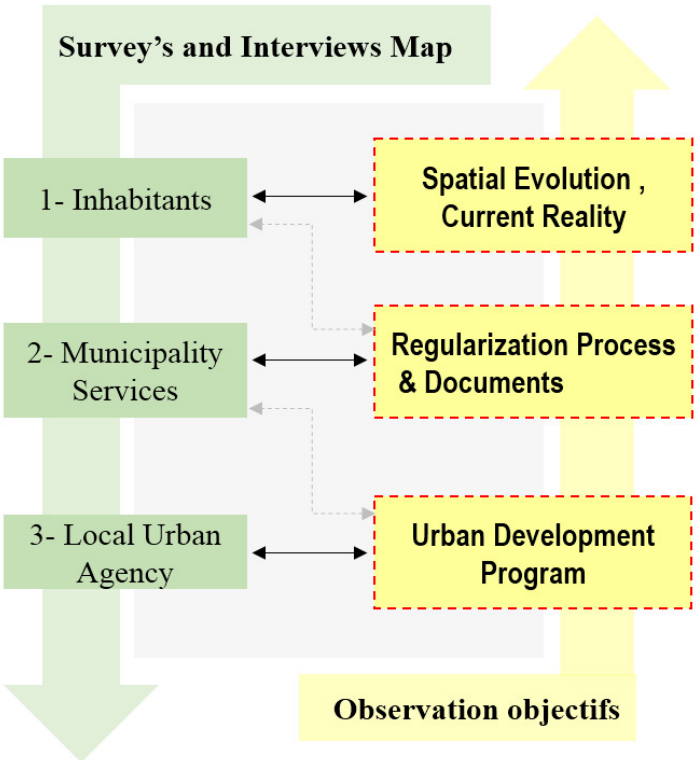

Figure 1. *Survey's and interviews map.*

In order to obtain a better understanding of the different characters of this quarter we organised a meeting with several actors. The interviews were scheduled with chronological programme (Figure 1).

Started with Inhabitants, where individual interview is extremely important to understand the spatial evolution of quarter and different historic and important moments, 2, the second important interview scheduled with municipality services, communal popular assembly ,that's allowed us to get more information from these official authority about the land tenure regularization project, legal documents; its circumstances, and the process obstacles, 3, the other meeting organised in the local urban agency desk where the meeting with architects ,urban planner director set to have information about the different programmes and project in the quarter.

In other hand, the survey's objective is to discover the spatial and socio-economic characters and to asses this project of urban recognition and land tenure and upgrading, a questionnaire distributed for more than 150 householders. In the period between November 2019 and March 2020, the questionnaire designed to draw out information, it contains more than 50 questions in four major parts; the first one about the householder (age, work, educational level, wife and family).While the second part is about the house (area, date of construction, age, occupation mode, property and land tenure information). Whereas the third part focused on house and neighbourhood environment (sanitation,sewage,public spaces, and natural environment about mountain... etc) . The last Part is about the neighbourhood relation with city (mobility, basis facilities, transportation links, urban and city belonging).

The lack of cartographic records is a major problem encountered in this study. Therefore, authors elaborated by their own the plans presented and finalised by a field survey.

3. The theoretical framework

One of the problems, of urbanizing countries, that can be mentioned is that of informal settlements (Hasgül, 2016), which have grown considerably over the last decade (Sanslaus, 2017). A various labels has been created to describe these neighbourhoods, as reported by Chaline Claude, including unregulated settlements or illegal settlements (Hafiane, 1989), spontaneous urbanization (Elkadi, 1987), or precarious neighbourhoods. Irregular settlements have also been used, which are defined as an area or settlement where spatial expansion and occupation are not legal (Durand-Lasserve & Clerc, 1996).

Squatter is another term usually used to indicate the non-legal or informal occupation of buildings or land, and all these definitions refer to the lack of land ownership (Marutlulle, 2017). For this type of settlements, illegal could be different than the informal because the first, could be with land ownership but without authorization for construction, whereas the Informal is lacking to both land ownership and authorization.

The irregularity of these informal settlements takes many forms, such as land irregularity, which is the lack of recognition of land. This means that the residence rights of the occupants are not recognized. In addition, urban irregularity is linked to non-compliance with the rules governing the development of plots, either because the areas concerned do not yet have development plans or because the constructions carried out do not take account of the development plans for the areas concerned. Finally, administrative irregularity is linked to the attitude of the public authorities towards precarious neighbourhoods, as most of these districts are ignored and are not officially recognized.

In 1975, the UN Habitat Secretariat and representatives of 132 nations approved many recommendations for national actions on habitat (Petropoulou, 2007), including public control of land use, support from the construction sector for both formal and informal ones, universal access to sanitation, and the creation of new public facilities.

According to the UN (Habitat from 1992 to 2012), the population of informal settlements in cities of the Global South has increased by approximately 200 million (from 650 million to over

860 million). The proliferation of urban spontaneity, especially habitat, marks the urban landscape of the developing cities.

3.1. Informal settlements in the Arab urban spaces

According to the UN Habitat report, by 2050. Over 70 % of the Arab population will be urban, the rapid urban growth witnessed by most developing countries. Mainly the Arab countries during the second half of the twentieth century, led to economic, social, demographic, and security problems, among others, and one the consequences of that rapid urban growth induce the emergence of informal settlements around the cities.

Urban growth has resulted in the proliferation of informal settlements, and their presence has not been limited only to Arab countries with economic problems, but has also occurred in some Arab countries with high or medium economies.

The phenomenon of informal settlements has emerged in response to multiple factors, including economic, political, demographic and natural conditions, which have led many rural residents and others to migrate to cities and capitals to reside on the periphery without being bound either by land ownership laws or by urban planning systems and regulations.

The location of informal settlements in the region has two different types; the first one about sub-standard structures in central informal settlements, in insecure and unsafe locations or in per-urban areas without access to basic services (UN Habitat). The second one about unplanned urban expansion through the subdivision of agricultural land.

This following information are about the informal settlements in some Arab countries largely inspired from the several UN Habitat reports, the selected countries are Egypt,Syria,Saudi Arabia,Tunisia and Morocco, this choice does not mean that the non-cited Arab countries are immune of this urban phenomenon.

For the Egyptian case; with a population of over 100 million.It is the most populated country in the Arab region. Informal settlements are called Ashwa'iyyat, which literally means spontaneous settlements; The demographic expansion cited is inherently spatial and urban. The increase in informal areas has been widely referred to as an indicator of the process of urbanization of cities all over the country. Indeed, at least 40 % of the urban population lives in informal areas (Hegazy, 2016).

The State established the Informal Neighbourhood Development Fund (ISDF) after the tragic event of 2008 in Manshiyet Nasser, where several citizens died as a result of a landslide. The fund has adopted various projects to identify informal settlements and develop policies for intervention, taking care of residents and relocating them to housing projects in other places. The Fund's policies are based on achieving social justice and ensuring the right of citizens to guarantee safe housing.

Informal settlements in Egypt are classified into four zones according to the geographical specificity of the locations. The ISDF adopted an approach based on controlling and limiting the expansion of these neighbourhoods in spontaneous areas and in spontaneous areas at risk and reported having improved 188 zones in total.

In Syria, the migration to the urban zones started in the second half of the 20th century .It created a demand for housing and real estate in the cities. Most of the formal systems cannot handle the demands for housing, in 2004; informal settlements comprised about 40 % of Damascus' population, or about 1.3 million of the capital's 3 million inhabitants (Clerc, 2013)

According to the UN Habitat, over 70 % of informal settlements were located on private lands, while less than 30 % involved and squatter on public property and Awqaf lands. These informal settlements characterize a large part of the neighbourhoods on the outskirts of Syrian cities; and have taken a large part of the urban population growth, (Wazzan, 2012). These areas are an essential element of the urban and per-urban space of the city of Damascus (Kafa, 2013).They are structured around its roads, and are positioned in relation to its production units occupy the agricultural space.

Additionally, In this Syrian case ,we can distinguish two types of a dual land occupation : some settlements had developed on lands squatted by the initial occupants like the case of Mount Qassioun in Damascus, the other settlements were built on privately owned land which, though legally held by its occupants but building was not permitted. This second one found in the Ghouta (Clrec, 2014). Before 2011 two scenarios were possible; the first is the upgrading with regularization and the second one is the urban renewal which consists in the demolition and legal reconstruction strategy.

In Saudi Arabia, the kingdom faced continuous population growth, which also increases the housing demand in the country significantly, the appearance and growth of the unplanned settlements is easily noticed in the two holy cities of Makkah Al-Mukarrama;Al-Medina Al-Munawarra; and for Jeddah and Taif. These cities have the largest concentrations of informal settlements in the country, for example in Makkah there are 66 informal settlements populated with almost 590.000 inhabitant, and Jeddah city has 64 informal settlements populated with over one 1 million people. Several strategies developed by municipalities and government urban development agencies to deal with the informal settlements such as clearance, upgrading and possible conservation. These types depend on urban, social and economic characteristics of the informal settlement zone.

For the Maghreb; in Tunisia; 3/4 of the population live on 10% of the whole territory, due to the migration of farmers to urban centres while informal districts are located near the centres of large cities. After the country gained independence in 1956, the city of Tunis was surrounded by informal settlements, between 1994 and 2014 brought a sharp increase in the urbanization rate of about 68%.

In order to deal with this phenomenon; actions have been taken to improve informal settlements, regulate land tenure and modernize local infrastructure. These actions have been carried out by several factors such as the Ministry of Infrastructure, the Ministry of Housing and Regional Development, the National Fund for the Improvement and Rehabilitation of Housing and the National Agency for Urban Renewal that has been involved in the improvement of more than 192 neighbourhoods in the country.

For the Moroccan case, the informal settlements had many faces those constructed on agricultural land (Essahel,2011), or located in the deteriorated traditional centres like the historic city of due to a long period of overcrowding from migration and lack of maintenance.

After Morocco's independence, many strategies were developed to reduce the phenomenon of informal settlements, the most important programme launched in 2004, called cities without slums " villes sans bidonvilles (VSB)"; was based not only on the specific urban and territorial context but also on three main strategies: Restructuring, Relocation and Resettlement (UN, 2016). It adopted a participatory strategy involving actors at the national, central and local levels and the population of informal settlements.

Upgrading or informal settlement improvement covers a package of basic services, such as clean water supply and adequate sewage disposal to improve communities' well-being. However, a fundamental aspect of this process is to legalize and regularize land properties (El Menshawya et al, 2011). Informal settlement upgrading strategies and policies are not a completely new idea because many countries as mentioned about Turkey (Bayram, 2015, 2010), South Africa (Hull et al, 2019) and for Afghanistan (Amiri, 2018), Egypt (Safey Eldeen, 2014), have dealt with this phenomenon to stop informal urbanization since the 1950s (Khalifa, 2015). Studies approach informal settlements by either focusing on the household and settlement level or discussing municipalities' policy and governance strategies (Saharan, 2018).

Upgrading actions are frequently conducted by community organizations with local government intervention (Nazire et al, 2016). Governments in developing countries are implementing land reform (Kyessi, 2010).

Although most Arab countries are seeking, through a set of laws, legal tools and administrative devices, to reduce the phenomenon of illegal neighbourhoods, the Arab city is still unable to control this urban problem. The exacerbation of social problems and poverty, as well as unstable security, political and economic conditions, have resulted in the presence of these informal settlements.

3.2. The squatter and informal settlements in the Algerian urban context

The organization of Algerian cities is characterized by a both land use and spatial extension, on the one hand, local authorities through its tools of action in the formal urban fabric and on the other hand, "popular spontaneity" (Belmallem-Chouguiat, 2011). With its own rules, generating informal settlements built on the fringes of formal and official development. In Algerian cities, the massive migration of rural residents to urban centres, the rapid demographic growth, and the incapacity of public authorities to propose decent housing have led to the emergence of informal urban settlements (Hafsi &Chabi, 2019).

The informal settlements are not only an urban phenomenon in Algerian big cities. Algiers as mentioned (Benalia, 2015; Semmoud, 2014), Constantine, Oran, Annaba (Serrab, 2006), Setif (Diafat, 2019). It's also present in the medium and small Saharan cities in Biskra City (Selatnia & Farhi, 2017); Bousaada city (Araba & Mazouz, 2018); Bechar city (Hamidi, 2011) and around southern industrial cities (Sofrani et al, 2018).

Historically, in the Algerian city, the emergence of informal districts dates back to the colonial period (Naceur, 2013), the expansion was divided into a Franco-European section planned according to urban rules and administrative tools and another Algerian natives section of informal districts. This presence of spatial divisions, which led to the emergence of segregated social differences, was the characteristic of the colonial city.

In order to trace the evolution of these informal settlements in Algerian cities after independence, it should be noted that during the socialist agrarian reform in the 1970s, many private landowners subdivided their agricultural land into small plots for sale as urbanized lots (Naceur & Belmessous, 2018).

From 1985 onwards, the Algerian city suffered from an acute housing shortage. The deficit was about 1 million dwellings; in response, the authorities implemented development programs in the informal settlements of most cities, which improved such elements as sidewalks, sewers, sanitation and street lighting (Naceur,2018). In the 1990s, the lack of security brought a new wave of migration to the city in seeking safety and better living conditions, which led the informal settlements around Algerian cities to become increasingly present.

After the year 2000, a new housing policy was introduced, financial aid to help the middle classes find housing, financial aid for rural housing was introduced, and several public agencies were set up, such as the Local Urban Management and Regulation Agencies and the Agency for the Improvement and Development of Housing (AADL), which oversees action to reduce precarious housing.

Informal housing reflects the effectiveness of the housing policy, in Algerian cities,housing production strategy shows the failure of the authorities in managing informal urbanization,social and spatial issues indicate their lack of control of this phenomenon (Araba, 2012). Indeed, the state has shown a low capacity to take charge of housing for poor families. The forms of regulation produced for informal neighbourhoods are tolerated and the role of local authorities has been limited to systematic regularisations.

In addition, one of the biggest challenges is this quarters is the land tenure regularisation which is important in the recognition process.

4. Geographical and historical context

As Saharan city with difficult living environment (Benslimane & Biara, 2019), Laghouat is considered a central gateway to southern Algeria; it is located 400 km south of Algiers, with a typical Saharan Morphology. Laghouat, like most Saharan cities, experienced four historical urbanization periods (Belguidoum, 2002), presented as follows:

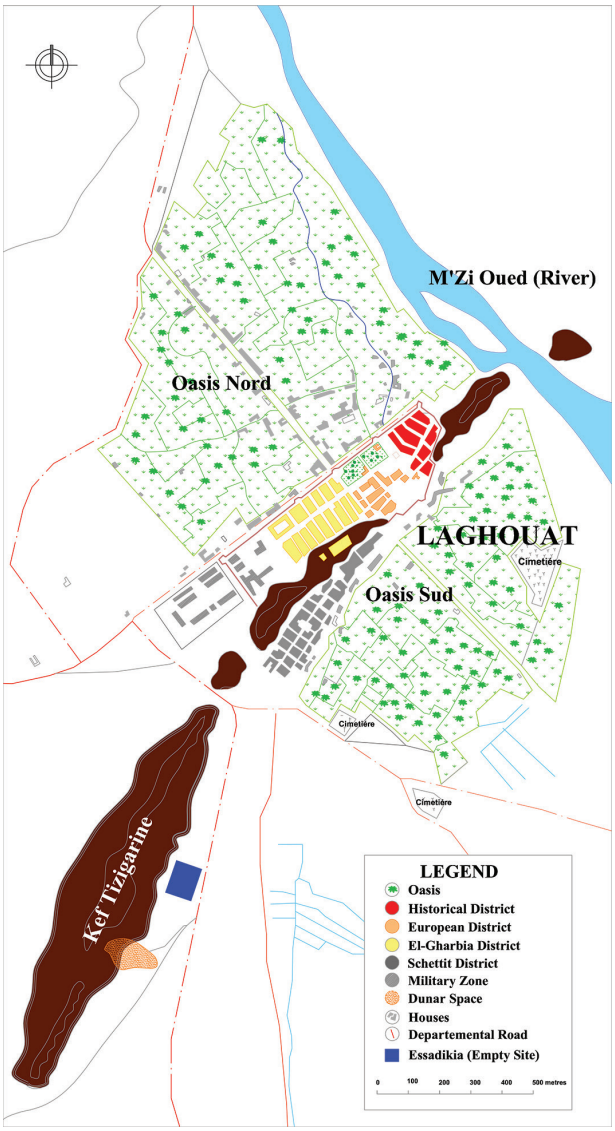

Figure 2. *Laghouat city before 1930.*

4.1. The ksar, the traditional town

The heart of the settlement is indeed a group of traditional houses. It has a specific organization that maintains complex causal relationships (Kadri et al., 2019), and it is loaded with signs representing the marks of a singular socio-cultural context (Layachi, 2016). For defensive reasons, the ksar was built on rocky soils and high ground, as the Laghouat Ksar see Figure 1.

4.2. The colonial city

In a new extension or on existing fabrics. The French military completely changed the urban structure of the city by introducing the urban grid on the rubble of the ksar (Benarfa, 2018). As for the creation of neighbourhoods, whose geometry is necessarily regular and the pillars are rectangular, as can be seen in the European neighbourhood and El-Gharbia quarter in the same city of Laghouat.

4.3. Informal settlement neighbourhoods

These neighbourhoods are the product of popular emanation (Déboulet, 1994). They spontaneously appeared before independence; quarters were created because of the housing crisis or the massive sedentarisation of nomads in the Saharan city. These spontaneous settlements also develop in other forms, such as precarious constructions and through the transformation of communal housing and construction without any authorization.

4.4. Regular urbanization zones

As a result of previous planning, these areas represent government-programmed operations in urban spaces as an example of the ZHUN (New Urban Habitat Area) Project with proper construction equipment, planning, and authorization.

5. Laghouat city urban evolution and spatial fragmentation

Focusing on the general urban development of the city of Laghouat, we can confirm that the city is characterized by a variety of urban compositions. The city is divided by the mountain, which serves as the backbone for districts which have enclosed oases on both sides.

The Southern Oases are mainly old residential areas, where some administrative and commercial activities are present, but where public transport is lacking (Othmani Marabout Bouchareb, 2019). The difficulty of mobility is related to the nature of traditional urbanization, such as the Shettit, Ksar Bezaime and Essadikia neighbourhoods.

The northern oases are the largest area of the city with various administrative, service and commercial activities well distributed and supplied by the transport means, such as the Màmourah, l'M'qam and Wiàm districts. In addition to the diversity of individual and mass housing, its population has increased due to the im-

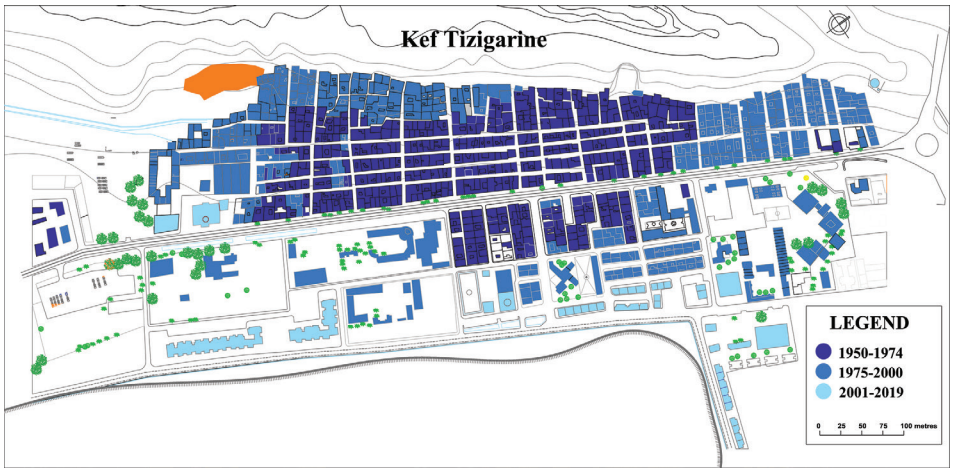

Figure 3. *Chronicle of spatial urban evolution.*

migration of some inhabitants of the southern oases.

This division of the city has resulted in the creation of two urban fragments, which has brought with it certain problems of social and urban discrimination in the city, especially the number of inhabitants due to increased migration (Rezzoug, 2013).

6. About the Essadikia Quarter

As an unplanned area, Essadikia is one of the most populated quarters of Laghouat city. It is located at the south-western end of the city, at the foot of the Tizigarine kef mountain (Dogs' Rock) and the river of Oued M'sàad on the south-eastern side, and the mountain that surrounds this district increases its spatial exclusion from the Centre and the rest of the city.

These two natural barriers such as the mountain and the river; have largely guided the formation of informal settlements. This site is always considered as dangerous due to the landslip and a very large concentrated dune in the middle of this mountain.

6.1. Chronicle of spatial evolution of Essadikia

For Laghouat, as for other Saharan cities, the emergence of auto-constructed houses predates independence (Maachou et al, 2018); the neighbourhood's first constructed houses is due to the displacement of 40 impoverished families living in the outskirt of the city of Laghouat; whose French administrators quickly drew up the first small areas in the district without building there.

The inhabitants of the quarter can be classified according to geographical origins from around the city and the date of settlement: the first are poor displaced families, followed by a few temporary residents living in the Schettit district, as well as settled nomads.

After independence, a wave of sedentarization increased the population of the district, while the sedentary nomads increased the already high population density of the southern districts. Very rudimentary buildings were constructed without basic hygiene standards or an urbanization plan (Pettit, 1976).

7. Urban recognition process strategy

Land is considered as the main support of formal or informal urban extension, informal settlements/ squatter occupy illegally these lands to be then a part of the city, by occupying large spaces of private or public property.

The Algerian governments adopted one of two these solutions cancellation or recognition (Hafsi &Chabi, 2019). It depends usually on the tensions and the relationship between state and society (Semmoud, 2015).

The legal approach and land tenure regularization shows that many different policies laws and texts used to regulate land tenure, such as the law no.81 of February 7th 1981 on transfer of state property where text explain new measures of land acquisition which is significant for the regularization of informal settlements.

It's important to clarify that the tendency of local authorities intervention shows a tolerate attitude. Il combines both of land titling and the physical

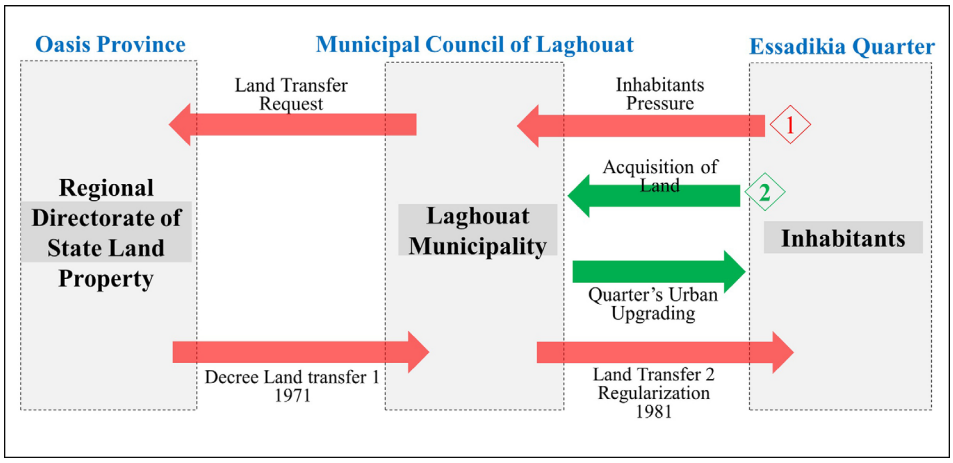

Figure 4. *Stakeholders strategy.*

upgrading. This policy aims to legalize informally occupied land through legal titling and administrative strategic tools (Okyere et al, 2016). The Algerian authorities advocate finding radical solutions to this phenomenon of spontaneous urbanization, but the rhetoric and practices lead to the recognition of the "fait accompli" through the regularization of illegal cities (Meskalji, 1994). Thus, recognition is understood as the overall strategy for the urban integration of these illegal neighbourhoods into the city.

In this context, Essadikia quarter was by squatting a public property; the municipality faces a problem in managing these informal practices and operate the land tenure regularization.

7.1. Stakeholder process and strategy

A long process involving several stakeholders, explained in the (Figure 3), has been set up to implement the recognition strategy led by the local authorities and put an end to the problem of this popular but unregulated neighbourhood. First, the neighbourhood needs to be recognized and defined. The inhabitants of this district also lobbied to improve their living conditions.

In response to the first demands of the inhabitants and their growing mobilization; and ;according to the deliberation document of the Laghouat municipality, dated 31 October 1969,the President, described the situation of this district of Essadikia (Ksar Ferroudj) as an entity without equipment, a drinking water ,sanitation system, electricity, and its alleyways are also without equipment, making the life of its inhabitants very difficult.

The municipality cannot publicly consider improvements until the proper status of legal situation of housing on these public property lands is resolved. The relationship between the property status and any future land use should be set.

For this reason, a request has been made by Laghouat Municipality to the Regional Domain Directorate (ownership of the public property land) to transfer the land concerned to the inhabitants with a price corresponding to the financial situation of the inhabitants.

In reply to the request by the local municipality, the transfer was authorized by the Domain Directorate; for the benefit of the municipality of Laghouat; for land parcels where houses have already been built. This transfer was granted for the price of 150.200,00 Da. (30000.00USD)

The transfer of land to the municipality of Laghouat allowed a second step of the land regularization process. The members of the local community accepted the returning the acquired plots of land to their occupants.

7.2. The specifications of land tenure regularisation

The schedule of conditions for the transfer of ownership was already drawn up; and approved by the Province/department of Oasis.

The administrative deed of sale was carried out as part of a plan to manage properly this procedure between the inhabitants and the municipality in order to avoid conflicts, among the elements of this plan many specifications are set, we can mention as an example:

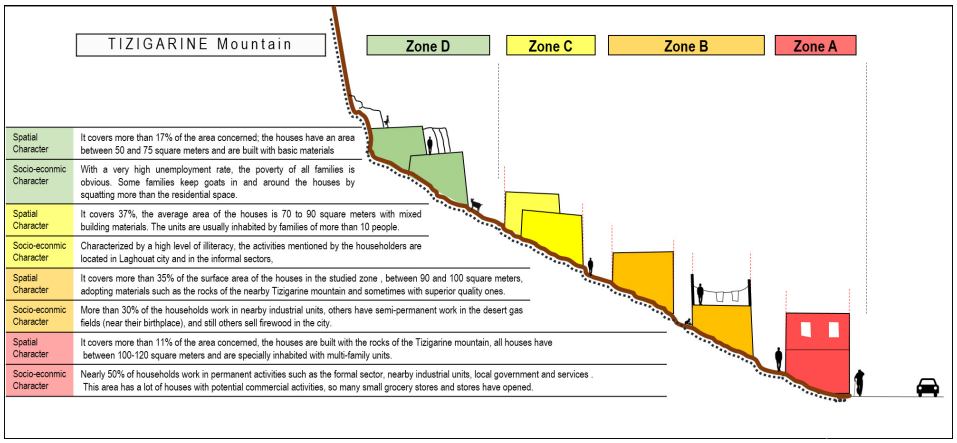

Figure 5. *Spatial and socio-economic character of zones.*

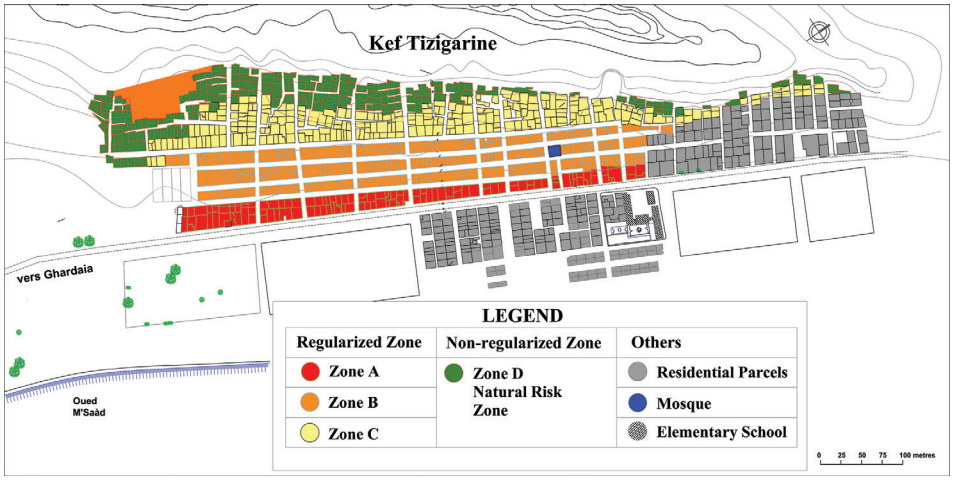

Figure 6. *Regularization zones.*

The buyer must be familiar with the property being acquired. If the surface area of the sold plot does not correspond to that indicated in the deed of sale, the difference will not lead to the resolution of the sale but only to an increase or decrease in the amount of the sale price.

During one month, the parties will have the right to have the land measured at the exclusive expense of the purchaser. They must accept any passive, apparent, hidden, continuous or de facto servitude that may be affected by the sale of the land, except to defend themselves and to take advantage of any active servitude, at their own risk and peril, without recourse to the municipality. we find the presentation of the spatial characters and the socio-economic by our survey.

The purchaser will not be able to change or modify, rent, or exchange the land or construction built for a period of 50 years except in cases of compelling circumstances and after the express agreement of the local authorities' administration.

7.3. The division of the quarter into zones

Division of the district into zones: A commission comprising several departments was appointed to survey, identify and draw up a general construction plan for the occupied areas, roads and a division into four zones (Figure 6).

The logic adopted for the zoning is the result of a topographical reading of the site, which is characterized by a significant gradient of zones:

Zone A: this first zone concerns the overall façade of the district, which is generally flat and does not present any topographical disadvantages. In addition, this zone is located along the main road in the district and in the city, as it connects with the National Road 1

Zone B: This zone is the lower-middle zone with a large number of houses; it has a slight slope with more than 200 houses. (Figure 6)

Zone C: It is the upper middle zone,

Table 1. *Lots retrocession and prices.*

Zone/ Price	First Land Transfer Price M²	Land Transfer Price After Revision M²	Concerned Dwelling Number	Area M²	Land Transfer Price DA	Land Transfer Price USD (1981 Rate)
Zone A	30.00	80.00	77	16200	129600,00	29808,00
Zone B	20.00	60.00	257	35000	210000,00	48300,00
Zone C	15.00	30.00	270	28200	84600,00	19458,00
Total	65.00	170.00	604	79400	424200,00	97566,00
Zone D	Non- evaluated (risk zone)		(120)	15000	/	

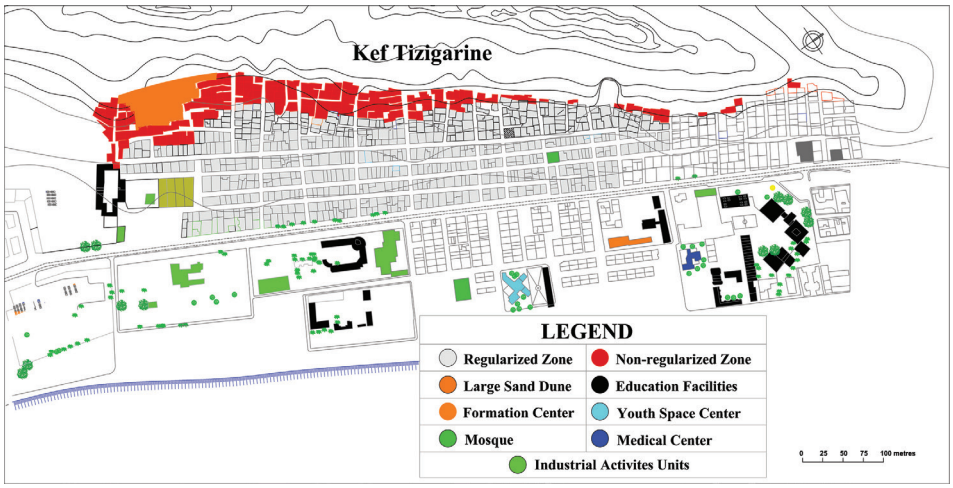

Figure 7. *Urban improvement in Essadikia Quarter.*

characterized by over 200 houses and a high slope, which makes several houses difficult to access.

Zone D: This is the upper zone of the quarter, situated on the edge and along the slopes of the surrounding mountain (Kef Tizigarine). A very steep slope presents a serious risk for landslip and the danger of a very large dune.

7.4. The land transfer price

The committee proposed a zoning of the quarter; and also the transfer prices per zone.After the relevant services (water, electricity, public works, etc.) have estimated the road work to be performed. Due to the state of the economy, as well as through the recommendations of the commission, prices were revised and each zone's price differs from the others, depending on its specific characteristics and geographical constraints.

Except for zone D;The local authority decided to demolish all houses after their occupants will be transferred because of their instability and the danger they present.

This decision could not be realized for several reasons, particularly the rejection by the residents of this dangerous zone.

Table 1 shows the figures obtained after the start of the retrocession regularization procedure and the sale of the Essadikia lots.

8. Urban development in the quarter

Prior to these procedures intended by the municipality, the neighbourhood had only a mosque and a Koranic madrasah (school) built and financed entirely by the inhabitants of the neighbourhood, as well as a school. The district had a population of more than 8,500 in 1985 and lacked many facilities.

The process of land retrocession took a few years due to the poverty of most of the quarter's inhabitants and the length of administrative procedures. The amount of the retrocession recovered by the communal receiver (person or entity financially responsible) was allocated to the equipment and investment section of the com-

mune's municipality budget in accordance with the provisions of the communal law code. In particular, it financed the construction of public facilities serving the Essadikia quarter.

Between 1983 and 2000, this neighbourhood underwent a significant urban improvement. The district was chosen for the location of several annexes and industrial units, which were direct sources of employment for the inhabitants. At the urban level, several basic and support facilities, including schools (three primary schools, two elementary schools and a high school), health care (district polyclinic), administrative (town hall, insurance funds, women's training centre, youth centres, etc.), and religious facilities, including two mosques, were built (Figure 7).

The improvement of the road infrastructure affected the main street of the Essadikia quarter, which then contained commercial premises managed by the inhabitants, as well as the urban transport network lines connecting it to other areas of Laghouat city.

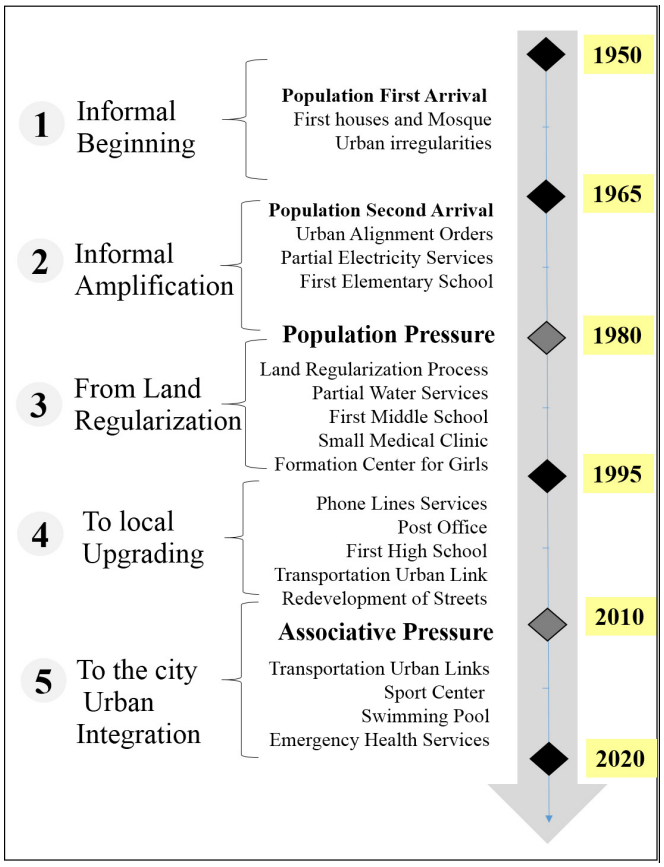

***Figure 8**. Urban recognition process.*

9. Urban recognition process finding and evaluation

The process shows the different strategies followed by both residents and local authorities to increase or stop this phenomenon, which can be identified in five important periods as shown in Figure 8.

9.1. Informal start: 1950-1965

Migration to Laghouat city and the lack of residential options led to the rise of rapid and unplanned expansion. Inhabitants built houses by day or night without any consideration of urban planning or hygiene, thus creating urban irregularities.

9.2. Informal expansion: 1965-1980

This second period is characterized by the second major influx of new residents, mostly nomads from the Laghouat region. They built hundreds of houses in a short period using simple materials. In response to this rapid growth, the first step taken by the local authorities was to control these houses and their inhabitants. As a result, numerous ordinances were issued to align certain plots of land and ensure urban regularity; this period was completed by the partial provision of the electricity services.

9.3. Land regularization: 1980-1995

The third period could be considered the most significant. After the urban regularizations, the demographic pressure increased, and the local authorities started the operational process of land regularization of almost the whole neighbourhood. After the presentation of economic and financial studies on the process, which took into account the topography of the neighbourhood and the financial situation of the residents, the officials finally promulgated their Land Rights Law.

9.4. Urban upgrading of the quarter: 1995-2010

After land regularization, the local authorities started urban upgrading. streets and roads paved and aligned,also several important facilities were built. In addition, many services were activated, such as public transport options and telephone lines.

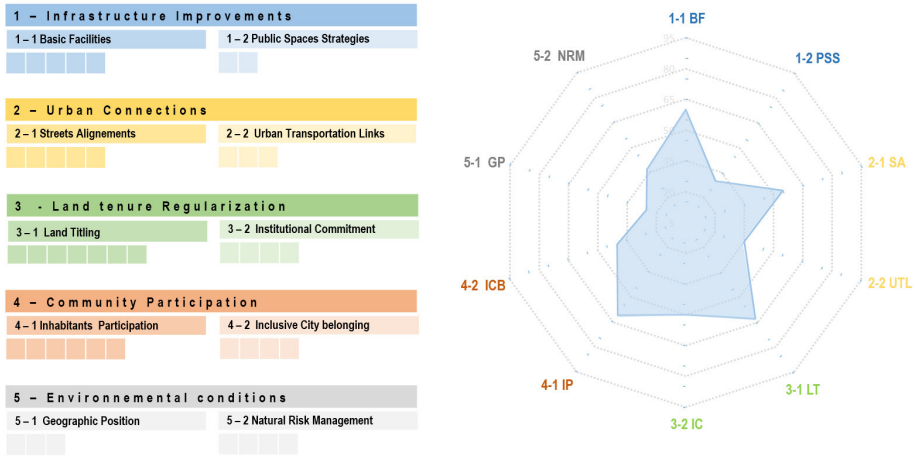

Figure 9. *Process evaluation profile.*

9.5. Urban Integration Project: 2010 to present

In this last period, the quarter is considered important for the whole city. As a result, numerous transport lines have been developed to connect it to other urban areas, and several meetings with local authorities organized, to gain new project facilities including a swimming pool and a sports centre, have been pressing for greater social and urban integration.

10. Process findings and evaluation

In this case, the (Re) Development based urban transformation is clearly adopted in this quarter, and, In order to assess the process.

we identified through different experiences, a strategy to get the evaluation through selecting and adjusting a set of indicators in five groups, such as infrastructure improvements, urban connections, land tenure regularization, community participation and environmental conditions.

The different interviews, observation in site and the questionnaire distributed led us to collect data information from residents, and analyse it by the evaluation profile (Figure 9). it presents for some indicators such as “basic facilities”, ”street alignments”, “land titling” and “inhabitants participations” results with middle performance.

Some indicators In the other side, such as “public space strategies”, ”urban transportation links”, ”inclusive city belonging” and “geographic situation” are even under the average of performance, these indicators affecting the process evaluation performance.

Despite the different basic facilities constructed, land tenure regularisation; Obstacles detected such as the long procedure of registration, the geographical position of the mountain situation make the physical upgrading difficult, and make also belonging to the city a big challenge to the local authorities and residents.

For the first group of indicators, more redirection is needed to better performance, and for the second a deep reorientation must be operated for better results and successful complete recognition process.

11. Conclusion

This article investigates one of the topics widely debated by researchers on the fate of informal settlements, urban legitimacy and the right to the city (Lefebvre, 1968), by showing the experience of informal settlements.

A reality that characterizes the cities of the Maghreb (Semmoud, 1995), it highlights an unplanned district of the city of Laghouat, as well as the process of urban recognition through the strategies followed by the various actors in this city.

Several difficulties that hindered the start of this process, such as the attempts to stop the escalation of informal settlements on the mountain of Tizigarine; satisfy the demands for facilities ,and, drinking water supply absent for a long time in this informal quarter, important changes were finally implemented as part of the land tenure regularization and upgrading whole process.

Findings show that the gradual integration of this type of informal settlement

is not too problematic (Hassan Farouk, 2012), and although difficult, it does not appear to be an impossible task. For decision-makers, land tenure regularization, the restructuring and upgrading of neighbourhoods (roads, networks, social and cultural facilities), and the participatory approach of the inhabitants have created a way of thinking, so that the solution can be sufficient and partially successful.

This strategy adopted by stakeholders has thus made this quarter, after all, an almost integrated part of the formal city, which is now included in the city's urban plans and official planning documents. The importance of this dense quarter is growing and is gaining an uneven reputation, especially for its political culture. It presents itself as an example of collective resistance to prove a kind of urban legitimacy in the city through land security, spatial restructuring and overall urban integration.

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References

Amiri, B.A., Lukumwena, N. (2018). An overview of informal settlement upgrading strategies in Kabul city and the need for an in-tegrated multi-sector upgrading model. *Current Urban Studies, 6* (3), 348-365. https://doi.org/10.4236/cus.2018.63019

Araba, M., & Mazouz, S. (2018). Apports de la syntaxe spatiale à la vérification de l'intégration d'un quartier d'habitat spontané dans le système urbain : Cas de Maïtar à Bou-Saâda. *Bulletin de la Société Royale des Sciences de Liège, 87*,121-135. DOI: 10.25518/0037-9565.8234

Araba, M. (2012). *Les quartiers périphériques spontanés entre les opérations d'intégration et les forces d'exclusion Cas d'étude : Quartier de "Maïtar" à Bou-Saada.* Magister Dissertation Thesis, university of Biskra, Biskra.

Bayram, U. (2015). Upgrading of illegal settlements in Turkey; The case of north Ankara entrance urban regeneration project. *Habitat International, 49* ,157-164. https://doi.org/10.1016/j.habitatint.2015.05.026

Bayram, U., Çete, M. & Palancıoglu, M. (2010). Legalizing and upgrading illegal settlements in Turkey. *Habitat International, 34* (2),204–209. https://doi.org/10.1016/j.habitatint.2009.09.004

Belguidoum, S. (2002). Urbanisation et urbanité au Sahara. *Méditerranée, 3-4*.53-64.

Belmallem - Chouguiat , S. (2011). *Marginalité socio – spatiale, violence et sentiment d'insécurité dans les quartiers périphériques de Constantine : Cas de Boudraa Salah et d'El Gammas,* Doctoral Dissertation Thesis , University of Constantine.Constantine.

Benalia, F. (2015). *La fabrique d'un quartier informel : de la marginalisation à l'intégration urbaine, Cherarba, une véritable polarité économique, puisant facteur d'intégration.* Doctoral Dissertation Thesis, university of François RABELAIS of Tours.Tours.

Benarfa, K., Boudjemaa, K. & Alkama, D. (2018). Rôle de la règlementation urbaine dans la préservation de l'oasis de Laghouat. *Courrier du savoir, 26*.175-186.

Benslimane, N., Biara, R. (2019). Collective ingeniosity in the construction of the popular home: The challenge of the know-how in Sahara. *ITU A|Z, 16*(1),67-81.

Clerc, V. (2014). Informal settlements in the Syrian conflict: urban planning as a weapon. *Built Environment, 40* (1) , 34-51.

Clerc, V. (2013). Les quartiers informels à l'épreuve de la crise en Syrie : Une inflexion inachevée des politiques d'habitat et d'urbanisme, Quartiers informels d'un monde arabe en transition ,Réflexions et perspectives pour l'action urbaine. Agence française de développement. LAATS,Paris.

Deboulet, A. (1994). *Vers un urbanisme d'émanation populaire : Compétences et réalisations des citadins : L'exemple du Caire.* Unpublished Doctoral Dissertation Theiss , l'université de Paris-Nord.

Diafat, A. (2019). *Quelles stratégies urbaines pour l'Algérie ?*. Doctoral Dissertation Thesis,University of Setif. Setif.

Durand-Lasserve, A., Clerc, V. (1996). Regularization and integra¬tion of irregular settlements: lessons from experience . UNDP, UN-Habi-tat, World Bank, Urban Management Program (UMP), Working Paper n°6, 113p, Urban Management and Land.

El Kadi, G. (1987). L'urbanisation spontanée au Caire. Tours ; Paris : URBAMA , O.R.S.T.O.M.

El Menshawya, A., Alya, S., Salmana, A.M. (2011). Sustainable upgrading of informal settlements in the developing world, case study: EzzbetAbd El Meniem Riyadh Alexandria, Egypt. *Procedia ingineering, 11*,168-177. https://doi.org/10.1016/j.proeng.2011.11.2001

El-Shorbagy, A. M., El-Shafie, M. (2014). An assessment study of unplanned settlements case study: al-ruwais district, jeddah, saudi. *European Scientific Journal ,10* (32), 266-277.7.

Essahel, H. (2011). *Politiques de réhabilitation des quartiers non réglementaires au Maroc et mobilisation(s) des habitants. Etudes de cas dans l'agglomération de Rabat (Rabat, Témara, Skhirat).* Doctoral Dissertation Thesis, university of François RABELAIS of Tours, Tours.

Farouk Hassan, G. (2012). Regeneration as an approach for the development of informal settlements in Cairo metropolitan. *Alexandria Engineering Journal, 51* (3), 229-239. https://doi.org/10.1016/j.aej.2012.02.003

Hafiane, A. (1989). *Les Défis à l'urbanisme : L'exemple de l'habitat illégal à Constantine,* Alger : OPU. 290.

Hafsi, F.Z., Chabi, N. (2019). Land tenure regularisation for sustainable land use in informal urban settlements: Case study of Lalaouia and Mesguiche, Souk Ahras, Algeria.*Town and Regional Planning*, 75,17-30. http://dx.doi.org/10.18820/2415-0495/trp75i1.4

Hamidi, A. (2011). L'évolution d'un quartier périphérique en centre d'animation : Debdaba (Bechar) . Insaniyat , *51- 52*, 185-196.

Hasgül, E. (2016). Incremental housing: A participation process solution for informal housing. *ITU A|Z*,13(1) ,15-27.

Hegazy, I.R. (2016). Informal settlement upgrading policies in Egypt: Towards improvement in the upgrading process. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability, 9*(3), 254-275. DOI: 10.1080/17549175.2015.1009845).

Hull, S., Babalola, K. & Whittal, J. (2019). Theories of Land Reform and Their Impact on Land Reform Success in Southern Africa. *Land , 8* (11), 172 doi:10.3390/land8110172

Gülersoy, N.Z., Gürler, E. (2011). Conceptual Challenges on urban transformation. *ITU A|Z, 08*(1),10-24.

Kadri, S., Kacemi, M. & Biara,R. (2019). The boundaries of streets across time, in Saharan space. *ITU A|Z,* 16(02),19-23.

Kafa, M. (2013). *L'habitat informel en Syrie le cas de Damas.* Doctoral Dissertation Thesis , university of Lorraine. Lorraine.

Khalifa, M.A. (2015). Evolution of Informal Settlements upgrading strategies in Egypt: From negligence to participatory development. *Ain Shams Engineering Journal, 6*(04), 1151-1159. https://doi.org/10.1016/j.asej.2015.04.008

Kyessi, A.G., Alphonce, Y. (2010).Enhancing security of land tenure in informal settlements the case of wat-human trust in hannanasif settlement, Dar es-Salam,Tanzania. *UATFITI ,8* (1),87-104

Layachi, A. (2016). The archetypes of landscape and sustainable design in the ksar of Kenadsa, *ITU A|Z, 13*(03) ,79-91.

Lefebvre, H. (1968). *Le Droit à la ville.* Paris : Anthropos,164p.

Maachou, H.M., Belouadi, L. & Trache, S.M. (2018). Difficultés d'intégration d'un quartier spontané dans une ville saharienne : Le cas de BniOusk¬out à Adrar. *Les Cahiers d'EMAM, 30*. https://doi.org/10.4000/emam.1460

Marutlulle, N.K. (2017). Causes of informal settlements in Ekurhuleni Metropolitan Municipality: An exploration. *Africa's Public Service Delivery and Performance Review 5*(1), a131. https://doi.org/10.4102/apsdpr.v5i1.131

Meskaldji, G. (1994). L'habitat spontané en Algérie : cas de Constantine. *Travaux de l'Institut Géographique de Reims, 85-86.* 83-91. https://doi.org/10.3406/tigr.1994.1306

Naceur, F., Belmessous, F. (2018). Informal settlement dwellers in Algeria: How local initiatives and practices contribute to improving their living con-

ditions . *"Wise cities" in the Mediterranean*, Paris, Sciences Po, France.

Naceur, F. (2013). Impact of urban upgrading on perceptions of safety in informal settlements : Case study of Bouakal,Batna. *Frontiers of Architectural Research , 2* (4), 400-408. https://doi.org/10.1016/j.foar.2013.06.004

Nassa D.M., Elsayed H.G. (2017). From informal settlements to sustainable communities. *Alexandria Engineering Journal, 57* (4), 2367-2376. https://doi.org/10.1016/j.aej.2017.09.004

Nazire, H., Kita, M., Okyere, S. A., & Matsubara, S. (2016). Effects of informal settlement upgrading in Kabul city, Afghanistan: A Case study of Afshar area. *Current Urban Studies, 4* (4) , 476-494. http://dx.doi.org/10.4236/cus.2016.44031

Okyere, S. A., Aramburu, K., Kita, M., & Nazire, H. (2016). COFOPRI's land regularisation program in Saul Cantoral informal settlement: process, results and the way forward. *Current Urban Studies, 4(*1) , 53-68.

Othmani Marabout Bouchareb, Z. (2019). *Introduction de nouveaux modes de composition urbaine.le renouvellement urbain à Laghouat,* Maison d'édition européenne.

Petropoulou, C. (2007). Quartiers d'origine spontanée. *Revue d'Aménagement PRAXIS*, 1.

Pettit, O. (1976). *Laghouat, essai d'histoire sociale,* Paris : collège de France.

Rezzoug, A. (2013). L*aghouat : De l'oasis à la fabrication durable de la métropole.* Unpublished Doctoral Dissertation Thesis, University of Paris 10, Paris.

Safey eldeen, H. (2014). Informal areas : Shortcomings and new perspectives in post-graduate programmes. *Égypte/Monde arabe, 3*(11),283-315. https://doi.org/10.4000/ema.3353

Saharan, T. (2018). *Slum and the City: Exploring relations of informal settlements comparatively in Chennai, India and Durban, South Africa,* Docotral Dissertation Thesis, University of Amesterdam.Amsterdam.

Selatnia, K., Farhi, A. (2017). Une typologie pour les quartiers informels a biskra.*Courrier du Savoir ,22*,35-40.

Semmoud , N. (2015). G*ouverner les urbanisations informelles ou la " gouvernance " en question. Cas des villes maghrébines. Acteurs et pouvoirs dans les villes du Maghreb et du Moyen-Orient*, Paris : KARTHALA.

Semmoud, N. (2014). Marginalisation et informalité : D'une domination à une autre. Cherarba au Sud-Est de la périphérie d'Alger. *Annales de géographie, 699*(5), 1146-1167. doi:10.3917/ag.699.1146.

Serrab – Moussannef, C. (2006). *Résorption de l'habitat précaire dans l'agglomération de Annaba (Algérie). Intégration ou épreuve de l'exclusion ?*. Doctoral Dissertation Thesis, university of Constantine. Constantine.

Sofrani, K., Chabou Othmani, M., & Dubois-Maury, J. (2019). La maîtrise d'urbanisation autour du champ gazier de Hassi R'mel: Algérie, entre réalité et action publique. C*inq Continents, 9*(19), 46-72.

Stanslaus, M. M., Peter, E. M., & Ramadhan, A. M. (2017). The challenges of development control of informal settlements Inarusha city: A case of ngaranaro ward. *international journal of innovation and scientific research, 32* (1),166-172.

Syagga, P. (2011). Land tenure in slum upgrading projects. *Les cahiers d'Afrique de l'Est,*103-113.

UN Habitat. (2020). Informal settlement in the Arab region: "Towards Arab Cities without informal settlements" analysis and prospects. Housing and Building Research Centre, Cairo, Egypt.

UN Habitat. (2015). Informal settlements, Habitat III Issue papers, https://unhabitat.org/habitat-iii-issue-papers-22-informal-settlements papers,New York.

UN Habitat. (2003). The challenge of slums: A New Global Report. United Nations Human Settlements Program, New York.

United Nations. (2016). Slum upgrading in the Arab region, Beirut.

Wazzan, K. (2012). *La production de la périphérie Nord de Lattaquié (Syrie) stratégies d'acteurs et formes produites : Mécanismes généraux et application au cas des quartiers non réglementaires de DAATOUR et de BISNADA*. Doctoral Dissertation Thesis, university of François RABELAIS of Tours. Tours.

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Traditional concepts of Dayaks in the longhouse of Nek Bindang Village of West Kalimantan

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Abstract

The architecture of a longhouse was/is built to protect the occupants from the environmental threats. This paper examines the traditional concept of Dayak in the longhouse of Nek Bindang Village in West Kalimantan. A Longhouse was built to facilitating activities for interaction between them or with people outside the longhouse. As the answer to the needs of the natural environment, a longhouse was/is established by an appropriate structure with the composition that is appropriate to the physical and spiritual activities inside/outside the longhouse. This study conducted in a qualitative method with an observation of the research object. The construction of the longhouse was in line with the availability of materials, the locals' capability on a method of the establishment at the time, the security factors, and the understanding of the structural system to supports the load. Indigenous thought and traditional concepts of thinking become the main factors in running customary law in the community of Dayak. The belief of nature as the basic norms to control the Dayak in Nek Bindang village to be sustained with the surrounding environment. The presence of a community leader as the key person in all aspects of activities formalizes in the design and composition of the longhouse. People of Dayak in Nek Bidang Village attached the design, the architecture, and the meaning of the longhouse as the thought of the community. The design and composition of longhouse expressed the traditional concept of the Dayak community on balance and harmony to nature.

Keywords
Construction, Dayaks, Environment, Longhouse, Traditional concept.

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1. Introduction

Kalimantan is a place of settlement for Dayaks and other ethnic communities to live together in harmony. Amidst different ethnicities in Kalimantan, the Dayak societies have evolved their cultures and traditions to use natural resources. Kalimantan is famous for its numerous biodiversity inside the tropical forest (Rahu et al., 2013). The Dayak ethnic group is one of the major communities which occupies and is spreading throughout the island of Borneo (Victoria et al., 2017). The Dayak ethnic group is divided into sub-ethnic groups of small communities and lives in some scattered areas in the hinterland of Kalimantan (Budiman et al., 2019; Lontaan, 1975). As a main community in Borneo, Dayaks have an indigenous house, a place to live together within the society (Beynon, 2013). The indigenous house is a microcosm of the society or culture and its shape is a representation of social beliefs and organisation (Bickle, 2013: 73). Wuysang et al. (2017) noted that longhouses in West Kalimantan still exist and have spread out all over the province, but have decreased in number. Furthermore, Wuysang et al. (2017) emphasized that Dayak architecture is fading away since it is no longer used by modern communities. Some of the Dayaks prefer to settle rather near to the road or industries as the timber and mine industries have developed in the hinterland of Kalimantan. They were convinced to hand over their hereditary lands to be developed as palm oil plantations. New, nuclear families who previously lived with their closest relatives in longhouses began to erect their own private homes. These houses were often built at some distance from each other along the lanes of small roads. On the other condition, any surviving longhouses were adjusted down and reorganized to a new physical structure with a smaller layout of whole villages (Collins & Herpanus, 2018). The traditional longhouse, in view of its architectural concept, materials, and function, shows the strong relationship between people, the environment, and the concept of sustainability. Traditional longhouses promote the use of materials with the awareness of environmentally friendly practices, as the construction was in line to a natural condition, and its concept lends itself to energy conservation (Victoria et al., 2015).

One of the locations of traditional longhouses that is/was occupied by the Dayak Desa sub-ethnic is in Nek Bindang Village of Sanggau Regency, West Kalimantan, and known as "*Rumah Batang Panjang*" (Beynon, 2013). Another name is also used to describe this longhouse, which is called as "*Domong Sembilan Raja Sepuloh*". This name was chosen to express gratitude to the previous leader of the community (Domong), who made many contributions to the community of the Dayak Desa sub-ethnic.

Longhouses were/are built to meet the physical and spiritual needs of the community of Dayaks (Wardani et al., 2018: 265). The architecture of a longhouse was/is built to protect the occupants from the environmental threats. The architecture was built by the communities as a dignified local cultural concept in the natural environment (Bickle, 2013: 70). Longhouses were built for facilitating activities for interaction between them or with people outside the longhouse (Wardani et al., 2018: 266; Jawan, 1996: 123). The construction of longhouses contributed to the requirement of comfort for the inhabitants by the use of local materials. The setting of the layout and space organization create harmonization with the local environment and climate conditions (Mahayuddin et al., 2017).

A longhouse was/is established by an appropriate structure with the composition that is appropriate to the physical and spiritual activities inside the longhouse—the obligation to serve the needs without disruption of the natural environment. Cultural sustainability is not only a discussion in a circumstance of the preservation or reinvigoration of the past, but also about in-depth exploration of the engagement in a continuing discussion of the dynamic nature of its locality (Beynon, 2013). This paper has examined the structural composition of the traditional longhouse in Nek Bindang Village in the Regency of Sanggau, West Kalimantan. This paper elaborates in-depth the relation of structure to the dignified local cultural concept and the natural environment.

2. The architecture of the longhouse in Nek Bindang Village

The longhouse in Nek Bindang Village has been occupied by the Dayak Desa ethnic group since the year 1900. In the past, the Dayak Desa community occupied a longhouse in Sebandang Village (around 5 km from the existing longhouse). People in Nek Bindang Village called the longhouse "Batang Panjang". While most recognizable for its length, the composition of a longhouse is most advantageously understood in a cross-sectional view. In terms of residency, the longhouse can be considered as a sequence of connected compartments (Bilik), each of which is owned and occupied by a single-family (Beynon, 2013). The longhouse in Nek Bindang Village is/was surrounded by 102 single houses (Dangau). The longhouse in Nek Bindang Village consists of nine Biliks, with only four families living together under the roof. People of Nek Bindang Village used the longhouse as their main place for the community to gather on a special occasion or meeting (Jawan, 1996). The bilik oriented onto a covered open-elevated-space that was spatially continuous with its neighbours. Its appearance seems like an extending space from one end of the Rumah Batang to the other side. A single-family owns an open-elevated-space in front of each bilik for daily activities. However, in a customary event, it is prescribed as communal space—the open gallery as space to hold gatherings, rituals, and festivities. The longhouse in Nek Bindang did not have

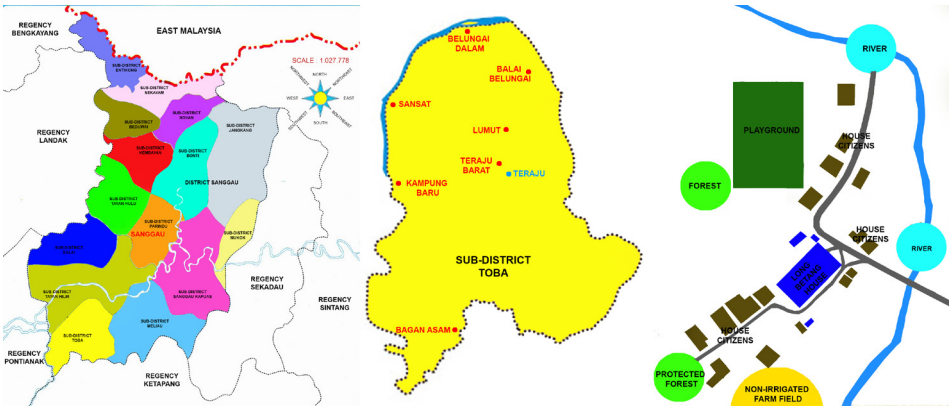

Figure 1. *Series information of the research object location of Dayak Desa longhouse (Source: a and b downloaded on the open access materials).*

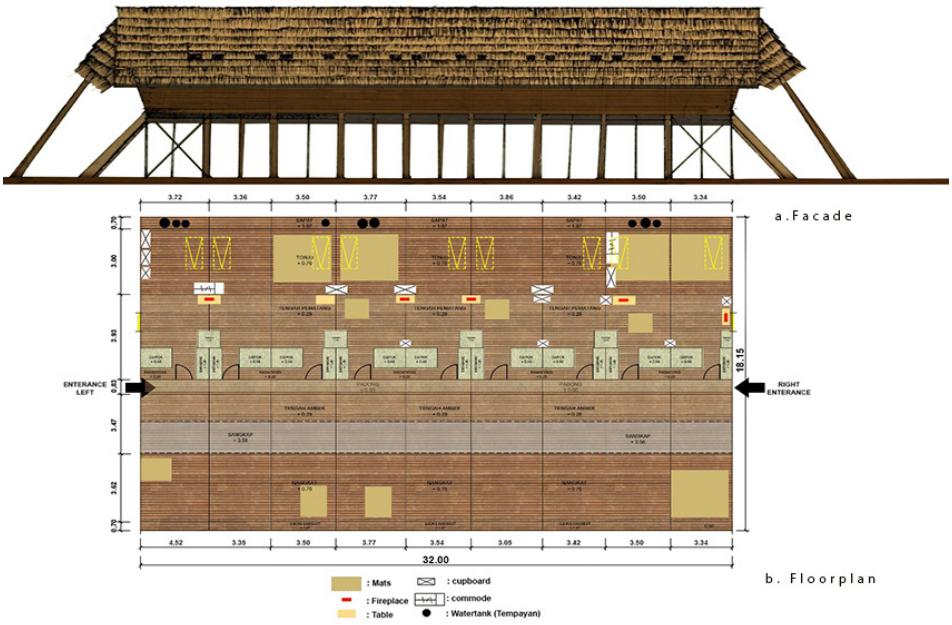

Figure 2. *Sketchs of the longhouse in Nek Bindang Village (Source: Document of the Department of Architecture of the Tanjungpura University, 2018).*

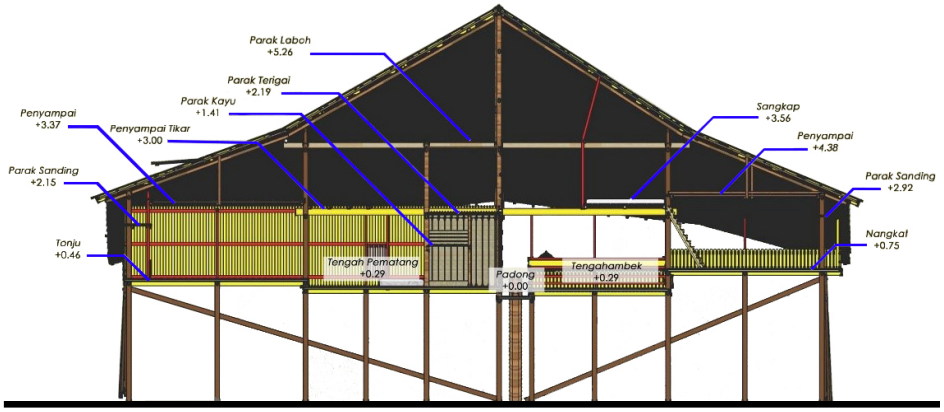

Figure 3. *A cross-sectional view of Rumah Batang Panjang in Nek Bindang Village, West Kalimantan (Source: Document of the Department of Architecture of the Tanjungpura University, 2018).*

an open platform on the other side of the gallery. Not as found in the layout of another longhouse in Kalimantan, which has an uncovered gallery called Tanju, in Nek Bindang village the longhouse is without an uncovered gallery and there is a yard outside of the longhouse. The yard serves to organize outdoor tasks, and a place to dry paddy or other natural food (Beynon, 2013).

The longhouse in Nek Bindang consists of two main sections: the public section and the private section (see Figure 2 a and b). In the private section, the observer will find some rooms called *Dapok, Tengah pematang, Tonju*, and *Sapat.* In the public section, the rooms found are called *Padong, Tengah ambek, Sangkap* and *Sangkat*.

3. Methodology

This paper is based on the methodology of basic research. This research used a qualitative method with an observation on the object. A Dayak Desa longhouse in Nek Bindang village is/was identified and examined based on the related theories. The technical drawing is a tool to explore the structural elements of the traditional Dayak longhouse in Nek Bindang village, West Kalimantan, and then followed by an investigation on the construction methods, material treatments, natural environment, cultural concepts, and local thought. All the graphical documents such as images, drawings, and plans were organized and compared to identify the similarity and common features. The analysis of the parameters was conducted during site visits at the selected longhouse. Observations of the parameters, interviews with occupants, and measurements of building dimensions were recorded in the catalogue cards of the respective longhouses. The influences of the thought concepts, the beliefs, and the community culture are the main focus to elaborate a process of thinking in the composition of structural elements of the longhouse. By simulating the thinking process of the locals, we find the relationship of structures to the development of a dignified local culture concept and to the natural environment and the composition of structural elements of the traditional Dayak longhouses in Nek Bindang West Kalimantan. The logic of this research is described in Figure 4.

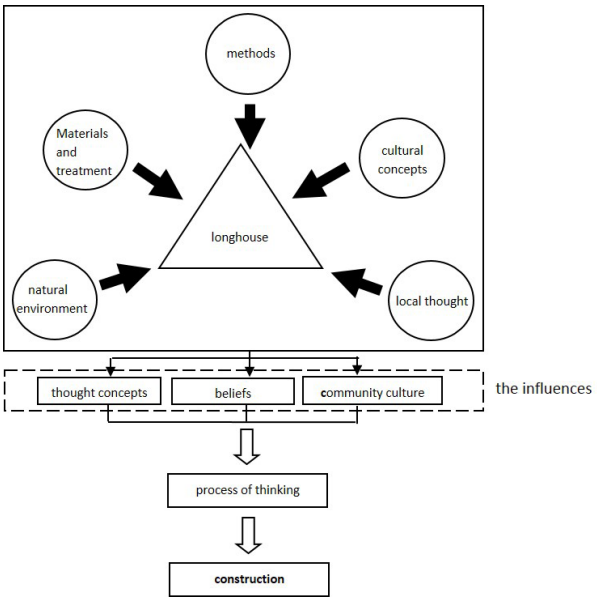

Figure 4. *The logic of research of the longhouse in Nek Bindang Village (Source: Author, 2019).*

4. Discussion

The current state of the structure, construction, and material characteristics of traditional buildings is important to investigate as inquiries to understand some elements that comprise structures. By the investigation of the building in its present state on the elements, i.e., the structure, techniques used during construction, the alterations, and their effects, we could also contribute to better construction practices in the future (Mahayuddin et al., 2017). The local thought is referring to the traditional views and knowledge as reference in behavior and has been practiced for generations to meet the needs and is beneficial for Dayak life (Fajarwati & Masruri (2019: 3). In the following, the examination on the Dayak Desa longhouse in Nek Bindang village is divided into five parts: construction methods, material treatment, natural environment, cultural concepts, and local thought.

Construction Methods

The passive structural concept on the longhouse in Nek Bindang Village is found in the composition, the components of materials, and space lay-outing to provide comfort to the interior. The passive structural concept of the longhouse provides comfort to the interior by the use of low-absorption materials, having high roofs and the presence of an attic space. (Victoria et al., 2017). The structure of the longhouse in Nek Bindang Village could be divided into three main parts: bottom part, middle part, and upper part. The bottom part consists of *Tiang* (post), *Tiang Sambut* (sambut post), *Suit* (main beam), *Pembotong* (support beam), and *Tungkang Huar* (bracing beam); the middle part consists of floor, wooden plate, *Mpaut* (cripple stud), *Pompah* (tie beam), and *Tiang* (stud); and the upper part consists of *Kasau Lelaki* (outrigger), *Reng* (batten), *Kasau* (rafter), *Tungkang Huar* (wind brace), *Katiti Tikus* (collar tie), prop, roof sheeting with Sago leaves, and *Tebing Layar* (wooden panels with struts).The *Tebing Layar*, a typical characteristic of the roof, are wooden panels that are commonly found in West Kalimantan timber structures. Wood and sago leaves are common materials used to cover the panels.

Rumah Batang Panjang consists of rows of poles used as foundations and columns. There are 27 units of continuous poles on the X-axis and 11 units of continuous poles in the Y-axis. In Figure 5, the pole is shown in yellow. According to Hartatik (2013), a continuous pole is a single timber log from a tree plant installed from the ground to the top of a longhouse (see in Figure 3). Barrett (2004) stated that the continuous poles are the row of poles of each *bilik* as marking line of the owner (Figure 5).

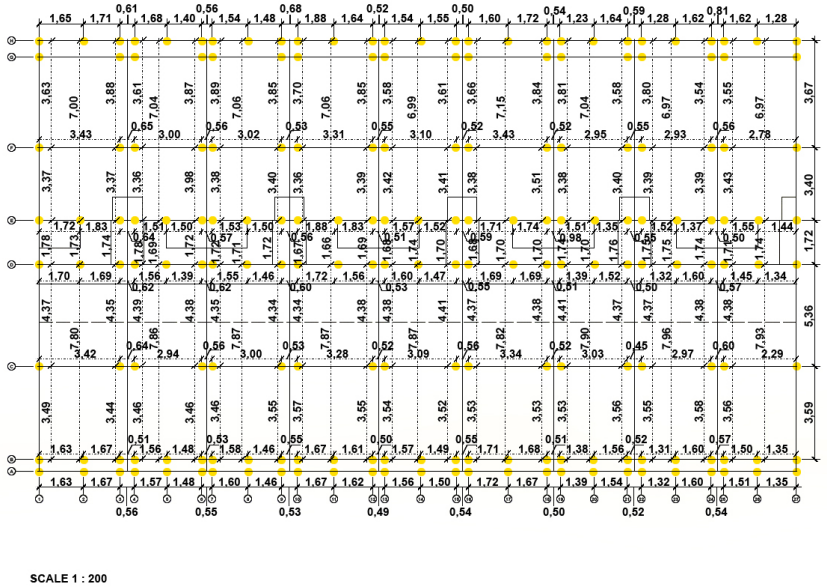

Figure 5. *Poles arrangement in the floorplan of Rumah Batang Panjang in Nek Bindang Village, West Kalimantan (Source: Document of the Department of Architecture of the Tanjungpura University, 2018).*

The longhouse in Nek Bindang Village has some poles – with height up to eight meters from the ground – and it is equivalent to two or three storeys of building in a normal house (Beynon, 2013). This was constructed with the assumption of ease in the first erecting, the security factors to protect against threats from wild animals and attacks of another ethnics, and also to support the load of the occupied houses, which was fully understood. The availability of the natural resource materials in the past and limited knowledge made Dayak communities build the pillars from one intact tree trunk as the foundation of the house (Hartatik, 2013).

According to the Dayak customary chief in Nek Bindang Village, the construction of longhouses follows the form and composition of spaces of the previous building (the previous longhouse was built in 1963 and has collapsed) with adjustments to the needs of the number of family heads living in the planned compartments (Bilik). The shape and space organization of the longhouse in Nek Bindang village is the local wisdom of the Dayak community and there is little similarity with other Dayak sub-tribes in West Kalimantan. The similarity is only in the type of stage construction with the number of compartments, while the space pattern and roof shape are their distinctiveness.

Material treatment

Material treatment is needed as preparation for house construction. Locals in Nek Bindang Village divided the treatment for longhouse materials into two parts: structural materials and non-structural materials. The life of the Dayak is dependent on, grows along with, and is learned from nature (Sada et al., 2019; Sobian et al., 2018). The longhouse was built using environmentally-friendly local materials (Victoria et al., 2017), so that they consumed the products of the forest for their life needs (Fajarwati & Masruri, 2019). Therefore, the Dayak, as part of community behaviours, circumlocutorily helps to maintain the preservation of forest ecosystems (Sari et al., 2019).

As structural material, timbers and *Akar Malam* were collected from the forest in the neighbouring area of the house site (Pebriano, 2013). There are some important rules for the Dayak community to use timber as materials for building construction. According to Roslinda (2016), Belian (*Eusideroxylon Zwageri*) can be used only for the first pole (Tiang Pemun) of the longhouse. For this usage, the community usually use newly cut belian. *Akar Malam* as binding material and timbers should be soaked overnight before being used on the house structure. *Akar Malam* must be dried under sunlight to reach the needed the level of dryness.

Struck wood is considered as the best timber material for the construction of the house. Kumpang tree (*Horsfieldia Polyspherula*) is usually used for the roof structure material with the belief in skin elements to protect the occupants from evil spirits (Roslinda, 2016). Timber materials for the floor structure also have an important treatment in drying under sunlight, so that the cross-sectional (growth ring) faces to the direction of sunlight (Pebriano, 2013). One other material used in the construction of the longhouse is sago leaves (Mahayuddin et al., 2017). The Dayak community may use a dead/lightning strike tree, especially with the species of the Durian tree (*Durio Zibethinus*) for another need of light construction in a longhouse (Roslinda, 2016). As non-structural material, sago leaves are the materials to envelope the top of the roof structure. Bamboo or a small log may be used as the attached material to bond the sago leaves layer by layer as a roof sheet. A roof sheet of sago leaves for the local Dayak people or the common people in West Kalimantan is mentioned as *atap daun*. Sago leaves could be used as a roof sheet without special treatment. Sago leaves were constructed on a small piece of log or cut bamboo. The original sago leaves from the forest must be separated from their stems and will be attached individually to a new stem of a small piece of log or cut bamboo to form a roof sheet.

Natural environment

The materials used in Batang Panjang are the natural resources that are commonly found in the surrounding area of the site (Pebriano, 2013; Mahayuddin et al., 2017). The Dayak

community has used the forest to fulfil the needs of life, both for subsistence and commercial activities. According to Herianto et al. (2018), the Dayaks need timbers from the forest as the construction materials of the longhouse in repairing and building, or basic needs for firewood. Materials of various types of timber are used for structures; sago leaves are used for roofing and gables, and akar malam (rattans) are used for structural bonding. This type of wood is very sturdy and strong for supporting building loads. The materials for structures are obtained from the tree logs of the types of Jengir, Bedaru, and Selamar. According to Herianto et al. (2018), other types of timber trees used are Banitan (*Polyalthia Hypoleuca*), Bunyau (*Santiria sp.*), Damar Pipit (*Pentace Triptera*), Katiau (*Madhuca sp*.), Mahang (*Macaranga Triloba*), Mahawai (*Cyathocalyx Biovulatus*), Medang (*Dehaasia sp.*), Menjalin (*Xanthophyllum sp.*), Meranti (*Shorea Leprosula*), Tehang (*Xerospermum sp.*), Terap (*Artocarpus sp.*), Ubar (*Syzygium sp.*), and Ulin (*E. Zwagerii*). The materials that are used on the joint method for binding are rattans, and these are also abundant in the forest near the settlement. Rattans are grown as a parasite, trailing on large trees like vines, and the common rattan type that is used by Dayaks for house construction is the *akar malam*.

The stage house is used not only as a means to avoid the wild animals but is also intended as an effort not to cover the ground surface (Wardani et al., 2018). The covered ground will preclude water infiltration into the ground, whereas uncovered ground certainly will not prevent the drainage of water into the soil surface. Natural conditions are vulnerable to the tidal river, which makes the traditional Dayak dwelling design created in an equilibrium assignment toward the river and the ground conditions (Bahauddin et al., 2015). The longhouse construction and concepts are to comply with all the principles of sustainability. The sustainability is complied with using less harmful materials, the use of sunlight for energy saving, affordable materials within the environment, a lay-outing concept for good living quality, and the society tends to gain more in the possibility of natural preservation (Victoria et al., 2015). The large openings are created for cross ventilation of wind flow for the occupants' comfort as well as to take advantage of sunlight abundance to illuminate all rooms. Roof style, the shape of the gable roof with a high slope, is an adaptation to the local weather conditions; this roof slope is beneficial for draining the rainwater immediately and at once contains it in the water tanks for daily purposes of water needs. A traditional longhouse does not necessarily need a fan or air conditioner to cool down its room environment. The permeable materials, such as *belian* wood, bamboo, lightweight timber, and sago leaves, allow natural ventilation into the longhouse. The longhouse has few windows but numbers log gaps surrounding the building and the permeability of the material among guarantees for the comfort of air circulation in the longhouse interior (Victoria et al., 2015).

Cultural concept

Customary law is still applied in the daily lives of Dayak people as a guideline, and rules to define norms for all members of the community (Roslinda, 2016). The ethnic group of the Dayak Desa community in Nek Bindang Village has traditional rituals that are carried out before they begin the construction of the longhouse. As related to culture, it is important to conduct a customary event in timber harvesting activities (Roslinda, 2016). A customary event in timber harvesting activities is called as the ritual of *Ngudas*. *Ngudas* is a ritual that is led by a Tumenggung (a traditional community leader), who is responsible for seeking permission from the forest authorities (the spirits) for the establishment of a longhouse and the activities to proceed with the construction (Jawan, 1996: 123; Roslinda, 2016: 181). The same ritual will also be carried out for the opening of a new village, asking for protection and fertility in the agricultural activities (Fajarwati & Masruri, 2019). The Dayaks believe in the natural and supernatural that is a distinc-

tive entity in other dimensions of life. The Dayak people have an awareness of living in harmony with nature by offerings to supernatural beings that have a significant effect on human life (Roslinda, 2016). Offerings must be served for the *Ngudas* ritual of the daily food of Dayaks by preparation of the food, which consists of chicken, rice, brown rice, eggs, water, Tengkawang fruits, betel leaves, traditional wine (arak), and rice. In special cases, the Dayak community also adds other various types of food items which they consume daily. These offerings are presented in containers and then placed on the ground at the location where the longhouse will be built. The method used in this traditional ritual is the reading of spells (*mantra*) as the community leader sprinkles water to the ground. The Tumenggung will collect two items of the prepared offerings, rice and eggs, which are then placed in a prepared hole in the ground before the first pole of the longhouse is erected. Simultaneous recitation of a mantra on the establishment of the first pole marks the continuation of the construction of a longhouse.

Local thought

As similar to the Iban people in Rumah Panjai, Sarawak (Beynon, 2013), Dayak people in Nek Bindang village are still maintaining a balance between egalitarian communalism and individual ownership in Batang Panjang to be relevant in ongoing contemporary society. Dayak people believe that guidelines are hereditary laws from the ancestors of the Dayaks and generally to be understood and executed in the form of oral culture in their communities. In line with the statement of the Zain & Andi (2020: 29) the Dayak people are still running the rules that control the lives of the Dayak people. The Dayak are always obeying the customary laws, traditional customs, and beliefs (*adat Keyakinan*) as guidelines in every activity that takes place within the society. Local thought is still found in some activities of a longhouse's construction. The local thought found in the activities of the longhouse's construction determines the direction of the longhouse, the best time for the land clearing on site, and the search of materials, the first pole establishment, and the method of construction. The Tumenggung will lead the inhabitants to determine the direction of the longhouse by observing the sun's orientation. The front facade of the longhouse will be directed to face the sunrise in the East while the back of the longhouse will be directed to face the sunset in West (Hafiid et al., 2015). The orientation is symbolic of the hard work involved to survive in everyday working hours from sunrise to sunset.

The Dayak also establish a small hut intended as a place to rest during construction and as a room to store materials brought from the forest. All activities of the land clearing and the collecting of construction materials in the forest must be done in the morning after sunrise. Dayak people cut the tree trunks by using a *Beliong* (axe) or a big saw. Dayak people always serve the supernatural beings with offerings and offering prayers as customary law (Wardani et al., 2018: 266). This customary (*adat*) law binds the inhabitants to always obey the natural spirits that live among them (Alcorn & Royo, 2000).

In the construction of longhouse, local thought was found in the system of house establishment. The Dayaks commonly used a method for connecting wooden joints called *Genggam Kora*. Another method used by the Dayaks, the post and beam connection system in the longhouse structure, is known as the method for locals for a beam penetrating the posts in the main structure without nails. The dimensional measurement used to form rooms in the Dayak longhouse is using units of the human body sections. The measurements often used are: *Depa'; Lengan, Badan, Seta; Jengkal, Kepal.* The conversion to international units is shown in Table 1. The width of a bilik's space usually is adjustable to the requirement of every family occupying these biliks. Each room has a different the size, adjusted for the body size of household heads who will occupy the Bilik. Each household head calculated the chamber width according to the number of occupants and his social status in the community. Before building the *biliks*, usually he will determine the width of each *Bilik*.

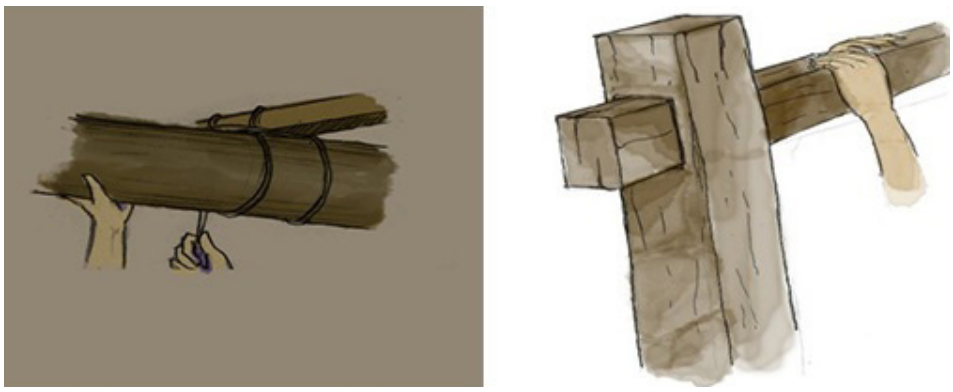

Figure 6. *Traditional methods in Dayak communities for house construction in West Kalimantan (Source: Document of the Department of Architecture of the Tanjungpura University, 2018).*

Table 1. *List of conversion of traditional units in Dayaks to international units (source: Author, 2018).*

No.	Measurement units	
	Traditional Dayak (local names)	International (approximate length)
1.	Se-Kepal	10 – 12 cm
2.	Se-Jengkal (2 kepal)	20 cm
3.	Se-Seta (2 Jengkal)	40 cm
4.	Se-Badan (2 Jengkal)	40 cm
5.	Se-Lengan (3 Jengkal)	60 cm
6.	Se-Depa Genggam (8 Jengkal)	170 cm

The rectangular shape is found in the middle structures of Dayak longhouses in the presence of wall construction. The wall formation of Dayak longhouses is found in the construction of *without gap* (massive wall) or *with gap* (transparent wall). The first type is found as the structure for the *Bilik*, while the second type is found as the structure for Sangkat which is set up by a row of wooden logs and installed horizontally with distance (gap). The rectangular and triangular shapes are used to form the structural elements of house. The triangle shapes are used to form the upper structure, while the rectangular shapes are used to form the middle structures. The shape of the triangle in the upper structure is an attempt to drain the rainfall water as well as to provide rooms in the section under the roof.

5. The influential aspects on the longhouse

Many aspects influenced to the longhouse in its first establishment. Knowledge of construction techniques and the characteristics of the traditional architecture are the attributes found in the longhouse (Mahayuddin et al., 2017). The influences affecting the construction of the longhouse in Nek Bindang Village are classified into three elements: the thought concept, the belief, and community cultures.

The thought concepts

The human form is the basis of the local Dayak concept of thought (Wardani et al., 2018: 265). In traditional units to establish rooms, the human body is a baseline to calculate the spatial units. A circulatory path is required for two persons passing the room together side by side with a distance in between one *kepal* respectively of left - right and center, so then it takes four *jengkal* three *kepal* or five *jengkal* one *kepal*. The size of spatial units is adjusted to the length of the human body while lying down in sleep. The length of the human body is equal to the length of the human hands outstretched (one *depa*') while the width of a human body is in the size of four *jengkal*.

Transparent walls provide an opportunity for the occupants to remain sheltered from the observation those of the outside but still provide sufficient light necessary to illuminate

their activities in the Sangkat. In addition, in the past, a transparent wall served to provide a sense of security from the wild animals or enemies attacking from another tribe, as well (Barret, 2004). In longhouse construction, rooms are formed by paying intention to the activities. The rooms will be covered by massive walls to facilitate the private activities. However, public spaces are placed in a position near to the river and formed by walls with gaps, or transparent walls. On the other hand, a bilik, as a private space, is placed away from the river and formed by massive walls. In addition, public space sections also are formed with no walls or transparent walls, indeed to "get closer to the nature" i.e., the river and the forest (Wardani et al., 2018; Sobian et al., 2018).

The stiffness of the longhouse structure is obtained from the relationship between the joints, which are interlocking (Mahayuddin et al., 2017). Connection between the columns with beams typically uses the system of pins (*pasak*) and the holes with a pin. Stiffness is also obtained from the use of timber poles that act as the foundation as well as its extension as the columns for the structure above it. This condition causes the loss of structure stiffness due to weakening of the connection among joints. On the floor or roof cover is found the use of rattan to bind the material layers to become rigid.

On the wall structure, columns in the longhouse are reinforced by the layers of wall that serve as a partition, but they also make the construction of the wall become more rigid. Layers that strengthen the walls on this structure are found in two types. The first type is the wall layers with tightly fitted wooden boards, while the second type is the wall layers with small wooden logs installed with a certain distance. The wall of wooden boards acts like a skin while a layer of small logs acts like nets; both of them have the same function to bind the structure so that it cannot be shifted. Both types are usually strengthened with the presence of additional columns and top beams as stiffeners. Stiffener beams are installed with penetration through the main column, which will then be the basis for the construction of floors and roofs. While at the bottom, the foundation pillars are also strengthened by the presence of diagonal beams that give a stiffness influence to the structure in order not to experience a shift due to external forces.

The beliefs

The triangular and rectangular shapes dominate the facades of buildings. The dominance of these two shapes in the Dayak longhouses illustrates the stability and balance principles of the Dayak people in their daily lives. The triangular shape placed at the top indicates that the Dayak people are always maintaining the stability of their social life in the spaces underneath the triangular shape, while the imaginary lines forming an angle toward the top of all intended activities is a form of respect to Gods. In Dayak Belief, God (*Jubata*) is the destination for spirits of the dead. However, the Dayak also believe, God (*Jubata*) dwells in things, such as mountains, hills, trees, rivers, riverbanks, caves, big stones, forks in paths, entrances to the village, and even the peak of the roof of the Rumah Panjang (Hartono et al., 2018).

The Dayak people believe in the existence of evil spirits that dwell in nature, e.g. on the mountains, in the forests, the rivers, and on fields (Wardani et al., 2018: 270). As an effort to avoid the influences of bad spirits, the floor of a longhouse is erected by giving elevation from the ground as the distance between *Dunia Bawah* and *Dunia Tengah*, or the distance between bad spirits and humans. So then, by these efforts, *Dunia Bawah* does not disturb the daily life activities of occupants in the longhouse (who live in *Dunia Tengah*). This also means to make differentiation between the bad things of evils or spirits and the good things of humankind. The Dayak people believe that there are other natural forces that also put the human lives and influences in the longhouse community in order (Guerreiro, 2013). By providing distances between *Dunia Bawah* and *Dunia Tengah* and differentiation between the good from humans and bad from the evil spirits, it is a manifestation of Dayak belief to control their

lives in the world. In the cosmological view of Dayak people, the height of the floor elevation from the ground also gives the meaning that humans have a higher status than other living creatures on the earth and other living things are not allowed to exceed the limit of their part of the of living world. According to Hartono et al. (2018), in the original meaning, the second realm (*Rumah Bawah*) means the dwelling place of the deceased human spirits. It is an indifferent spiritual realm, where the deceased dwell temporarily in a journey towards Jubata. The human spirit in the second realm (*Rumah Bawah*) can still stay with the living humans, and even can be requested to come to help the living family members. Furthermore, the Dayak also believe in the possibilities at some point that the spirits may be changed into malevolent creatures or evils toward humans (Hartono et al., 2018).

The community cultures

The concept of adat to the Dayak is manifested in customary laws, each of which is a rule of the norm about the rights and obligations of people in the community (Hadi, 2019). According to Lontaan (1975: 415) the Tumenggung is a leader who has the function as a customary chief, the leader of a village chief (*Dusun*), head of religious or the community leaders. The leader is chosen, determined, and appointed by the descendants of the previous leaders. To be a leader, one has to fulfil the criteria of a notable comprehension of customary rules and the ability to lead the traditional ceremony (Bahauddin, 2014: 8). In an *adat* context, traditional Dayak leaders (Tumenggung) are the primary executors of living arrangements based on prevailing customs (Hadi, 2019). The Tumenggung is a person who is respected, adhered to, or obeyed by the whole society in both communities who live in the longhouses or other houses nearby (Sobian et al., 2018). As the tribal leader, the Tumenggung is also acting as the leader of the tribal ritual, the decision-maker of criminal cases, or acts as a judge of traditional justice (Bahauddin, 2014: 8). The Dayaks believe that the Gods and spirits of their ancestors are controlling the world and the universe. They also believe that leaders who exist today, such as tribal chiefs and customary leaders, are descended from Gods to help people manage their lives on earth (Hadi, 2019).

In line with the obligations of a Tumenggung, the roominess of each bilik is adjusted to the position of the head of family in the longhouse community. According to Alexander in Fox (1993), the present headman's (Tumenggung) apartment is considerably bigger than most others, but does not have the raised roof, extended gallery, or elaborate paintings decorating in the front wall. The present Temenggung was the eldest of the occupants when the longhouse was erected. The Temenggung becomes the centre of the community of the longhouse and the roominess represents communal honourability (Hartatik, 2013). Tumenggung and the customs will control the rights to extradite tribal people to be isolated from the tribe for doing an unjustifiable behaviour (Hadi, 2019). Also assigned to guests when they come inside the longhouse, it is easy to recognize the headman's apartment.

6. The process of thinking of the Dayaks

The stage house is an adaptation and the local wisdom of the Dayaks toward the local environmental conditions. The Dayak community also has myths and beliefs to protect the forest as remaining sustainable. The community considers some trees to be forbidden species of illegal logging. The people believe the trees have a guardian, and a physical condition will impact the person who cuts such trees down, such as sickness or death (Sari et al. 2019). The architectural and cultural understanding of the Dayak in respecting nature's offering has been established as an architectural expression of the longhouse (Bahauddin, 2014: 8).

In the Dayak community, the stage longhouse with the use of pile wood foundations is logically meaningful to deal with threats from outside, such as the wild animals or enemies from another tribes. The longhouses were built with elevation from the ground on stilts for several purposes. These include

keeping the building above water in avoiding flooding conditions, allowing the animals such as pigs, chickens, and livestock to live underneath, to serve as a refuge or fortress in case of attack, and to allow air circulation throughout the house (Bahauddin, 2014:8). A house with many compartments (*Biliks*), is an adaptation of the security conditions in the surrounding longhouse environment. In the past intertribal war in the hinterland of Borneo often happened, so they made the high elevation from ground level and transparent wall in the front as the part of self-defence (Barrett, 2004: 26). Each *Bilik* is usually inhabited by one family (or more) which are related to one another with other dwellers of the biliks. Usually, they are forming in groups because of ties of kinship, relationship in social strata, or in community relations from the same village.

The Dayak longhouse characteristics found are generally with fewer openings. However, the air circulation and the room illumination are obtained from the front of the wall façades, which are formed by the wood logs and installed with distance (Barrett, 2004: 26). The wood logs serve to observe, from the distance, people who come to the longhouse, and the in the past, this wall acted well as the defensive barrier to enemy attacks from outside. Another orientation considered before erecting a longhouse is the rotation of the sun. This analogy is often used to describe human life in the world by life and death: the east as a symbol of life and the west as symbol of the dead. According to Sather in Fox (1993), a basic orientation of the longhouse is in terms of the sun's movement through the sky from east to west. In Dayak langauges, east is called *matahari tumboh*, literally, 'the direction of the growing sun', and west, *matahari padam*, 'the direction of the extinguished sun (Hafiid et al., 2015: 40; Zain & Andi, 2020: 28).

Matahari tumboh is intended as the beginning of Dayak activities outside the longhouse. *Matahari padam* is intended as the end of Dayak activities outside the longhouse. They used to have activity in the fields (ladang) or in the forest after sunrise and get home before sunset. The activities at sunrise meant that the Dayak people were working as their livelihood, while at night they used to rest. In Dayak cognition, humans conducting activities meant that human beings were alive, and taking sleep meant that humans did not do anything. Not doing anything means that humans are "in dead condition" (Hafiid et al., 2015: 41; Zain & Andi, 2020: 28).

In addition, the rotation of the sun from east to west gave the effect to the existing rooms in the longhouse of becoming a "have enough" of the sunlight and a "did not have enough" of the sunlight. The rooms formed to obtain the sunlight were created without walls or transparent walls. These rooms were especially formed for public space or semi-public space. This section is the place where the Dayak people do activities at noon (in conditions: "alive"). On the other hand, the rooms formed as not obtaining the sunlight were created with massive walls. These rooms were especially formed for private space. This section is the place where the Dayak people take rest (in condition: "dead") or engage in private activities. For the Dayak cognition, considering their "in alive conditions", it is necessary to obtain guards from the influence of evil spirits or supernatural beings. For the Dayak, a bright room as an effort to anticipate when there was interference from evil spirits, would be "visible", while a dark room was illustrated as a safe place and did not need preservation because the Dayak people were not active, or they were "in dead condition".

Dayak traditional people are very reliant on the surrounding environment where they reside. The resilience of a strong relationship between Dayak people and nature is always expressed in the construction process of a new longhouse. On the establishment, Dayak people repeatedly exploit material for construction from the abundant sources around the building site. Dayak people always take into account the relocation of a new longhouse with the position of the building site and with the customary forest and cultivated land. The traditional community will leave the old location and will not return to the same location after several generations. The principle of sustainability is a concept of thought that is understood by the Dayak community. Building materials

are also processed using preservatives obtained from nature so that they do not disturb environmental conditions. The construction of the building also has an awareness of the signs from nature. Dayak people will give symbols in the form of offerings before and during construction.

7. Conclusion

The traditional concept of the Dayak's longhouse In Nek Bindang, West Kalimantan is found as the way of thinking of Dayaks about the surrounding environment. They attached the design, the architecture, and the meaning of the longhouse as the thought of the Dayak community. The appearance of the façade or the arrangement of space are the traditional concepts of thought, belief, and cultures of Dayaks as the influences of the life journey in their community. The concepts of the longhouse are the traditional views and knowledge of the Dayaks as their references in behavior and are practiced for generations to meet the needs of the local community and the surrounding environment. The reference ties the Dayaks as individuals or members of the community to have certain attitudes or to be engaged in the longhouse.

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References

Alcorn, J B., & Royo, A. G., eds. (2000). *Indigenous Social Movements and Ecological Resilience: Lessons from the Dayak of Indonesia.* Washington DC: Biodiversity Support Program.

Bahauddin, A. (2014). The Architectural and Cultural Heritage of Sabah - The Rungus Longhouse. *SHS Web of Conferences 12, 01030 (2014), Published by EDP Sciences.* DOI: 10.1051/shsconf/20141201030.

Bahauddin, A., Abdullah, A., & Maliki, N. Z. (2015). The Rungus Longhouse of Sabah, Malaysian Borneo – A Dying Architecture. *SHS Web of Conferences, 0 002 (2015) 51 02002.*

Barrett, R. J. (2004). Space, repetition and collective interlocution: Psychiatric interviews in a Borneo longhouse. *Communication & Medicine 1(1),* pp. 25–34

Beynon, D. (2013). The Contemporary Iban Longhouse: The Sustenance and Applicability of a Socio-spatial Culture, *International Journal of Social Sustainability in Economic, Social, and Cultural Context, 9(1), 87-99.*

Bickle, P. (2013). *Life and death of the longhouse: daily life during and after the early Neolithic in the river valleys of the Paris Basin.* Ann Arbor, Ml : ProQuest LLC.

Budiman, E., Wati, M., & Norhidayat. (2019). The 5R Adaptation Framework for Cultural Heritage Management Information System of the Dayak Tribe Borneo. *Journal of Physics: Conference Series 1341 (2019) 042016, IOP Publishing DOI:10.1088/1742-6596/1341/4/042016.*

Collins, J. T., & Herpanus. (2018). The Sekujam Language of West Kalimantan (Indonesia). *Wacana 19(2): 425-458, DOI: 10.17510/wacana.v19i2.702.*

Fajarwati, N., & Masruri, M. S. (2019). Role of Local Wisdom Community Dayak Kanayatn in the Fire Disaster Prevention (Forest Fires for the Opening of Farming Fields in West Kalimantan). *ICHMGEP IOP Conf. Series: Earth and Environmental Science 271 (2019) 012022 DOI:10.1088/1755-1315/271/1/012022.*

Fox, J. J. (1993). *Inside Austronesian Houses : Perspectives on Domestic Design for Living* (editorial). Canberra, Australia: Department of Anthropology Australian National University.

Guerreiro, A. (2013). Ancestors in Borneo Societies. Death, Transformation and Social Immortality, Pascal Couderc & Kenneth Sillander, ed. *Copenhage: NIAS Press, Nordic Institute of Asian Studies, "Studies in Asian Topics*

n° 50", 2012, 390 p., index. Moussons Recherche en sciences humaines sur l'Asie du Sud-Est 21. 2013-1, 141-173.

Hadi, K. (2019). The Source of Power of the Dayak Ma'anyan Tribes' Political Thought and its Influence on the Elites. *Masyarakat, Kebudayaan dan Politik, 32(3), 251-261.*

Hafiid, M. A., Antariksa, & Ridjal, A. M. (2015). Perubahan Ruang pada Bangunan Rumah Panjae Suku Dayak Iban Kalimantan Barat. *Jurnal RUAS 13(2), 37-47.*

Hartatik. (2013). Rumah Panjang Dayak Monumen Kebersamaan Yang Kian Terkikis oleh Zaman: Studi Kasus Dayak Kanayatn Di Kalimantan Barat. *Naditira Widya 7 (1), 44-58.*

Hartono, F., Sukawiti, & Nuryadi, H. (2018). Idealized Abstraction of the Concept of Human in Dayak Kanayatn's Byword and Its Importance in Dissolving Ethnic Conflicts in West Borneo. *International Conference on Life, Innovation, Change, and Knowledge (ICLICK, 2018). Advances in Social Science, Education and Humanities Research, volume 203. Atlantis Press.*

Herianto, Kusuma, Z., Nihayati, E. & Prayogo, C. (2018). The Plant Wisdom of Dayak Ot Danum, Central Kalimantan. *The Journal of Tropical Life Science 8(2), 130-143.*

Jawan, J. A. (1996). Conflict Resolution Through Consensus Building: Experiences from the Dayak Iban Community of Sarawak, East Malaysia. *Pertanika J. Soc. Sci. & Hum. 4(2),121-127.*

Lontaan, J.U. (1975). *Sejarah – Hukum Adat dan Adat Istiadat Kalimantan Barat , First Edition.* Pontianak: Provincial Government of West Kalimantan.

Mahayuddin, S. A., Wan_Zaharuddin, W. A. Z., Harun, S. N., & Ismail, B.. (2017). Assessment of building typology and construction method of traditional longhouse. International High- Performance Built Environment Conference – A Sustainable Built Environment Conference 2016 Series (SBE16), iHBE 2016. *Procedia Engineering 180*, 1015 – 1023.

Pebriano, V. (2013). Material Lantai Pada Bangunan Rumah Panjang (Long House) Sebagai Pendukung Mythos (Studi Kasus Budaya Bermukim Tradisional Masyarakat Dayak Dosan di Kalimantan Barat). Proceeding on *SEMINAR NASIONAL SCAN#4:2013 "Stone, Steel, and Straw" Building Materials and Sustainable Environment, II214-II227.*

Rahu, A. A., Hidayat, K., Ariyadi, M., & Hakim, L. (2013). Ethnoecology of Kaleka: Dayak's Agroforestry in Kapuas, Central Kalimantan Indonesia. *Research Journal of Agriculture and Forestry Sciences 1(8), 5-12.*

Roslinda, E. (2016). Dayak Desa Forestland Use System as Social Capital to Acquire Forest Management Rights in West Kalimantan, Indonesia. *Biodiversitas 17(1), 177-184*

Sada, C., Alas, Y., & Anshari, M. (2019). Indigenous People of Borneo (Dayak): Development, Social Cultural Perspective and Its Challenges. *Cogent Arts & Humanities, 6: 1665936 published by Cogent OA, part of Taylor & Francis Group https://doi.org/10.1080/23311983.2019.1665936.*

Sari, I. P., Nisyawati, & Rohmat, S. (2019). Utilization and Management of Landscape Unit in Dayak Ngaju Community in Three villages, Mantangai sub-district, Kapuas Regency, Central Kalimantan. *IOP Conf. Series: Journal of Physics: Conf. Series 1317 (2019) 012074 IOP Publishing DOI:10.1088/1742-6596/1317/1/012074 1.*

Sobian, P., Maryunani, Setyowati, E., & Riniwati, H. (2018). Social Capital (Trust, Belief, Faith) Of Dayak Custom Community in Ensaid Panjang Village Sintang District West Kalimantan Indonesia. *IOSR Journal of Business and Management (IOSR-JBM) 20(2), 62-67.*

Victoria, J., Mahayuddin, S. A., Wan_Zaharuddin, W. A. Z., Harun, S. N., Ismail, B., & Mahat, N. (2015). Sustainability of Building Elements in Bidayuh Traditional Longhouse Construction. *Proceedings of Postgraduate Conference on Global Green Issues (Go Green), UiTM (Perak), Malaysia, 7-8 0ctober 2015.*

Victoria, J., Mahayuddin, S. A., Wan Zaharuddin, W. A. Z., Harun, S. N., & Ismail, B. (2017). Bioclimatic Design Approach in Dayak Traditional Longhouse. International High-Perfor-

mance Built Environment Conference – A Sustainable Built Environment Conference 2016 Series (SBE16). *Procedia Engineering 180, 562 – 570.*

Wardani, K. L., Sitindjak, R. H. I., Nilasari P. F., & Widjayadi, D. F. (2018). Form and Meaning of Dayak Traditional House in East Kalimantan, Indonesia (Case Study: Lou Pepas Eheng Dayak Benuaq's House). *Atlantis Press, Advances in Social Science, Education and Humanities Research, Volume 207, 265-272*

Wuysang, P. A., Prijotomo, J., & Dwisusanto, Y. B. (2017). Tectonic Method for Traditional Longhouse the Core Form of So Langkepatamuan Architecture. *The International Journal of Engineering and Science (IJES) 6(1),* 24-32.

Zain, Z., Andi, U.F. (2020). The intangible characteristics of the two indigenous traditional dwellings in West Kalimantan. *ITU J Faculty Arch.,* 17(1), 25-36, DOI: 10.5505/itujfa.2019.97720.

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Walking experience in mixed use developments in Lagos, Nigeria

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Abstract

Mixed use development serves as an important tool in tackling the very many challenges caused by urbanisation. Furthermore, it provides the city with some sort of architectural identity by infusing the culture, and socio economic characteristics of the people into it. The modern day transitioning into mixed use development have become a viable way of efficiently maximising land use and improving the overall sustainability of the environment. One of the goals of mixed-use developments is to ensure pleasant pedestrian experiences. However very few studies have focused on the experiences of pedestrians in these mixed use developments. This paper presents findings from a survey aimed at investigating pedestrian experience at various urban crosswalks and facilities in mixed use developments in Marina, Lagos State, Nigeria. The study investigated the influence of walkability features on walking experience and how walking experience influence the satisfaction of occupants of mixed use developments in Marina, Lagos, Nigeria. The methodology employed is the questionnaire survey approach with data analysed using frequency distribution, mean ranking and categorical regression analyses. The findings of the study suggest that new designs of this type of buildings should take into consideration the distance between adjacent buildings in order to ensure that the pedestrians are able to have a pleasant experience. Furthermore, there is need to provide for lighting features to enhance pedestrian experience. The place of pedestrian walk designs with the shortest routes and non-slip surfaces in enhancing occupants' satisfaction were also highlighted.

Keywords

Mixed use developments, Pedestrian experiences, Pedestrian satisfaction, Walkability, Walking experience.

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1. Introduction

Mixed use development has been regarded as one of the vital tools to ensure sustainable development (Lee et al., 2013). This is because it creates an avenue for multiple use of land for different functions. Mixed use developments have the goal of altering the existing pattern of urban growth to prevent urban sprawl (Herndon, 2011). According to Bahadure and Kotharkar (2015), it entails the co-existence of more than one type of land-use function such as the use of land for residential, commercial, recreational, and educational purposes in a specific area. Therefore, the construction of mixed use developments has the potential to create socio-economic benefits for a community.

Striebig et al. (2016) noted that one social benefit of mixed use areas is the decreased dependency on cars, which can lead to less traffic congestion and lower greenhouse gas emissions. This is not only beneficial for the environment, but a more pleasant experience overall for everyone involved. This calls for a pedestrian-friendly environment which encourages residents to have more active travels (Larco et al., 2012).

Despite the numerous benefits and the need for the establishment of mixed use developments to ensure sustainable development, most of these buildings are designed without taking into consideration users' perception, thereby, leading to poor experiences for the users. Lee et al. (2013) noted that most of mixed use developments are often associated with high noise levels and unorganised space layouts, all culminating into an unpleasant pedestrian experience. However, Herndon (2011); and Nared and Lamovšek (2015) suggested that mixed use developments are meant to attract pedestrians to the streets. In fact, this is necessary for urban vibrancy (Jurkovič, 2014). As such, pedestrian circulation is one design element that is vital for the success of mixed use developments. There has however been little or no empirical research on pedestrians' perception of mixed use development in Nigeria, to inform the design process. Therefore, this study aims at empirically investigating pedestrian experience in mixed use developments in Lagos, Nigeria with a view to facilitating the improvement of the designs of these sites and enhancing pedestrian experience. The study answered two questions: (1) which pedestrian features influence walking experience in mixed use developments? (2) How does pedestrian experience influence the satisfaction of the occupants of the mixed use developments in Lagos, Nigeria? This study is justified on the need to identify the site features that influence walking experience to inform the design of future similar developments. Mixed use developments always aim at enhancing pedestrian experience. Very few studies have however investigated the influence of pedestrian experience on the satisfaction of occupants of those developments. The second justification is therefore based on the need to contribute to literature on pedestrian experience and occupants' satisfaction, especially in relation to mixed use developments. A study of this nature is important to architects and urban designers, as it will inform future designs of similar developments. The study will also provide the much needed empirical data to inform review of planning and development standards for mixed use buildings.

2. Literature review

Historic cities have been said to be mixed use in nature and developed spontaneously. In fact, Raman and Roy (2019) asserted that mixed land use is the natural pattern of human settlement. With the advent of the industrial era, municipalities began to zone buildings. Mixed use developments as we know them today are however a reinvention, as intended mixtures of complimentary land uses (Niemera, 2007). Wardner (2014) noted that mixed land uses were advocated as a strategy to mitigate the limitations of zoning and segregation; and realise sustainability and smart growth goals. Mixed land uses have been categorised in two different ways by Raman and Roy (2019). The first is the planned/ unplanned mixed land uses; while the second is composite/ tonal/ zonal mixed land uses. The settlements that develop spontaneously mixed land uses are referred to as unplanned. These are predominantly in core city areas, sprawls and fast-growing settlements. The planned mixed

land uses often develop through densification and urban renewal attempts of government. While composite mixed land uses have no predominant land use, the tonal mixed land use have a predominant land use, and the zonal mixed land use make deliberate zones with specific predominant land uses. The planned mixed land use development is the focus of this paper.

Raman and Roy (2019) described mixed use developments as real estate developments that have more than one land use. Such developments are further characterised by integration of components, such that pedestrian connections are uninterrupted. These developments conform to a coherent plan, contain elements or work, play and live; and have amenities to mitigate traffic and sprawl. As such, mixed use developments are designed to reduce reliance on automobiles. In addition to decreased dependency on cars in mixed-use developments, (Striebig et al., 2016) the sharing of community space, such as parks and plazas for different purposes provides an opportunity for more interaction among residents, thereby, strengthening social ties throughout the community. This also translates into economic benefits, as Bahadure and Kotharkar (2015) opined that a community with mixed land-use promotes a high level of economic activity, therefore, providing sources of income especially for dwellers in the community. Whitherspoon et al. (1976) defined the concept of mixed use development as the development of a particular area with many significant revenue producing outlets such as retail, offices, residential, and entertainment among others. These spaces are well planned and mutually supporting.

A number of studies exist on mixed-use developments. For instance, Lee et al. (2013) examined the environmental characteristics and roles of intermediary spaces in mixed use complexes in Korea. In another study, Li et al. (2016) explored users' satisfaction towards transit-oriented development (TOD) around Banqiao station in China. The findings of the paper indicate that residents are generally contented with a 10 minute walk distance to mixed use complexes or stores. The regression analysis revealed that land use, transportation and high density development are significantly related to resident satisfaction. Similarly, Bahadure and Kotharkar (2015) conducted household survey to evaluate factors relating to trip length, travel mode, satisfaction, pollution, safety and social interaction to develop a sustainability index. This index was then correlated to land-use mix measure to identify the relationship. The major finding of the paper is that neighbourhoods with high and moderate land-use mix are sustainable with travel behaviour, with the correlation level as high as 88 percent. Very little study has however been conducted on the perception of residents of mixed use developments in Lagos, Nigeria.

The modern day transitioning into mixed use development has become a viable way of efficiently maximising land use and improving the overall sustainability of the environment. This system has been adopted by urban planners around the globe to resolve issues relating to land availability and use, overcrowding, site design, transportation, safety and zoning. African communities historically developed with mixed land use. Globalization and industrialisation however led to the zoning or industrial areas away from residential areas. The current drive for mixed use development emanated from the need for more effective use of space particularly in city centres, hinged on the high value of land in those centres. As such, gentrification and urban renewal redevelopments in city centres have led to the pulling down of old structures in city centres and their replacement by mixed use buildings. In Nigeria, according to Baba et al. (2015), mixed use developments have been driven by population growth, infrastructural implementation, need for multifunctional precincts in city centres and efficient land use.

Anecdotal evidence suggests that pedestrians often have to compete for space with vehicles in mixed use developments. Risser et al. (2006) noted that pedestrian experience and urban mobility can be enhanced by wider walkways, improved lighting and interconnected pedestrian paths. These are related to site planning and individual satisfaction

preference. For a country like Nigeria, the issue is more pronounced given the high level of rural-urban migration and most especially the total population of the country. Rural-urban migration and population issues place a lot of pressure on the limited land resources and infrastructure in the country.

As earlier stated, one of the characteristics of mixed use developments is that it is pedestrian-oriented. This implies that the infrastructure for pedestrians will be a consideration in planned mixed use developments. This is because environmental variables have been found to influence the propensity of individuals to walk (Karim and Azmi, 2013; Zakaria and Ujang, 2015).In recent years, there has been an increase in studies on walkability and walking experience in neighbouhoods (Cambra and Moura, 2020, Jeong et al., 2018). According to Karim and Azmi (2013) and Zakariaand Ujang (2015) walkability connotes residents' perception of design features in neighbourhoods that enhance pedestrian comfort and safety. These include traffic and crime safety, street connectivity, land-use mix, and infrastructure for walking. These features can influence the walking experience of residents. Walking experience is important in the functioning of neighbourhoods. The assessment of experience has been said to be important in vital in realising user-centred designs (Kari, 2016). Walking experience describes the impression left on a person as a result of walking. The measures of walking experience vary in literature.

Good walking experience, according to Karim and Azmi (2013) can be achieved by improving convenience, safety and pleasure. Safety and convenience were also captured in the meta-analysis of previous qualitative studies by Dadpour, Pakzad and Khankeh (2016) and a survey carried out by Kari (2016). In addition however, these authors identified environmental aesthetics and social relations as themes that influence walking.

Hess et al. (1999) investigated the relationship between site design and pedestrian travel in mixed-use, medium density environment. These authors investigated variables such as street systems, sidewalks, route length and route directions, Hess et al. found that short, safe and direct pedestrian routes encourage pedestrian activities in those environments. This was similar to the findings of Zakaria and Ujang (2015). Of these however, Zakaria and Ujang (2015) noted that connectivity and accessibility were the most important criteria for pedestrian comfort. Shriver (1997) also noted that long distances inhibit the choice to walk. To achieve the goal of sustainability mixed use developments need to encourage walking. Other pedestrian infrastructures highlighted by Shriver include street lights, crosswalks, planting strips and terrain of walkways.

Studies have suggested that the perception of features of the walking environment may vary by respondents' demographic characteristics. For instance, Kari (2016) found that female respondents assessed statements on walking environment lower than their male counterparts in a study of Otaniemi Campus, Finland. Kari also found that respondents aged above 35 years rated safety lower than their peers below that age did.

The empirical study conducted by Zakaria and Ujang (2015) in Malaysia suggest that satisfaction of residents with pedestrian facilities may be acceptable whether or not walkways are provided. In the case of Kaula Lumpur investigated, a part of the street is turned into walkways by pedestrians.

Lagos, Nigeria presents an interesting case. Lagos has been one of the major commercial cities of Nigeria for generations. Despite the fact that it is no longer the capital city, it has remained the premier city in terms of size, dynamism, economy, finance and culture. The Lagos Strategic Development Plan seeks to build upon this legacy and help drive Lagos to greater heights. Metropolitan Lagos is classified as a Megacity by virtue of its population size of 18 million (2012 estimate). With an overall State population of over 20 million in 2012, Lagos State is expected to grow by further 7 million by 2025.

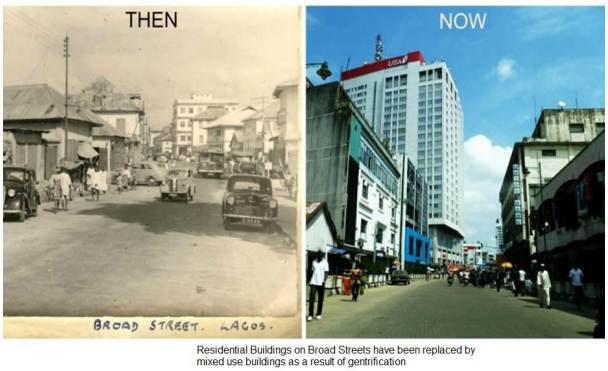

Figure 1. *The transformation in Broad Street, Marina, Lagos (Source: MyNewsArena, 2017).*

Figure 2. *Marina, Lagos, Nigeria (TVC News, 2017).*

Figure 3. *Marina, Lagos, Nigeria, showing central car park (Source: Google Maps, 2020a).*

This could make Lagos City the largest megacity in Africa. Whilst the metropolitan area of Lagos dominates Lagos State, It is important to recognise that the State has important rural areas with agriculture as the dominant activity as well as large tracts of inland water. Lagos has, in the past, been described as a failed city because of the extreme levels of poverty, poor safety and security, inadequate infrastructure, including bad roads and electricity, weak social services and a polluted and vulnerable environment. Whilst many of these problems remain in some form, there have been considerable improvements, as the state is coming up with re-densification schemes, particularly in trade centres like Marina.

The reasons for choosing Marina is that it is the hub of commercial activities in Lagos Island as many company has their headquarters situated there and as such there is high influx of people daily. The Marina area is the corporate central business district of Lagos, Nigeria. The earlier residential areas were fast converted into mixed use towers (Figure 1). The land use zones in Marina are recreational, residential, administrative, commercial and few industrial zones. Currently, Marina hosts a number of corporate offices buildings including banks, real estate consultancy firms, and electrical appliances manufacturing companies; as well as several retail and wholesale stores. In recent years, the Lagos State Government has also been executing an urban regeneration programme. The focus of this programme include the revitalization of the Lagos Island central business district; the development of the Marina city and upgrading the derelict residential areas (Abosede, 2006). Marina, Lagos is in Lagos Island, which has a population of 209,437. Persons in the area are often clients, store owners, employees of corporate offices, and sometimes worshippers in the religious buildings in the area. There were also a few who reside in the area. Currently, the Marina area of Lagos has several mixed-use buildings of varying heights (Figures 2 and 3). The case of Marina is that of expansion of already built-up area to accommodate more activities. Many buildings that were originally residential have been partly or fully converted into complexes, commercial shops, stores and ware houses although the upper floors are still for residential purposes.

The area is surrounded by a ring road and large centralised car parks. The layout of the area is shown in Figure 4.

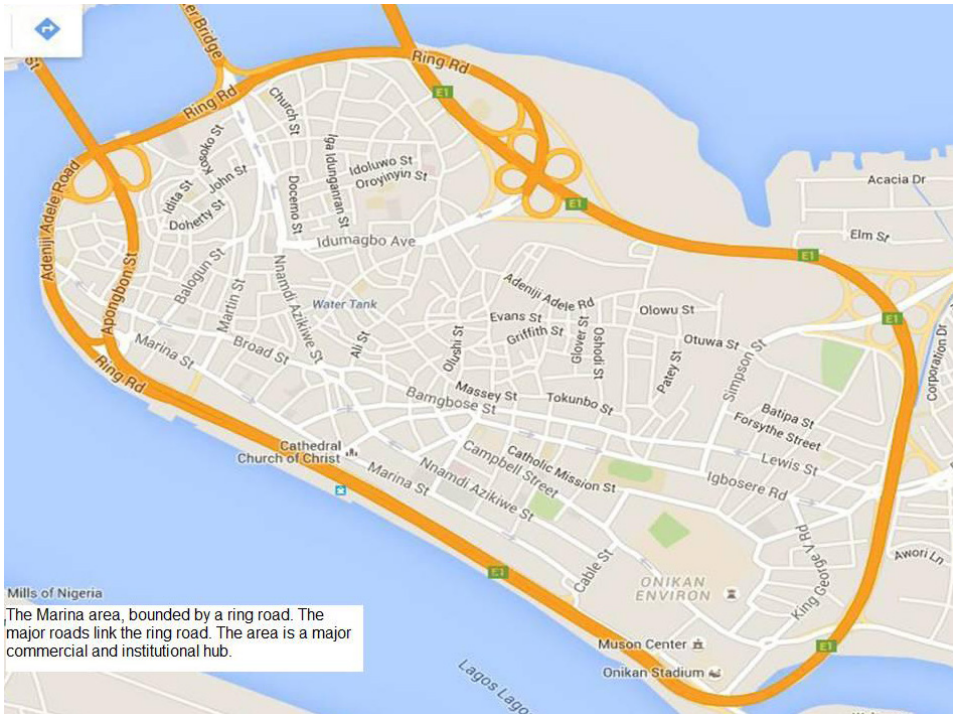

Figure 4. *Map of Marina, Lagos, Nigeria (Source: Google Map, 2020b).*

3. Methodology

The study adopted the survey method. Copies of administered questionnaire were used to obtain information on the perception of users of mixed use developments in Marina, Lagos state. The copies of questionnaire were administered to pedestrians in the area between March and May 2019. These copies were administered between the hours of 7:00-9:30am and 2:00-5:30pm, when pedestrian movement is at its peak as persons commute to and from work. The researchers worked with five research assistants. The questions were posed to the respondents while the researchers and other research assistants filled in the responses on copies of paper questionnaire. Sometimes the respondents walked on. There were however, respondents who waited to give the 5-7 minutes required to fill the questionnaire. Such respondents filled the copies of questionnaire personally. The survey covered Broad, Marina, Balogun, Nnamdi Azikiwe, Igbosere, Idumagbo, Simpson, Bamgbose, Catholic Mission and Martins Streets (Figure 4). The questionnaire had three sections: the first section was used to capture the general information of the respondents; the second section comprised questions in relation to the site pedestrian features and walking experience; and the third section was used to determine occupants' satisfaction with mixed use developments. The variables used to gather data on site pedestrian features and experience were adapted from the work of Cervero and Kockelman (1997); Hess et al. (1997) and Evans (2014). Variables used in assessing pedestrian experience were comfortability of walkways, safety, rowdiness, traffic jam, ease of way-finding, and lengthiness of walkways. For site pedestrian features, variables investigated include lighting, route directness, location of shops relative to sidewalks, walkway shelter, distance between buildings, and organisation of car parks for walkability. Only mixed use developments in Marina, Lagos, Nigeria were investigated. Issues of site pedestrian features and walking experience may however vary with culture and climate. In addition, building codes differ with countries.

A total number of 130 copies of questionnaire were distributed based on the simple random sampling technique and only 105 were suitable for analysis, indicating a response rate of 80.7 percent. The data were analysed with the use of frequency distribution, mean ranking and categorical regression analyses.

4. Results

Table 1 presents the general information of the variables of the study. From the Table, it can be observed that a larger proportion of the respondents are between the ages of 31-40 years representing 41.9 percent of the total respondents. In addition to this, more than half of the respondents are married and male comprising of 52.4 percent and 56.2 percent respectively of the respondents. It can also be observed that a larger percentage of the respondents had completed their tertiary education, while the lowest proportion had no formal education. In relation to occupation, most of the respondents were employees (representing 41.9 percent), followed by self-employed individuals (representing 33.3 percent), students; and "others" category (representing 13.3 percent and 11.4 percent, respectively). On the type of accommodation occupied in the mixed use development, 24.8 percent of the respondents were in residential facilities, 62 percent in office facilities, 11.4 percent in shops/ commercial facilities, and 4.8 percent in other types of facilities, which included warehouses and other ancillary facilities. Table 1 also reveals that37.1percent of the occupants had been in the area for between 6 and10 years.

Respondents were asked to rate the site pedestrian features in terms of their impact on the walkability in the mixed use development. Table 2 presents the results of the data gathered on the perceptions of pedestrians on the site features of mixed use development that impact on their movement. The results suggest that the most influential are the distances between adjacent buildings, as well as presence of lighting features on, and directness of pedestrian routes as these were ranked high in terms of impact on walkability. The site features that least impact on the residents movements are sheltering of pedestrian routes and the location of shops either by sidewalks or on the ground floor of the buildings (Figures 5 and 6). The low rating of sheltering of pedestrian walks may be due to the fact most of the walkways were not sheltered. On the experiences of pedestrians (Table 3), the respondents mostly agreed that although way-finding is easy and pedestrian walks are safe, their strongest impression is that there are often traffic jams on the streets.

Kruskal Wallis tests were carried out to find out if the respondents perception of site features varied with their age,

Table 1. *Respondents' profile.*

	Variables	Percent
Age Range	20 years or less	11.4
	21-30 years	24.8
	31-40 years	41.9
	41-50 years	15.2
	51-60 years	2.9
	60 years and above	3.8
Gender	Male	56.2
	Female	43.8
Marital status	Single	38.1
	Married	52.4
	Widowed	6.7
	Divorced	2.9
Educational Qualification	No formal education	12.4
	Primary school	17.1
	Secondary school	21.9
	Tertiary	48.6
Occupation	Student	13.3
	Employees	41.9
	Self employed	33.3
	Others	11.4
Type of accommodation occupied in the mixed use development	Residential	24.8
	Office	59.0
	Shop	11.4
	Others	4.8
Length of Residence	Less than 5 years	33.3
	6-10 years	37.1
	11-15 years	10.5
	More than 15 years	19.0

gender, educational qualification, type of accommodation occupied, length of residence, and occupation. The respondents did not vary significantly in their perception of site features based on their gender, marital status and type of accommodation occupied. They however varied significantly in their perception of these features based on their ages, educational qualification, occupation and length of residence. The perception of organisation of carparks varied with the ages (Chi Squared λ = 22.115, degree of freedom df = 5, p = 0.000) and educational qualifications of the respondents (λ = 10.101, df = 3, p = 0.018). Respondents who were younger than the age of 20 years as well as those with educational qualifications lower than tertiary had higher median scores on their perception of the influence of organisation of car parks on walkability. Location of shops on the ground floor also varied with their ages (λ = 29.943, df = 5, p = 0.000) and educational qualifications (λ = 9.775, df = 3, p = 0.021) of the respondents. Respondents who were over the age of 40 years and those that had tertiary education had higher median scores on their perception of the influence of location of shops on ground floors of buildings. The respondents' perception of influence of sheltered walkways on walkability varied significantly with their educational qualification (λ = 9.383, df = 3, p = 0.025), and length of residence (λ = 8.927, df = 3, p = 0.030). Respondents with no formal education as well as those who had stayed in the area for more 10 years had higher median scores on their perception of this site feature. Students, employees, and those in private businesses had higher median scores on their perception of directness of the route (λ = 10.764, df = 3, p = 0.013) than those in other occupation groups.

The perception of the pedestrians on their experiences on the pedestrian walks in the mixed use developments also varied with their ages, educational qualification, and their length of residence. The perception of crowdiness (λ = 17.556, df = 5, p = 0.004), ease of wayfinding (λ = 12.185, df = 5, p = 0.032) and traffic jam (λ = 11.881, df = 5, p = 0.036) on the pedestrian walkways varied significantly with the ages of the respondents. The experience of crowdiness and ease of wayfinding was highest among respondents, who were aged below 21 years, while the experience of traffic jam was perceived highest among those who were aged above 40 years. The respondents also varied significantly in the perception of crowdiness based on their educational qualification (λ = 33.343, df = 3, p = 0.000). Interestingly, those without formal education had the highest median score on the perception of crowdiness. The length of residence is also another respondents' profile that defined how they perceived their experience of wayfinding (λ = 7.978, df = 3, p = 0.046) and safety (λ = 7.858, df = 3, p = 0.049). While respondents that rated wayfinding in the neighbourhood higher had stayed in the area for more than 10 years, those who with residency more than 15 years rated their experience of safety lowest. The respondents did not vary significantly in their experiences based on their gender, marital status and occupation.

To assess the impact of site pedestrian features on walking experience of the occupants of mixed use developments, regression analyses were carried out. Each of the variables used in assessing walking experience were entered as dependent variables in different regression analyses, while the variables used in measuring perception of site pedestrian features were entered as independent variables. The results of the regression analyses revealed the site pedestrian features that influenced different aspects of walking experience and these are pre-

Table 2. *Site pedestrian features that impact on walkability in mixed use developments.*

	Mean	Std. Deviation
Distances between adjacent buildings	3.79	.987
Lighting features on pedestrian routes	3.63	1.361
Directness pedestrian routes	3.51	1.233
Organisation of car parks	3.30	1.232
Location of shops on or close to sidewalk	2.87	1.294
Location of shops on ground floor of buildings	2.67	1.268
Sheltered pedestrian walks	2.16	1.395

Table 3. *Walking experience in mixed use developments.*

	Mean	Std. Deviation
Traffic jams often take place on streets in the neighbourhood	3.69	1.235
It is easy for a pedestrian to find his/her way around	3.65	1.315
The pedestrian routes are safe	3.65	1.177
Pedestrian routes are often crowded	3.48	1.186
Pedestrian routes are unnecessarily long	3.31	1.086
The pedestrian walks are slippery and uncomfortable	2.51	1.367

Figure 5. *A view of Broad Street adjacent showing pedestrian walks (Source: Field work).*

Figure 6. *A view of some of the store front (Source: Field work).*

sented in Table 4. The experience of traffic jam as perceived by the respondents was significantly influenced by the location of shops on ground floors of buildings (beta β = 0.501, p < 0.05), directness of pedestrian routes (β = 0.481, p < 0.05) and the sheltering of pedestrian walks (β = 0.158, p < 0.05). Most of the respondents who agreed that they experience traffic jams on the streets of the mixed use developments identified location of shops on the ground floor of mixed use developments, directness of pedestrian paths and sheltering of pedestrian walks as features that impact their movement. The location of shops on ground floors of buildings (β = -0.369, p < 0.05) or on/close to sidewalks (β = -0.245, p < 0.05) influence the perception of slipperiness/comfortability of walkways. This is in addition to distances between adjacent buildings (β = 0.335, p < 0.05). The perception of safety of pedestrians was significantly influenced by the distance between adjacent buildings (β = 0.494, p < 0.05) and presence of light features on pedestrian routes (β = 0.309, p < 0.05). As may be expected, the presence of light features on pedestrian routes (β = 0.354, p < 0.05) also influenced the perception of the length of pedestrian routes. The site pedestrian features that significantly influence the perception of ease of way-finding were distance between adjacent buildings (β = 0.268, p < 0.05), directness of pedestrian routes (β = -0.343, p < 0.05) and availability of light features on pedestrian walks (β = 0.493, p < 0.05). None of the site features influenced the perception of rowdiness of the pedestrian routes.

The overall occupants' satisfaction of the respondents was investigated. Table 5 shows that a little less than half (47.6%) of the respondents are satisfied with the mixed use developments that they occupied. This suggests that the residents are not so satisfied with the developments.

To investigate the relationship between occupants' satisfaction and pedestrian experience, a categorical regression analysis was carried out. The level of satisfaction of the occupants was entered as a dependent variable, while the six variables used in measuring pedestrian experience were entered as independent variables. The results (Table 6) show that pedestrian experience accounted for 31.6% of the variance in occupants' satisfaction with mixed use developments (R2 = 0.316, F = 2.973, p = 0.001). Only two

Table 4. *Categorical regression coefficients of the influence of site pedestrian features on walking experience.*

	Standardised Beta					
	Traffic jams often take place on streets in the neighbourhood	The pedestrian walks are slippery and uncomfortable	The pedestrian routes are safe	Pedestrian routes are unnecessarily long	Pedestrian routes are often crowded	It is easy for a pedestrian to find his/her way around
F	5.064**	4.059**	3.157**	3.954**	1.097	3.555**
R square	0.46	0.425	0.347	0.381	0.073	0.410
Distances between adjacent buildings	-.156	.335**	.494**	.205	-.141	.268*
Location of shops on or close to sidewalk	-.297	-.245*	-.150	.278	-.062	-.195
Organisation of car parks	-.150	.186	-.159	-.144	.096	-.124
Location of shops on ground floor of buildings	.501**	-.369**	-.167	-.154	-.083	.175
Directness of pedestrian routes	.481**	.185	-.205	.147	-.125	-.343**
Lighting features on pedestrian routes	-.121	.254	.309*	.354**	.119	.493**
Sheltered pedestrian walks	.158**	.312*	.209	.193	-.006	.300

*p< 05, **p<0.01

of the pedestrian experience variables however account for this variance. The variables are the perception of slipperiness and discomfort experienced on the pedestrian routes ($\beta = -0.393$, $p < 0.05$) and the distance to be covered when using the pedestrian routes ($\beta = -0.212$, $p < 0.05$). The results reveal that the more slippery and uncomfortable the respondents indicated the pedestrian routes are, the less satisfied they were with the mixed use developments. Lower occupants' satisfaction was also recorded with respondents who strongly rated the pedestrian routes as unnecessarily long. A greater effect size was however recorded with the effect of the slipperiness and discomfort experienced by pedestrians on their satisfaction with the mixed-use developments where they are occupants.

Table 5. *Occupants' satisfaction with mixed use developments.*

	Percentage
Not satisfied at all	10.5
Not satisfied	22.9
Undecided	19.0
Satisfied	33.3
Highly satisfied	14.3
Total	100.0

Table 6. *Categorical regression coefficients on the influence pedestrian experience on user satisfaction with mixed use developments.*

	Standardized Coefficients		df	F	Sig.
	Beta	Bootstrap (1000) Estimate of Std. Error			
Traffic jams often take place on streets in the neighbourhood	.317	.243	2	1.699	.189
The pedestrian walks are slippery and uncomfortable	-.393	.144	3	7.494	.000
The pedestrian routes are safe	.130	.202	3	.411	.745
Pedestrian routes are unnecessarily long	-.212	.122	3	3.037	.033
Pedestrian routes are often crowded	-.225	.156	2	2.072	.132
It is easy for a pedestrian to find his/her way around	-.123	.234	1	.278	.599
F = 2.973, p = 0.001					
R square = 0.316					

5. Discussions

Mixed use developments, according to Lee et al. (2013), creates an avenue for multiple uses of land. This study was carried out in neighbourhoods in Marina, Lagos, with shops, offices, schools, residences, religious houses and warehouses. An important goal of mixed use developments, according to Striebig et al. (2016) is providing a pedestrian-oriented environment. The way pedestrians view such environments therefore become important. As noted by Bahadure and Kotharkar (2015) and Larco et al. (2012), the designs of mixed use developments influence the travel behaviours of pedestrians. In an earlier study, Shriver (1997) as well as Hess et al (1999) had found that walkability is influenced by short and direct routes, streetlights, cross-walks, planting strips and terrain of walkways. Crosswalks and planting strips were not provided in the neighbourhoods studied. However streetlights as well as direct walkways were rated high in this study as features that impact walkability.

The findings of this study probably points to the need to separate vehicular traffic from pedestrian routes in mixed use developments. Although the area investigated has a centralised car park, respondents agreed that traffic jams on the streets is the most significant perception of the neighbourhood in terms of walking experience. Safety and way finding were found to be important criteria for good walking experience. This appears to be in line with the findings of previous study by Karim and Azmi (2013), which highlighted the importance of safety in enhancing pedestrian experience. In addition to this criteria for good experience however, this study found that negative experience also arise from traffic jam, as earlier mentioned; length and slipperiness of walkways, as well as crowded walkways. The crowded nature was however found to be a function of the width of the walkways or their non-availability.

Kari (2016) had found in a study of a campus in Finland that male and female respondents varied in their perception of safety in the walking environment. This study found that perceptions of site features as well as experiences of respondents also varied with their socio-economic characteristics. However in this study, respondents did not vary significantly in their perceptions of the walkability features and their experiences based on gender and marital status. They however varied in their perceptions of these subjects based on their ages and educational qualifications. This suggests a need to consider age- and

educational qualification-related preferences in the planning of such mixed use developments.

Certain site pedestrian features were found to influence walking experience in the mixed use developments investigated. The same result had been found in the study by Zakaria and Ujang (2015). In this study, however, the organisation of car parks did not influence the experience of the pedestrians in any way. A close look at the mixed use developments reveal that the car parks were mostly located away from pedestrian routes (Figures 3 and 7). The experience of crowdedness of pedestrian routes was not also influenced by any pedestrian features. Further studies would be required to identify the factors that influence the crowdedness that is often observed on pedestrian routes in mixed use developments (Figure 5). One explanation however may be the absence of defined walkways in some areas and the undersized nature of the ones that were available. The findings of the study also corroborate the fact that improved lighting is necessary for enhanced pedestrian experience (Risser et al., 2006).

It is interesting to note that location of shops close to walks and on ground floors of the mixed use developments negatively predicted the slipperiness and discomfort experienced on sidewalks. This suggests that having these shops by the pedestrian walkways may have improved the maintenance of those walkways. This can be explained by the fact that shop owners in the often take the surrounding areas as part of their territory, when it comes to daily cleaning and maintenance of their shops.

Li et al. (2016) noted that transportation is related to the satisfaction of residents of a version of mixed use development called the transit oriented development. In this case, the occupants' perceptions of traffic jam in the neighbourhood, which is related to transportation, did not significantly influence their satisfaction. The quality and the length of the pedestrian walks in the mixed use developments however influenced the occupants' satisfaction. Short distances have been said to encourage walking and cycling (Rogatka & Ramos Ribeiro 2015). Pedestrian walks are landscape features, which Lee, Kim and Moon (2013) suggested will influence the satisfaction of occupants of mixed use developments with intermediary spaces. One would however note that although studies (Risser et al. 2006) have linked safety and comfort of pedestrian paths to satisfaction, only comfort of pedestrian paths have been found to influence the satisfaction of pedestrians in this study.

Figure 7. *A view of Marina Road showing the existing car park (Source: Field work).*

6. Conclusion

This study set out to investigate the walking experience of pedestrians in a mixed use development area in Marina, Lagos, Nigeria. The study was premised on the fact that there has been little or no empirical research on pedestrians' perception of mixed use development in Nigeria, to inform the design process. The study identified the features that influence walkability in the mixed use development. It also assessed pedestrian experience and examined the relationship between the presence of walkability features and pedestrian experience. The influence of pedestrian experience on residential satisfaction was also investigated.

This study has provided evidence that on the features in the mixed use developments that influence walking experience and also indicate that walking experience significantly influence user satisfaction. Several studies on user satisfaction have considered other variables apart from site pedestrian features. The fact that site pedestrian features accounted for about 30 per cent of the variance in user satisfaction highlights

its importance, indicating that further studies on user satisfaction in mixed-use developments should take these into consideration. The findings therefore provides a cue that pedestrian experience may be one of the missing links in occupants' satisfaction studies, especially in mixed use developments.

The findings of the study have implications for design and policy. The findings suggest the need for future designs to address the issue of distances between buildings as well as lighting features on pedestrian walks as these impacted the most on pedestrian experiences. The exact distances between buildings may however be the subject of further studies.

Since issues of site and experience for pedestrian may vary with culture and climate, further studies may investigate pedestrian experiences in other contexts. This will establish the limit of generalisability of findings of research.

References

Abosede, F. B. (2006). Housing in Lagos Megacity – Improving Liveability, Inclusion and Governance, Paper presented at the International Conference on Building Capacity to Implement Economic, Social and Cultural Rights, Abuja, 27-28 September

Baba, A. N., Yusoff, N. B. and Elegba, E. O. F. (2015). Towards cities inclusiveness: the land use paradigm option for Nigeria. *Procedia - Social and Behavioral Sciences* 172; 367 – 374 doi: 10.1016/j.sbspro.2015.01.381

Bahadure, S., & Kotharkar, R. (2015). Assessing Sustainability of Mixed Use Neighbourhoods through Residents' Travel Behaviour and Perception: The Case of Nagpur, India. *Sustainability*, 7, 12164-12189.doi:10.3390/su70912164

Cambra, P. & Moura, F. (2020). How does walkability change relate to walking behavior change? Effects of a street improvement in pedestrian volumes and walking experience. *Journal of Transport & Health.* https://doi.org/10.1016/j.jth.2019.100797

Cervero, R. & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design Transportation Research Part D: *Transport and Environment* 2(3); 199-219 https://doi.org/10.1016/S1361-9209(97)00009-6

Dadpour, S., Pakzad, J. & Khankeh, H. (2016). Understanding the Influence of Environment on Adults' Walking Experiences: A Meta-Synthesis Study. *International Journal of Environmental Research and Public Health 13*(7), 731- 746; https://doi.org/10.3390/ijerph13070731

Evans, G. (2014). Accessibility and user needs: pedestrian mobility and urban design in the UK. *Proceedings of the ICE - Municipal Engineer*, 168 (1). pp. 32-44. ISSN 0965-0903

Google Maps (2020a). Marina Lagos Retrieved from https://www.google.com/maps/place/Marina,+Lagos/@6.4491744,3.354821,14z/data=!3m1!4b1!4m5!3m4!1s0x103b8bb1e98fb0e5:0xee695fa5bda894b5!8m2!3d6.4446406!4d3.3640841

Google Maps (2020b). Marina Lagos Retrieved from https://www.google.com/maps/place/Marina,+Lagos/@6.4542064,3.388767,15z/data=!4m5!3m4!1s0x103b8bb1e98fb0e5:0xee695fa5bda894b5!8m2!3d6.4446406!4d3.3640841

Herdon, J. D. (2011). *Mixed-Use Development in Theory and Practice: Learning from Atlanta's Mixed Experiences.* Retrieved from http://hdl.handle.net/1853/40790

Hess, P. M., Moudon, A. V., Snyder,

M. C. & Stanilov, K. (1999). Site Design and Pedestrian Travel.*Transportation Research Record: Journal of the Transportation Research Board* 1674 (1); 9-19 https://doi.org/10.3141/1674-02

Jeong, D. Y., Kwahk, J., Han, S. H., Park, J., Lee, M. and Jang, H. (2018). A pedestrian experience framework to help identify impediments to walking by mobility-challenged pedestrians. *Journal of Transport & Health* 10, 334-349 https://doi.org/10.1016/j.jth.2018.06.001

Jurkovic, B.N. (2014). Perception, experience and the use of public urban spaces by residents of urban neighbourhoods. *UrbaniIzziv*, 25(1); 107-125.

Kari, S. (2016). Pedestrian experience: Affordances and habits in utility walking – Case Otaniemi campus (Kävelijäkokemus: Tarjoumatjakävelytottumuksethyötykävelyssä – TapaustutkimusOtaniemenkampus) Masters Thesis Aalto University.Retrieved from https://aaltodoc.aalto.fi/handle/123456789/20966

Karim, H. A. & Azmi, D. I. (2013). Convenience and Safety of Walking Experience in Putrajaya Neighbourhood Area. *Procedia Social and Behavioral Sciences* 101, 318-327

Larco, N., Steiner, B., Stockard, J. & West, A. (2012). Pedestrian-friendly environments and active travel for residents of multifamily housing: The role of preferences and perceptions. *Environment and Behaviour,* 44(3), 303–333.

Lee, Y. M., Kim, S. K., & Moon, H. N. (2013). Intermediary Spaces Linking Urban Space to Buildings: Functions and User Satisfaction in Three Mixed-Use Complexes. *Journal of Sustainable Development,* 6(9), 12-24.

Li, C. N., Lin, C., & Hsieh, T. K. (2016). TOD District Planning Based on Residents' Perspectives. *International Journal of Geo-information, 5*(4), 52; 1-18.

Mok, J., Landphair, H. C., & Naderi, J. R. (2006). Landscape improvement impacts on roadside safety in Texas. *Landscape and Urban Planning*78(3), 263-274

MyNewsArena (2017). Transformation in Broad Street, Marina, Lagos. Retrieved from http://mynewsarena.blogspot.com/2017/07/the-city-of-lagos-then-and-now.html

Naderi, J. R. (2003). Landscape Design in Clear Zone Effect of Landscape Variables on Pedestrian Health and Driver Safety *Transportation Research Record* 1851 Paper No. 03-3937, 119-130

Nared, P. V. & Lamov.ek, A. Z. (2015). Public Open Space as a Contribution to Urban Development in Small Slovenian Cities. *UrbaniIzziv,* 26, S114-S129.

Niemira, M. P. (2007). The Concept and Drivers of Mixed-Use Development: Insights from a Cross-Organizational Membership Survey, R*esearch Review,* 4(1); 54

Raman, R. & Roy, U.K. (2019). Taxonomy of urban mixed land use planning. *Land Use Policy* 88(104102),1-9. https://doi.org/10.1016/j.landusepol.2019.104102

Risser, R., Schmeidler, K., Steg L., Forward, S. & Martincigh, L. (2006). Assessment of the quality of life in cities Environmental conditions and mobility. *UrbaniIzziv,* 17(1–2), 187-193.

Rogatka, K.& Ramos, Ribeiro R. R. (2015). A compact city and its social perception: A case study. *Urbani Izziv,* 26(1), 121-131.

Shriver, K. (1997). Influence of Envi

ronmental Design on Pedestrian Travel Behavior in Four Austin Neighborhoods. *Transportation Research Record: Journal of the Transportation Research Board* 1578(1): 64-75 https://doi.org/10.3141/1578-09

Striebig, B., Ogundipe, A. A. & Papadakis M. (2016). *Engineering Applications in Sustainable Design and Development.* USA: Cengage Learning.

TVC News (2017). *Lagos State govt. announces traffic diversion along Marina.* Retrieved From https://www.tvcnews.tv/lagos-state-govt-announces-traffic-diversion-along-marina/

Wardner, P. (2014). Explaining Mixed-Use Developments: A Critical Realist's Perspective. 20th Annual Pacific-Rim Real Estate Society Conference Christ Church, New Zealand, 19-22 January 2014

Whitherspoon, R, E., Jon P. A. & Robert M, G. (1976). *Mixed Use Development: New Ways of Land Use.* Washington D. C.; Urban Land Institutes.

Zakaria, J. and Ujang, N. (2015). Comfort of Walking in the City Center of Kuala Lumpur. *Procedia - Social and Behavioral Sciences 1*70(27), 642-652 https://doi.org/10.1016/j.sbspro.2015.01.066

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Determination of the difference between environmental attitudes of 1st and 4th year students of landscape architecture

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Abstract

The present study aimed to determine the difference between the environmental attitudes of freshmen and senior students attending Karadeniz Technical University Landscape Architecture Department in Turkey. The study group included 160 freshmen and senior students at KTU Landscape Architecture. A scale developed by Uzun and Sağlam (2000) was employed as the environmental attitude scale. The scale includes 27 items in environmental behavior and environmental thought subscales. The environmental behavior subscale includes 13 items and the environmental thought subscale includes 14 items. The Cronbach alpha internal consistency coefficient of the environmental behavior subscale was calculated as 0.855, and the Cronbach alpha internal consistency coefficient of the environmental thought subscale was 0.812. Thus, it could be suggested that the scale was valid and reliable. It was determined in the study that the environmental behavior (46.9875) and environmental thought (52.0375) and total environmental attitude scores (99.025) of the senior students were higher when compared to the freshmen (90.3375).

Keywords

Environmental attitude, Environmental behavior, Environmental thought, Landscape architecture, Attitude scale.

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1. Introduction

1.1. Environment

Environment is defined as "the habitat of human beings or any living being " (Özey, 2009). The harmony between living and non-living elements in this environment is important for the sustenance of the environment. However, this harmony has started to deteriorate over time due to human intervention (Erbasan and Erkol, 2020).

According to another definition, the environment; It is defined as the living environment of a living thing. In ecological sense, it is a term that includes everything related to the individual, living and non-living (Berkes and Kışlalıoğlu, 1993). This definition includes the natural and artificial environment.

If we make a more comprehensive definition, the environment, which has a very important place for living things, can be defined as the integrity of the factors that affect the life of living things (Türk, 1998). It can also be expressed as the sum of physical, chemical, biological and social factors at a certain time that can have direct or indirect effects on the environment, human activities and living things (Dinçer, 1996). Environment is the physical, biological, social, economic and cultural environment in which people and other living beings maintain their relationships and interact mutually throughout their lives.

The physical environment is a dynamic phenomenon that includes natural, cultural, historical, social and artificial elements, including humans, which are in continuous and changing interaction with each other. In other words, it could be defined as a set of all factors that affect the living beings within the environment and are affected by mutual interactions. As a constantly changing dynamic phenomenon, the environment is formed by natural and artificial elements due to the requirements of daily life. The environment that includes abiotic factors such as climate, soil, water, and natural structure, and biotic factors such as humans, animals and plants, acquires various qualities, definitions and characteristics based on titshe resources and features. The natural, cultural, historical, aesthetic, visual elements and features that form the environment are described as environmental values (Erdoğan, 2006).

1.2. The importance of the environment for humans

Biological importance of the environment; The biological aspect of the environment is directly related to biological diversity (plants, animals and microorganisms). Elliot Norse et al. Biodiversity concept introduced to the literature by 1990; It is a concept that serves to explain the variability of plants, animals and microorganisms, their relationships with the environments in which they live or with each other. There is also a permanent and irreplaceable relationship between biological diversity and human beings. The existence of human beings today and in the future depends on the state of biological diversity. The reason for this is that human beings, who are in the food chain, meet their basic needs such as shelter, clothing, nutrition and medicine from plants, animals and microorganisms (Keleş et al., 2009).

Economic Importance of the Environment; The most important relationship between the environment and the economic system is the allocation of the resources needed in the production of goods and services from the environmental environment consisting of living and non-living natural resources. Because human needs can only be met with goods and services resulting from the completion of the production process, in which natural resources are also a factor (Ulucak & Erdem, 2013).

1.3. The human-environment relation

Human beings have been living in nature since their creation, and for a while they were content with what nature provided. While other creatures tried to adapt to the existing natural conditions, humans wanted to control the nature by changing the natural environmental conditions through technology (Yıldız et al., 2000). The mistakes associated with this control attempt led to the environmen-

tal problems. According to Sever and Yalçınkaya (2012), human beings dominated nature since the industrial revolution, and the change in the balance of power in favor of humans resulted in a rapid and insensible consumption of global resources and the onset of environmental problems (Erbasan and Erkol, 2020).

1.4. Environmental problems

Following the industrial revolution in the 19th century, significant developments were observed in the world. The rapid population growth and technological developments led to an increase in production and aggravated use of natural resources. Humans destroyed nature, which they considered as an unlimited resource, to meet the increasing consumption and production requirements. Economic, social, and technological growth also led humans to neglect environmental values (Özcan and Arık, 2019).

Especially due to the efforts of growth, development and to become a strong nation after the Second World War, several countries managed to become economically developed nations, leading to environmental problems that threaten human life. Environmental problems, which were initially justified for growth and wealth, gradually became a global threat (Güzelyurt and Özkan, 2019; Çelik, 2019).

One of the consequences of human development was environmental problems. Environmental problems were initially observed in industrial regions; however, they later became global. Thus, environmental problems became an issue that concerns all living beings. Due to environmental pollution, the natural balance has deteriorated, certain living species disappeared, the recent phenomena of global warming and climate change became an issue. Today, environmental problems threaten all living beings (Çetin et al., 2020).

As the environmental problems grew and deepened, humans realized the limitless nature of these problems, and national and international efforts are spent to solve these problems (Yücel and Babuş, 2005).

1.5. Environmental education

The negative impact of various environmental attitudes and behavior of the individuals lead to environmental problems (Capra, 2009). The future of the world and therefore that of future generations lies in the solution of environmental problems. To develop positive environmental attitudes and behavior as a solution to the problems, it is necessary to investigate the factors that affect these attitudes and behavior, and to describe the relationship between these factors. Based on the findings, education that would improve environmental awareness in new generations could be a step in the right direction (Çetin et al., 2020).

It is known that educational activities are important for permanent solution approaches to environmental problems. Raising environmental awareness is the most effective way to solve these problems. The individuals should be informed about the environment and their behavior towards the environment should be changes through positive attitudes. Thus, the significance of education is clear in resolving and preventing environmental problems. The success would be possible through creating positive attitudes and behavior among the members of the society. There is no doubt that individuals with negative attitudes towards the environment will be insensitive to environmental problems and even continue to create new environmental problems.

According to Bozkurt and Cansüngü (2002), the most basic method to tackle environmental problems is to educate all individuals in the society and raise awareness with organized methods. The value of the environment for the individuals is reflected in their behavior. The positive changes in environmental values and attitudes raise environmental awareness. Ayvaz (1998) reported that there was a correlation between environmental sensitivity and environmental awareness, and individuals should be informed about what could be harmful for the environment. Bozkurt and Aydoğdu (2004) reported that 6th, 7th and 8th grade students had inaccurate knowledge on environmental problems. Yılmaz et al. (2002), reported

that the students' level of knowledge on environment and environmental problems was inadequate, they did not learn the environmental concepts adequately and they were not fully aware of the environmental problems in a study conducted with secondary and higher education students. Çabuk and Karacaoğlu (2003) stated that adequate education was not provided in educational institutions on air, water and soil pollution in a study conducted with college students. Uzun and Sağlam (2006) reported that individuals who had negative attitudes towards the environment would remain insensitive to environmental problems and even continue to create environmental problems. Thus, the attitudes of individuals towards the environment are important.

1.6. Attitude

Attitude includes emotions, thoughts and behaviors about an object. However, these dimensions are not independent. They mutually affect one another, and often these effects are consistent (Aydın, 2000; Özgüven, 1998).

In other words, attitude is a mental, emotional, and behavioral reaction or predisposition that one organizes towards oneself, any object, social problem or event based on self-experience and knowledge (İnceoğlu, 2004). Attitude towards the environment is described as learned consistent tendencies towards the environment that manifest in positive or negative attitudes (Pelstring, 1997). However, attitude includes emotions, thoughts and behaviors about an object. However, these dimensions are not independent from each other, they mutually influence one another, and often consistent (Özgüven, 1998). Attitude makes the individual prone to a certain behavior towards the object of attitude. An individual with a positive attitude towards an object or event tends to behave and approach positively, and exhibit affinity, support and assistance towards that object or event, while an individual with a negative attitude towards an object or event, is indifferent for that object or event, and tends to alienate, criticize or harm the object or event (Aydın, 2000). In a study on the attitudes of high school students towards the environment, Kaya et al. (2009) reported that high school students could not convert their environmental thoughts into behavior. Hungerford and Volk (1990) reported that a citizen with environmental awareness and sensitivity is an individual who is aware of environmental problems, has basic knowledge on environmental problems, contributes to the conservation of the environment, has the ability to solve environmental problems, and takes an active role in solving environmental problems. Thus, it could be suggested that there is a direct correlation between environmental problems and environmental awareness, environmental sensitivity and environmental education.

1.7. The study approach

In the last 3 decades, the number of studies on the correlation between environment and humans has increased exponentially. The study of the correlation between human behavior and the environment became a field of interest in social sciences (psychology, sociology, geography and anthropology) and environmental/spatial design (landscape architecture, architecture, interior architecture, city and regional planning). Environment, which became a multi-disciplinary concept, has been the topic in various studies and approaches. The correlation between environment and behavior was initially researched in environmental psychology and spatial design disciplines. Environmental research in architectural disciplines were mostly on environmental psychology (Bell et al., 2011; Düzenli et al., 2018; Özgüner et. al, 2012; Gifford, 2014; Steg et al., 2018; Gatersleben, 2018; Düzenli et. al. 2019), environmental behavior (Batavia, et al. 2019; Gage and Graefe, 2019; Henkel et al., 2019;), environmental cognition (Kaplan, 2016; Wallner et al., 2018; Berto, 2019; Stenfors et al., 2019; Van Hedger et al., 2019, Çorbaci et al, 2020), and environmental perception (Smith, 2015; Lindquist et al, 2016; Prior, 2017; Tarakci Eren et. al, 2018; Torres-Lima et al., 2018; Eroğlu et. al, 2018; Hong et al, 2019; Eisenhart et al., 2019; Menatti et al., 2019 ; Shang and Zheng, 2019; Kang and Kim, 2019).

Topics such as environmental awareness, environmental sensitivity (Kiessling, et al., 2017; Cavanna, 2019; Cao and Chen, 2019; Cattaneo, 2019; Huang et al., 2019; Nikologianni et al., 2019; Purwanti and Musadad, 2019), and environmental attitude (Strack et al., 2019; Diekmann, and Franzen, 2019; Aznar-Díaz et al., 2019; Janmaimool and Khajohnmanee, 2019; Stanley and Wilson, 2019; Baur, 2019), on the other hand, were researched by scientific branches other than architecture.

There are only a few studies on environmental problems, environmental awareness, environmental attitudes in landscape architecture and behavioral issues in Turkey (Alpak et al., 2018; Alpak et al., 2020; Kiper, 2014; Özhanc and Yılmaz, 2015; Oguz et. al., 2011; Yucel et.al., 2006 ; Selim et.al.,2011; Ertürk et.al., 2017, Bayramoğlu et al., 2019).

Landscape architecture profession is taught in various faculties of several universities with different course content in Turkey. Thus, the course weight and content of environment courses may differ. In Karadeniz Technical University Landscape Architecture Department, the most important environmental course is the environmental design project. In this course, 6 environmental design projects are developed, including one semester in the freshmen and senior years, and two semesters in sophomore and junior years. This course is one of the most important courses that instruct environmental knowledge to landscape architecture students with social, psychological, architectural, technical and applied approaches. Furthermore, students take courses such as Soil, Ecology, Plant Material (Dendrology), Botany, Environmental Behavior, Geographic Information Systems, Planting Techniques, Planting Design, Ground Covers, Sustainable Recreational Planning, Irrigation Techniques, Landscape Engineering Knowledge and Applications, National Parks, Rock Gardens, Water Gardens, Aquatic Biotopes, Zoos, Green Roads, Planning Participation, National Park Management, Indoor Plants, Green Infrastructure Systems, and Tourism and Recreation Planning during their education and they are expected to expand their knowledge on environment and attitudes before graduation. Furthermore, they are expected to contribute to the individuals around them. The aim of the present study was to determine the differences between the environmental attitudes of the freshmen students who recently started to attend the school and senior students who took all above-mentioned courses. Because it was assumed that these courses had a positive impact on student attitudes towards the environment. As mentioned above, the present study was considered essential since most previous studies were conducted in the field of education in Turkey, and lack of studies in landscape architecture.

2. Materials and method

Descriptive survey model was employed in the present study. The study was conducted with randomly assigned 160 freshmen and senior students attending Karadeniz Technical University Landscape Architecture Department. The study data was collected with the environmental attitude scale developed by Uzun and Sağlam (2000). The scale includes two sub-dimensions: the environmental behavior and environmental thought subscales. The environmental behavior subscale includes 13 items and the environmental thought subscale includes 14 items. The scale includes 27 items. The Environmental Attitude Scale is a 5-point Likert-type scale (5 completely agree and 1 (completely disagree) for both positive and negative statements, and the total score reflects the environmental attitude score of the participant. The possible scores vary between 13 and 65 in the 13-item Environmental Behavior Subscale, while possible scores vary between 14 and 70 in the 14-point Environmental Thought Subscale. The minimum total scale score, thus, is 27, and the maximum score is 135.

In Likert type scales, the scale score is the sum of the scores for individual responses to the items. Scoring is conducted as presented in Table 3 in Likert type scales. Furthermore, the scoring of positive and negative items is different.

After the application, it was determined that the Environmental Attitude Scale was two-dimensional. The analysis of the items revealed that the first dimension measured the environmental

Table 1. *Item scoring.*

Option		Positive attitude items	Negative attitude items
Completely agree		5	1
		4	2
		3	3
		2	4
Completely disagree		1	5

behavior of the students, and the items in the second dimension measured the environmental thoughts of the students. The items that measured these two sub-dimensions of attitude were classified as "Environmental Behavior Subscale" and "Environmental Thought Subscale".

2.1. Environmental Attitude Scale

2.1.1. Environmental Behavior Subscale

1. I watch radio and TV shows about the environment
2. I follow environmental developments in daily newspapers
3. I watch documentaries on environment
4. I read books on environment other than textbooks
5. I read popular magazines on environ ment
6. I read scientific articles on environment
7. I would not hesitate to warn people who harm the environment
8. I would like to volunteer in environmental activities at school
9. My friends know that I am sensitive for the environment
10. I can volunteer for long term for a habitable environment
11. I share my environmental knowledge with my friends
12. I pay attention weather the waste of the product is recyclable when shopping
13. I prefer environment-friendly products even if they are more expensive

2.1.2. Environmental Thought Subscale

1. Endangered species are exaggerated, there are already several species in nature, extinction of a few is not important.
2. It is more beneficial for our country to construct better roads instead of spending money on historical places.
3. Erosion is no longer a reality in our country
4. Agricultural pesticides are beneficial for the environment
5. It is conceivable to sell degraded forest land to increase national revenues
6. The state should allow the construction of touristic buildings in national parks and forests.
7. It is best to wick the wetlands to build houses.
8. Human waste is not a problem since the environment cleans itself.
9. The ozone layer thinned out especially over the US. Turkey is not in danger.
10. Turning off the lights when leaving a room would not cause significant energy savings.
11. There is plenty of water on earth: humans could never contaminate it.
12. The rapid depletion of natural resources is a significant problem for our future.
13. Urban sprawl is one of the most important problems in Turkey.
14. Global warming could lead to disasters in the future.

3. Data analysis

In the analysis of the study data, environmental behavior and environmental thought subscale arithmetic averages and scores of all respondents in the sample were initially calculated. Then a correlation analysis was conducted to determine whether there was a correlation between the environmental behavior and thought scores based on student seniority. Simple linear regression analysis was conducted to determine the effect size. Finally, ANOVA was conducted to determine whether there was a difference between the environmental behavior and thought mean scores of freshmen and senior students.

4. Findings

The total mean student scores for the environmental behavior and environmental thought subscales are presented in Table 2. It was determined that the mean environmental attitude score

Table 2. *The environmental behavior, environmental thought and the environmental attitude scores of freshmen and senior students.*

attitude scores of freshmen and senior students

	N		Total mean score
Environmental behavior	Freshmen	80	40,9375
	Senior	80	46,9875
Environmental thought	Freshmen	80	49,4
	Senior	80	52,0375
Environmental attitude	Freshmen	80	90,3375
	Senior	80	99,025

Table 3. *The arithmetic mean environmental behavior score of the students in each related scale item.*

S.	EB1	EB2	EB3	EB4	EB5	EB6	EB7	EB8	EB9	EB10	EB11	EB12	EB13
1.	3,3	3,3	3,2	3,2	2,7	2,3	3,4	2,9	3,1	2,8	3,7	3,2	3,4
4.	3,7	3,9	3,7	3,4	3,6	3,9	3,7	3,8	3,2	3,4	3,7	3,3	3,2

Table 4. *The arithmetic mean environmental thought score of the students in each related scale item.*

S.	ET1	ET2	ET3	ET4	ET5	ET6	ET7	ET8	ET9	ET10	ET11	ET12	ET13	ET14
1.	3,5	3,5	3,06	3,2	4,3	3,5	3,2	3,6	3,6	3,4	3,5	3,9	3,08	3,4
4.	3,4	3,5	3,8	3,8	4,05	3,6	3,5	3,7	3,7	3,9	3,8	3,6	3,8	3,5

(99.025) of the senior students, which is the sum of the mean environmental behavior (46.9875), and environmental thought (52.0375) subscale scores, was higher than those of the freshmen (90.3375).

The mean score for each item in the environmental behavior and environmental thought subscales are presented in Tables 3 and 4.

Correlation analysis was conducted to determine whether there was a correlation between students' environmental behavior and thoughts based on seniority. Correlation analysis findings are presented in Table 5. Thus, it was determined that there was a positive correlation between the total environmental behavior and total environmental thought scores. Correlation coefficient was calculated as r = 0.489. As the total environmental behavior score increased, the total environmental thought score increased. There was also a positive and significant correlation between the student seniority and total environmental behavior and environmental thought scores. In other words, the total environmental behavior and environmental thought scores of the senior students were higher than those of the freshmen. The scale scores increased with seniority. Environmental behavior score correlation coefficient was r = 0.631 and environmental thought score correlation coefficient was r = 0.360.

Table 5. *Correlation analysis findings.*

Partial Correlation Findings				
		EBTS	ETTS	SENIORITY
Environmental Behavior Total Score (EBTS)	Pearson correlation	1	,419**	,631**
	Sig.		,000	,000
Environmental Thought Total Score (ETTS)	Pearson correlation	,419**	1	,360**
	Sig.	,000		,000
SENIORITY	Pearson correlation	,631**	,360**	1
	Sig.	,000	,000	
**, (p<0.01), N=160				

Table 6. *The regression findings conducted to determine the effect of seniority on environmental behavior and thinking scores.*

Model		B	Std. error	ß (Beta)	t	Sig.
1	Constant	-1,979	,441		-4,489	,000
	EBTS	,061	,007	,583	8,632	,000
	ETTS	,016	,009	,116	1,720	,031
R=,640; R2=,410; Corrected R2=,402; Model F= 54,519; df1=2; df2=157; p<0,05						

After the direction and size of the correlation between student seniority and environmental behavior and environmental thought scores was determined with the correlation analysis, simple linear regression analysis was conducted to determine the effect of seniority on environmental behavior and thinking scores (Table 6).

As seen in Table 6, it was determined that the effect of seniority on environmental behavior and thought scores was positive and statistically significant. This effect was higher on the environmental behavior score (ß =, 583; p = 0.01) and lower on the environmental thought score (ß =, 116; p <0.05). The effects of seniority on environmental behavior and environmental thought scores are presented in Figure 1.

Based on analysis of the scores of the freshmen and senior students, their mean environmental behavior and thought scale scores were calculated and ANOVA was employed to determine whether there was a difference between the mean scores based on seniority (Tables 7 and 8). The review of Table 7 demonstrated that "Sig." value was <0.05 for all variables. In other words, there was a significant difference between environmental behavior and environmental thought scores based on seniority. The difference based on seniority was predominant in environmental behavior scores (F = 105,331; p = 0,00). The difference

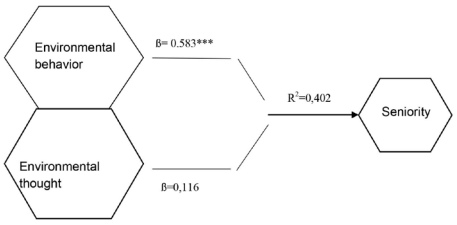

Figure 1. *The theoretical model for the effects of seniority on environmental behavior and environmental thought scores.*

Table 7. *The mean environmental thought and environmental behavior scores based on seniority.*

		N	Mean of Squares	Standart Errors
EBMN	Freshmen	80	3,1506	,31430
	Senior	80	3,6144	,25424
	Total	160	3,3825	,36787
ETMN	Freshmen	80	3,5286	,23085
	Senior	80	3,7170	,25927
	Total	160	3,6228	,26231

Table 8. *The results of the one way analysis of variance conducted to determine whether there was a difference between environmental thought and environmental behavior scores of the freshmen and senior students.*

		Sum of squares	Degree of freedom	Mean of squares	F	Sig.
EBMN	Intergroup	8,607	1	8,607	105,331	,000
	In-group	12,910	158	,082		
	Total	21,517	159			
ETMN	Intergroup	1,420	1	1,420	23,560	,000
	In-group	9,521	158	,060		
	Total	10,941	159			

between the environmental thought scores was also significant based on seniority (p = 0.00). However, the difference was lower than environmental behavior scores (F = 23,560).

5. Discussion

The review of previous studies conducted on environmental attitude, environmental behavior, and environmental though revealed that various scales were developed by different authors, while certain scales were utilized with different samples in different research fields. One was the 15-item "New Ecological Paradigm (NEP)" scale (Dunlap et al. 2000), which is widely used in the literature to determine environmental attitudes. NEP (Dunlap and Van Liere 1978; Dunlap et al. 2000; Dunlap, 2008) was developed by Dunlap and Van Liere in 1978 and revised in 2000. In the literature review, it was observed that NEP was applied to several groups. In the literature, there are studies developed especially for students and certain other applications. Demirel et al. (2009) investigated the impact of nature recreational activities on environmental attitude. The sample included students attending different universities in Ankara. The analysis was conducted on a 5-point Likert type scale. Erdoğan (2006) tested the NEP scale on students attending four colleges in different provinces and investigated whether the students had nature-centered or human-centered thinking. Alnıaçık and Koç (2009) determined the attitudes of students attending 5 universities and Alnıaçık (2010) determined the attitudes of students attending 7 universities towards the environment using the NEP scale and reported that the awareness of university students about environmental problems was above average.

Yet another scale was developed by Altınöz (2010). This test included 15 multiple choice questions. Each item has five choices, and it was first used by the authors and then by various others. Kıyıcı et al. (2014) used the scale in a study on the analysis of the change in environmental literacy of pre-service teachers with nature education and their views, Erbasan and Erkolun (2020) used the scale in their study titled 'Investigation of Environmental Knowledge, Attitudes and Behavior of Classroom Teachers' in 2020', Akıllı and Genç (2015) used the scale in a study on the analysis of environmental literacy sub-dimensions of middle school students based on various variables, Kışoğlu et al. (2016) used the scale to investigate the environmental problem attitudes of pre-service teachers who will instruct environmental education in primary and middle schools, and also certain other authors used the scale.

The environmental attitude scale used in the present study was initially used by Uzun and Sağlam, who developed the scale, in 2000, and later used on various sample groups by various authors in different fields. Sadık and Çakan (2010) used the scale in a study on environmental knowledge of biology students and their attitudes towards environmental problems. The aim of that study was to investigate the students' environmental knowledge and their attitudes towards environmental problems based on certain variables. The study was conducted with 212 students attending Çukurova University, Faculty of Arts and Sciences, Department of Biology. T-test and variance analysis were employed in data analysis. The analyzes demonstrated that environmental behavior and attitudes of female students were more positive when compared to male students. While there was no significant difference between the environmental thought scores of the students based on seniority, it was determined that the environmental behavior scores of freshman students were more positive. Yet in another study, Kahyaoğlu (2013) investigated the correlation between the environmental attitudes and intelligence domains of middle school students based on the multiple intelligence theory. The study data were collected with the "multiple intelligence domains inventory" developed by Armstrong (1999) and translated into Turkish language by Saban (2002) and the "environmental attitude scale" developed by Uzun and Sağlam (2006) that includes environmental behavior and environmental thought sub-dimensions. The analysis of the correlation between the environmental attitudes and intelligence domains of the middle school students revealed that there

was no significant difference between the environmental attitudes and logical, social, physical, intrinsic, naturalistic and visual intelligence domain scores of the middle school students, while a significant difference was determined between verbal intelligence and musical intelligence domain scores. On the other hand, it was determined that there were low significant correlations between environmental attitude scores and logical mathematical intelligence scores of the pre-service teachers. The scale has been used in several other studies. Poley and O'Connor (2000) developed the "Environmental Attitude Scale" and applied the scale to 92 individuals. In a study on curricula, it was revealed that the attitude and behavior dimensions were neglected in the curricula and the curricula mostly aimed to provide information. Environmental attitudes, beliefs and emotions were discussed in the study. It was concluded that besides providing information about environmental programs, raising environment awareness and environment-friendly individuals should be prioritized based on the dimensions of environmental attitudes and behavior.

Yilmaz, Boone, and Andersen (2004) developed a 51-item "Attitudes Towards Environmental Problems Scale." The scale was applied to 458 students, and the attitude scores were compared and analyzed based on independent variables such as gender, education level, socio-economic status, and the region of the school.

Tuncer, Ertepinar, Tekkaya, and Sungur (2005) developed a Likert-type survey that included 45 items and four factors (environmental problem awareness, national environmental problems, problem solutions, individual responsibility awareness) and applied the scale to 1497 students attending private and public schools. In the study, a statistically significant difference was determined between students environmental attitudes based on school type and gender.

In a study on the impact of social desirability on environmental awareness, attitudes and behavior, Çınar et al. (2019) sampled individuals who participated in nature hiking tours. The findings demonstrated that the environmental awareness, environmental attitudes and environmental behavior of these individuals were significantly affected by social desirability. Thus, it was observed that raising environmental awareness, attitudes and behavior is very difficult and even the sincerity was affected by social pressures via social desirability.

Gazeloğlu (2019) investigated the environmental behavior of academicians and reported that academicians were more environmentally sensitive to pass a clean world on to the children. Furthermore, they proposed legal regulations for businesses that pollute the nature. Finally, they argued that will file a complaint to relevant authorities about environmental problems (such as businesses, vehicles, machinery, etc.). These sensitivities were among the prominent arguments of the academicians.

Turkistani (2019) investigated the impact of the environmental attitude levels of consumers on purchasing behavior, and they applied a questionnaire to 400 students at Marmara University. The findings revealed that the effects of environmental interest, sensitivity, awareness, pollution and environmental problems and other demographic variables (age, gender, education level, etc.) on purchasing environmentally friendly products were statistically significant.

A similar study was conducted by Dinavasova (2019). The findings of the study on the effect of individual environmental attitudes on sustainable consumption behavior demonstrated that environmental attitudes had an effect on sustainable consumption behavior. Furthermore, it was observed that the environmental attitude and sustainable consumption behavior sub-dimensions varied based on certain demographics.

6. Conclusion

Although the difference between the environmental behavior scores of the freshman and senior students was not significant in the study, the environmental behavior scores of the senior students were higher than the environmental behavior scores of the freshman students. Similar findings were obtained about the environmental thought scores. In other words, the environmental thought scores of the freshman students were lower than the

environmental thought scores of the senior students. Finally, it was determined that the environmental attitude scores of the senior students were higher than those of the freshman students.

The analysis of the item scores in the environmental behavior subscale revealed that the arithmetic mean score of senior students was higher in all items except two items. Only in the 11th item, the average scores of the freshman and senior students were equal. In the analysis of the 13th item scores, the mean score of freshman students was higher.

The analysis of the item scores in the environmental thought subscale revealed that the mean scores of the senior students were higher in 9 out of 14 items, while the mean scores of the freshman students were higher in the 1st, 5th and 12th items. In the 2nd item, the mean scores were equal.

The statistical analyses were conducted to determine whether there was a correlation between environmental behavior and environmental thought scores of the freshman and senior students, and a significant and positive correlation was found between these scores. In other words, when the environmental behavior score increased, the environmental thought score increased as well. Furthermore, the impact of seniority on environmental behavior and thought scores was investigated, and a positive and significant correlation was determined. In other words, as the class level increased, the score increased as well. The effect on the environmental behavior score was higher, while the effect on the environmental thought score was lower. Also, it was tested whether the total environmental behavior and environmental thought scores differed based on seniority, and a difference was determined between the freshmen and seniors.

The present study was based on the assumption that education will have an impact on environmental behavior and environmental thought; and thus on environmental attitudes, and the accuracy of the assumption was determined with the statistical analysis conducted on the scale data. The scale scores demonstrated that, the sensitivity of the students who took environmental courses for four years increased and the courses had a positive impact on their behavior, thoughts and attitudes. The assumption was confirmed in the present study conducted with the freshman and senior students attending Karadeniz Technical University, Landscape Architecture Department.

References

Akıllı, M., & Genç, M. (2015). Examination of middle school students' subdimensions of environmental literacy in terms of various variables. *Sakarya University Journal of Education,* 5(2), 81-97.

Alnıaçık, Ögdü, & Koç, Ö. G. F. (2009). Yeni Çevresel Paradigma Ölçeği İle Üniversite Öğrencilerinin Çevreye Yönelik Tutumlarının Değerlendirilmesi. *Bölgesel Kalkınma Kongresi,* 14-16.

Alnıaçık, Ü. (2010). Çevreci yönelim, çevre dostu davranış ve demografik özellikler: üniversite öğrencileri üzerinde bir araştırma. *Selçuk Üniversitesi Dergisi*, 10(20); 507-532.

Alpak, E. M., Özkan, D. G., & Düzenli, T. (2018). Systems approach in landscape design: a studio work. *International Journal of Technology and Design Education,* 28(2), 593-611.

Alpak, E. M., Düzenli, T., & Mumcu, S. (2020). Raising awareness of seating furniture design in landscape architecture education: physical, activity-use and meaning dimensions. *International Journal of Technology and Design Education*, 1-25.

Altınöz, N. (2010). Fen bilgisi öğretmen adaylarının çevre okuryazarlık düzeyleri. Yayımlanmamış Yüksek Lisans Tezi, Sakarya Üniversitesi Fen Bilimleri Enstitüsü, Sakarya.

Aydın, M. (2000). *Eğitim yönetimi.* Ankara: Hatiboğlu Yayınevi.

Ayvaz, Z. (1998). *Çevre eğitiminde temel kavramlar el kitabı.* İzmir: Çevre Koruma ve Araştırma Vakfı, Çevre Eğitim Merkezi Yayınları, (5).

Aznar-Díaz, I., Hinojo-Lucena, F. J., Cáceres-Reche, M. P., Trujillo-Torres, J. M., & Romero-Rodríguez, J. M. (2019). Environmental Attitudes in Trainee Teachers in Primary Education. The Future of Biodiversity Preservation and Environmental Pollution.

International journal of environmental research and public health, 16(3), 362.

Batavia, C., Bruskotter, J. K., & Nelson, M. P. (2019). Pathways from Environmental Ethics to Pro-Environmental Behaviours? Insights from Psychology. *Environmental Values.*

Baur, J. W., Ries, P., & Rosenberger, R. S. (2019). A relationship between emotional connection to nature and attitudes about urban forest management. *Urban Ecosystems*, 1-11.

Bayramoğlu, E., Büyükkurt, U., & Yurdakul, N. M. (2019). Peyzaj Mimarlığı Eğitiminde Proje Tasarım Süreci: Trabzon "Karagöz Meydanı" Çevre Tasarım Projeleri. *Social Sciences*, 14(1), 15-24.

Bell, P. A., Green, T., Fisher, J. D., & Baum, A. (2001). E*nvironmental Psychology*. New Jersey.

Berkes, F., & Kışlalıoğlu, M. (1993). *Ekoloji ve çevre bilimi.* İstanbul: Remzi Kitabevi.

Berto, R. (2019). Our wellbeing in modern built environments is rooted in our evolutionary history. Are we aware of this?. *Visions for Sustainability,* 11:3-8.

Bozkurt, O., & Aydoğdu, M. (2004). İlköğretim 6., 7. ve 8. sınıf öğrencilerinin "ozon tabakası ve görevleri" hakkındaki kavram yanılgıları ve oluşturma şekilleri. *Kastamonu Eğitim Dergisi*, 12(2), 369-376.

Bozkurt, O., & Cansüngü, Ö. (2002). Primary school students' misconceptions about Greenhouse effect in environment education. *Hacettepe University Journal of Education*, 23, 67-73.

Cao, H., & Chen, Z. (2019). The driving effect of internal and external environment on green innovation strategy-The moderating role of top management's environmental awareness. *Nankai Business Review International, 10*(3), 342-361.

Capra, F. (2009). The new facts of life: Connecting the dots on food, health, and the environment. Public Library Quarterly, 28(3), 242-248.

Cattaneo, T., Giorgi, E., & Ni, M. (2019). Landscape, Architecture and Environmental Regeneration: A Research by Design Approach for Inclusive Tourism in a Rural Village in China. *Sustainability, 11*(1), 128.

Cavanna, A. (2019). How can the replacement of public lots with planted green spaces promote environmental awareness and encourage social involvement in Long Beach, NY.

Çabuk, B., & Karacaoğlu, C. (2003). Examination of Sensitivity of University Students. *Ankara Univ. Edu. Sci. Faculty Mag*, 36(1-2), 189-198.

Çelik, S. (2019). Hızlı Şehirleşmenin Doğurduğu Sorunlar Ve Çözüm Yolları. *Journal of International Social Research, 12*(62).

Çetin, T., Turan, M. E., Aytekin, P., & Yurdusev, M. A. (2020). Üniversite Öğrencilerinin Çevresel Yaklaşımlarını Ölçmeye Yönelik Bir Araştırma: Manisa Celal Bayar Üniversitesi Örneği. *Doğal Afetler ve Çevre Dergisi,* 6(1), 1-12.

Çınar, B., Duran, A., & Taştan, H. (2019). Sosyal İstenirliğin Çevreci Duyarlılık, Tutum ve Davranışlar Üzerindeki Etkisi; Doğa. *Journal of Tourism and Gastronomy Studies,* 1727, 1736.

Çorbacı, Ö. L., Abay G., Oğuztürk, T., & Üçok M. (2020) Kentsel Rekreasyonel Alanlardaki Bitki Varlığı; Rize Örneği/ Plant Existence in Urban Recreational Areas; Rize Example. *Düzce Üniversitesi Orman Fakültesi Ormancılık Dergisi, 16*(2), 16-44.

Demirel, M., Gürbüz, B., & Karaküçük, S. (2009). Rekreasyonel Aktivitelere Katılımın Çevreye Yönelik Tutum Üzerindeki Etkisi Ve Yeni Ekolojik Paradigma Ölçeği'nin Geçerliği Ve Güvenirliği. *Spormetre Beden Eğitimi Ve Spor Bilimleri Dergisi,* 7(2), 47-50.

Diekmann, A., & Franzen, A. (2019). Environmental concern: A global perspective. *In Einstellungen und Verhalten in der empirischen Sozialforschung* (pp. 253-272). Springer VS, Wiesbaden.

Dinavasova, J. (2019). Bireylerin çevresel tutumlarının sürdürülebilir tüketim davranışına etkisi üzerine bir araştırma.

Dinçer M. *Çevre gönüllü kuruluşları.* Ankara: Türkiye Çevre Vakfı Yayını; 1996.

Dunlap, R. E. (2008). The new environmental paradigm scale: From marginality to worldwide use. The Journal of environmental education, 40(1), 3-18.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: a revised NEP scale. Journal of social issues, 56(3), 425-442.

Duzenli, T., Alpak, E. M., & Yilmaz, S. (2019). Chıldren's Imagınatıons About Envıronment and Theır Perceptıons on Envıronmental Problems. Fresenıus Envıronmental Bulletın, 28(12 A), 9798-9808.

Düzenli, T., Yılmaz, S., & Alpak, E. M. (2018). Peyzaj Mimarlığı Eğitiminde Bir Tasarım Yaklaşımı: Doğal Örüntülerden Esinlenme. SED-Sanat Eğitimi Dergisi, 1:21-35.

Eisenhart, A. C., Crews Meyer, K. A., King, B., & Young, K. R. (2019). Environmental Perception, Sense of Place, and Residence Time in the Okavango Delta, Botswana. *The Professional Geographer, 71*(1), 109-122.

Erbasan, Ö., & Erkol, M. (2020). Sınıf Öğretmenlerinin Çevreye Yönelik Bilgi, Tutum ve Davranış Düzeylerinin İncelenmesi. *OPUS Uluslararası Toplum Araştırmaları Dergisi,* 16(24), 1-1.

Erdoğan, E. (2006). Çevre ve kent estetiği. B*artın Orman Fakültesi Dergisi,* 8(9), 68-77.

Erdoğan, M. (2011). Ekoloji temelli yaz doğa eğitimi programının ilköğretim öğrencilerinin çevreye yönelik bilgi, duyuşsal eğilimler ve sorumlu davranışlarına etkisi. *Kuram ve Uygulamada Eğitim Bilimleri,* 11(4), 2223-2237.

Eroğlu, E.; Kaya, S.; Dogan, T.G.; Meral, A.; Demirci, S.; Başaran, N.; Corbaci, O.L. Determination of the Visual Preferences of Different Habitat Types. FEB, 2018, 2018070243 (doi: 10.20944/preprints201807.0243.v1).

Ertürk, Ö.G.İ.E., Uçar, U.M., Yıldırım, M.N., Karaman, A., & Ertekin, S. (2017). Öğrencilerin Çevre Duyarlılığının Eko-Girişimcilik Eğilimleri Üzerine Etkisi, *Akademik Sosyal Araştırmalar Dergisi*, 5(63):526-538.

Gage, R., & Graefe, D. (2019). Campus conservation initiatives: factors influencing student engagement, attitudes and behaviours. *International Journal of Higher Education and Sustainability,* 2(3), 197-215.

Gatersleben, B. (2018). Measuring environmental behaviour. *Environmental psychology: An introduction,* 155-166.

Gazeloğlu, C. (2019). Akademisyenlerin Çevresel Davranışlarının İstatistiksel Yöntemlerle Belirlenmesi. *Journal of Social Sciences/Sosyal Bilimler Dergisi,* (31).

Gifford, R. (2014). Environmental psychology matters. *Annual review of psychology, 65,* 541-579.

Güzelyurt, T., & Özkan, Ö. (2019). Environmental Education in Pre-School Period: An Examination of Children's Books. *Elementary Education Online, 18*(1), 20-30.

Henkel, C., Seidler, A. R., Kranz, J., & Fiedler, M. (2019). How To Nudge Pro-Envıronmental Behavıour: An Experımental Study. In Proceedings of the 27th European Conference on Information Systems (ECIS), Stockholm & Uppsala, Sweden, June 8-14, 2019. ISBN 978-1-7336325-0-8 Research Papers

Hong, C. Y., Chang, H., & Chung, E. S. (2019). Comparing the functional recognition of aesthetics, hydrology, and quality in urban stream restoration through the framework of environmental perception. *River Research and Applications, 35*(6), 543-552.

Huang, Y., Wang, J., & Yang, S. (2019, April). Research and Analysis on How to Improve the Awareness of Environmental Protection. In IOP *Conference Series: Earth and Environmental Science* (252(3): 032-035). IOP Publishing.

Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. The journal of environmental education, 21(3), 8-21.

İnceoğlu, M. (2004), *Tutum, Algı, İletişim* (1. Baskı). Ankara: Elips Yayınları

Janmaimool, P., & Khajohnmanee, S. (2019). Roles of Environmental System Knowledge in Promoting University Students' Environmental Attitudes and Pro-Environmental Behaviors. *Sustainability, 11*(16), 4270.

Kahyaoğlu, M. (2013). Ortaöğretim öğrencilerinin zekâ alanları ile çevreye yönelik tutumları arasındaki ilişkinin değerlendirilmesi.

Kang, Y., & Kim, E. J. (2019). Differences of Restorative Effects While Viewing Urban Landscapes and Green Landscapes. *Sustainability, 11*(7), 2129.

Kaplan, S. (2016). Cognitive maps, human needs and the designed environment 5.4. *Environmental Design Research: Volume one selected papers,* 275.

Kaya, E., Akilli, M., & Sezek, F. (2009). An investigation of high school students' environmental attitudes in terms of gender. *Mehmet Akif Universi-*

ty Journal of Education, 9, 43-54.

Keleş, R., Çoban, A. & Hamamcı C. (2009). *Çevre Politikası.* Ankara: İmge Yayıncılık.

Kışoğlu, M., Yıldırım, T., Salman, M., & Sülün, A. (2016). İlkokul ve ortaokullarda çevre eğitimi verecek olan öğretmen adaylarında çevre sorunlarına yönelik davranışların araştırılması. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi,* 18(1), 299-318.

Kıyıcı, F. B., Yiğit, E. A., & Darçın, E. S. (2014). Doğa eğitimi ile öğretmen adaylarının çevre okuryazarlık düzeylerindeki değişimin ve görüşlerinin incelenmesi. *Trakya Üniversitesi Eğitim Fakültesi Dergisi*, 4(1), 17-27.

Kızgın, Y., Karaosmanoğlu, K., Okulu, M. M. Y., Örmeci, G., & Özlem, T. A. Ş. (2017). Tüketicilerin Sürdürülebilir Tüketim Bağlamında Yeşil Tüketim Eğilimleri Ve Demografik Özelliklere Göre Farklılıkları. *Proceedıngs Book*, 762.

Kiessling, T., Salas, S., Mutafoglu, K., & Thiel, M. (2017). Who cares about dirty beaches? Evaluating environmental awareness and action on coastal litter in Chile. *Ocean & coastal management,* 137, 82-95.

Kiper, T. (2014). Peyzaj Mimarlığı Öğrencilerinin Çevre Tutumlarının Belirlenmesi Determination of Environmental Attitudes of Students of Landscape Architecture. *Tekirdağ Ziraat Fakültesi Dergisi, 11*(2), 80-88.

Lindquist, M., Lange, E., & Kang, J. (2016). From 3D landscape visualization to environmental simulation: The contribution of sound to the perception of virtual environments. Landscape and *Urban Planning, 148*, 216-231.

Menatti, L., Subiza-Pérez, M., Villalpando-Flores, A., Vozmediano, L., & San Juan, C. (2019). Place attachment and identification as predictors of expected landscape restorativeness. *Journal of Environmental Psychology, 63*, 36-43.

Nikologianni, A., Moore, K., & Larkham, P. J. (2019). Making Sustainable Regional Design Strategies Successful. *Sustainability, 11*(4), 1024.

Oğuz, D., Çakcı, I., & Kavas, S. (2011). Environmental awareness of students in higher education. *Türkiye Ormancılık Dergisi, 12*(1), 34-39.

Özcan, H., & Arık, S. (2019). Çevre Kirliliğine Yönelik Tutum Ölçeği'nin Geliştirilmesi: Geçerlik ve Güvenirlik Çalışmaları. *Igdir University Journal of Social Sciences,* (17).

Özey, R. (2009). *Çevre Sorunları*, Aktif Yayıncılık, 3. Baskı, İstanbul.

Özgüner, H., Eraslan, Ş., & Yilmaz, S.(2012). Public perception of landscape restoration along a degraded urban streamside. *Land Degradation & Development, 23*(1), 24-33.

Özgüven, İ. E. (1998). Psikolojik Testler. Ankara: Pdrem Yayınları.

Özhancı, E., & Yılmaz, H. (2015). Doğa Sevgisi Değeri (Doğayı Koruma ve Doğadan Yararlanma) ve Peyzaj Mimarlığı Eğitimi. Namık kemal üniversiteleri dergileri Tekirdağ Ziraat Fakültesi Dergisi, 12(1).

Pelstring, L. (1997). *Measuring environmental attitudes: the new environmental paradigm.* Human Dimensions Research Unit, Cornell University, Ithaca, NY.

Prior, J. (2017). Sonic environmental aesthetics and landscape research. *Landscape research, 42*(1), 6-17.

Purwanti, D., & Musadad, A. A. (2019). The Effect of Local-Based 2013 Curriculum Implementation on Students' Environmental Awareness. *International Journal of Educational Research Review, 4*(1), 65-75.

Saban, A. (2002). *Çoklu Zekâ Teorisi ve Eğitim.* Ankara: Nobel Yayın ve Dağıtım.

Sadik, F., & Çakan, H. (2010). Biyoloji Bölümü Öğrencilerinin Çevre Bilgisi Ve Çevre Sorunlarına Yönelik Tutum Düzeyleri. *Journal of the Cukurova University Institute of Social Sciences,* 19(1).

Selim, S., Karakuş, N., Elkan, S., & Selim, C. (2011). Meslek yüksekokulu öğrencilerinin çevre sorunlarına ilişkin görüş ve tutumlarının değerlendirilmesi: Ortaca Meslek Yüksekokulu örneği. *SDÜ Orman Fakültesi Dergisi SDU, 12*, 148-154.

Sever, R., & Yalcinkaya, E. (2012). Examining the environmental attitudes of pre-service teachers on primary school teaching. Marmara *Geographical Review,* (26), 1-15.

Shang, H., Lin, M., & Zheng, Y. (2019, July). The Perception Reshaping Strategy of Campus Public Space.

In *International Conference on Applied Human Factors and Ergonomics* (381-391). Springer, Cham.

Smith, J. W. (2015). Immersive virtual environment technology to supplement environmental perception, preference and behavior research: a review with applications. *International journal of environmental research and public health, 12*(9), 11486-11505.

Stanley, S. K., & Wilson, M. S. (2019). Meta-analysing the association between social dominance orientation, authoritarianism, and attitudes on the environment and climate change. *Journal of Environmental Psychology, 61*, 46-56.

Steg, L., van den Berg, A. E., & de Groot, J. I. (2018). Environmental Psychology: History, Scope, and Methods. *Environmental psychology: an introduction*, 1-11.

Stenfors, C. U. D., Van Hedgere, S. C., Schertz, K. E., Meyer, F., Smith, K. E., Norman, G., ... & Berman, M. G. (2019). Positive effects of nature on cognitive performance across multiple experiments: Test order but not affect modulates the cognitive effects. *Frontiers in psychology, 10*, 1413.

Strack, M., Shephard, K., Jowett, T., Mogford, S., Skeaff, S., & Mirosa, M. (2019). Monitoring surveying students' environmental attitudes as they experience higher education in New Zealand. *Survey Review, 51*(366), 257-264.

Tarakçı, E. E., Alpak, M. E., Düzenli T. (2018). Mevsimsel Bitki Görünümlerinin Tercih Ve Algısal Farklılıklarının Belirlenmesi. Uluslararası Bilimler Araştırma Dergisi, 3(1), 145-154.

Torres-Lima, P., Conway-Gómez, K., & Buentello-Sánchez, R. (2018). Socio-Environmental Perception of an Urban Wetland and Sustainability Scenarios: a Case Study in Mexico City. *Wetlands, 38*(1), 169-181.

Tuncer, G., Ertepinar, H., Tekkaya, C., & Sungur, S. (2005). Environmental attitudes of young people in Turkey: Effects of school type and gender. *Environmental Education Research*, 11(2), 215-233.

Turkistani, F. N. (2019). *Tüketicilerin çevresel tutumlarının çevre dostu ürün satın alma davranışları üzerinde etkisinin incelenmesine yönelik bir araştırma.* Marmara Üniversitesi Tezi.

Türk A. (1998). Çevre nedir?. Kıvanç M ve Yücel E, editörler. Çevre ve insan. Eskişehir: Anadolu Üniversitesi Yayınları; 1-12.

Uzun, N., & Sağlam, N. (2006). Orta öğretim öğrencileri için çevresel tutum ölçeği geliştirme ve geçerliliği. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 30(30), 240-250.

Van Hedger, S. C., Nusbaum, H. C., Clohisy, L., Jaeggi, S. M., Buschkuehl, M., & Berman, M. G. (2019). Of cricket chirps and car horns: The effect of nature sounds on cognitive performance. *Psychonomic bulletin & review, 26*(2), 522-530.

Wallner, P., Kundi, M., Arnberger, A., Eder, R., Allex, B., Weitensfelder, L., & Hutter, H. P. (2018). Reloading pupils' batteries: Impact of green spaces on cognition and wellbeing. *International Journal Of Environmental Research And Public Health, 15*(6), 1205.

Yıldız, K., Sipahioğlu, Ş., & Yılmaz, M. (2000). *Environmental Science.* Gündüz Education and Publishing, Ankara, 104-114.

Yılmaz, A., Morgil, F. İ., Aktuğ, P., & Göbekli, İ. (2002). Ortaöğretim ve üniversite öğrencilerinin çevre, çevra kavramları, ve sorunları konusundaki bilgileri ve öneriler. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 22(22).

Yücel, M., Altunkasa, F., Güçray, S., Uslu, C., Say, N. P., & Say, N. P. (2006). Adana'da Çevre Duyarlılığı Düzeyinin Ve Geliştirme Olanaklarının Araştırılması. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi, 19*(2), 217-228.

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The using of urban park as perceived by visually impaired

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Abstract

Visually impaired individuals deserve a comfortable outdoor experience. They need to perceive the space in the urban outdoors and act independently in the urban environment. These individuals have multi-sensory perceptual abilities in understanding the formal criteria in accessing and using urban spaces. Subsequently, it is essential to discuss these multiple sensory perceptions within the design and planning of the public spaces. This study aims to understand the sensory references of visually impaired individuals and their perception of landscape and space while they use urban parks. In this context, the focus is on how these individuals take their positions, develop orientations, coordinate movements, and behaviors based on the tactile, auditory, olfactory, and gustatory clues they receive from the environment. For this purpose, we conducted semi-structured one-on-one interviews with 22 visually impaired individuals. As a result of in-depth interviews, we understood visually impaired individuals' sensory references and their independent mobility in the urban environment. While each individual's sensory references vary, sometimes different references are collected in one sense, and sometimes a reference was perceived by more than one sense. Developing sensory references in the urban landscape design is useful in providing comfortable space usage for the visually impaired and all other users.

Keywords

Universal design, Visually impaired, Sensory perception, Sensory references, Sensory perception of a landscape.

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1. Introduction

Visually impaired individuals are a significant reference group for universal design. The universal design promotes a sound design approach to meet potential user groups' needs, while taking into account all users with specific characteristics (Mace, 1988; Rocque et al., 2015). There are a lot of people in society who live partially or fully lacking vision. Even though some individuals have a congenital visual impairment, sometimes people might be visually impaired due to an illness or accident. Visually impaired people have the right to participate in social life in the urban environment as much as every human being.

The visually impaired individuals are limited in their ability to use, experience, and perceive the space. However, they cannot perform their movement independently in the urban environment and therefore cannot use the urban environment.

The problems faced by visually impaired individuals in urban life are related to the physical structure of the cities. It is inevitable that these individuals, who cannot act most of the time independently, lose their area of movement thoroughly due to unplanned construction and inadequate arrangements in the urban environment. Besides, spatial designs can restrict the mobility of these individuals. Improper implementation of relevant standards in the urban built environment prevents these individuals to move out of their homes and restrict participation in urban life and their access to health services provided by the government (Republic of Turkey, 2010; Gezer 2014; Akcalı, 2015).

A study conducted with visually impaired young people living in the UK shows that 20% of the young people who participated in the study could not go out of their houses. 34% of them could go to places close to the area they live in, and only 41% of them can walk alone in the neighborhood (Bruce et al., 1991). Thus, another study shows that 70% of the visually impaired individuals who participated in this survey can move independently outside their home and environment (Clark-Carter et al., 1986; Belir, 2012). In providing accessible urban living standards to visually impaired individuals, resolving physical barriers may help to overcome social constraints.

Studies on visually impaired individuals in the literature vary in architectural and urban design scales and contents, and try to reveal the event in the context of buildings, streets, and squares. Most of these studies focus on urban space's physical properties and not the sensory perception of the visually impaired. However, there are insufficient number of studies investigating visually impaired individuals in the city parks context and focusing on the use of multiple senses.

This study aims to understand visually impaired individuals' sensory references and their perception of the landscape space. In this context, the focus is on how these individuals direct their positions, develop descriptions, understand orientations, decide on movements and behaviors by using the tactile, auditory, olfactory, and gustatory clues in the urban park scale.

In this paper, we study the perception of landscape and understanding of landscape space with visually impaired people's auditory, tactile, olfactory, and gustatory senses, which reveals the importance of a different starting point in multi-sensory perceptible landscape design. In universal design context, this study has original value in terms of the perception of all senses to shape landscape design and providing sustainable solutions in promoting exclusive urban public space design.

2. Visually impaired individuals and their perception patterns

The visually impaired persons prefer a cane, guiding visionary, or guide dog more than electronic devices. The guiding visionary can facilitate a comfortable, fast, and safe stroll of the visually impaired; however, the guiding visionary may not be available all the time to give this service. The guide dogs can also lead the movement and become the best friends of the visually impaired towards developing emotional connection. However, the guide dogs may be costly, and not welcomed some places including café and such; therefore, their utility may diminish (Gürkan, 2012). The visually impaired persons mostly

use a cane as a tool to move in different environments. Although they support the independent movement, these solutions are addictive for the visually impaired.

Gaunet (2006), investigates the direction-finding performances of visually impaired pedestrians, where 7 of the observations in this study use a cane, and 3 use a guide dog. Her findings reveal that direction performance can change according to the technical assistance they use in their journeys. Similarly, her findings suggest that there should be guidance clues and design rules to help the visually impaired find direction in urban environments (Gaunet, 2006). Sound design is imperative to include visually impaired public spaces and essential for exclusively promoting quality of life in urban environments.

Quality of life in urban environments depends on spatial experiences and decisions in different situations and scales. Every individual living in the city has a spatial awareness formed by vision, auditory, tactile, olfactory, and gustatory senses. Sensory inputs from the surrounding environment enable people to perceive their environments (Stankiewicz & Kalia, 2007). People create their spatial knowledge by experiencing urban contexts; in this way, one knows the geography of the city and learns the locations of places. (Jacobson, 1998; Belir, 2012). Therefore, experience in urban space is essential in the perception of space (Porteous, 1996). The mental evaluation initiates the formation of behavior in space orientation. This formation is completed by the individuals choosing and perceiving the infinite signs in the space according to their importance (Giritlioglu, 1991; Pallasmaa, 2006).

Within the social life of the city, every individual perceives the environment, ultimately with visual stimuli (Turkoz Sarp, 2013). If the vision is impaired, individuals employ other sensory stimuli while conceiving their perception of the environment. Individuals who are born blind or blind after a limited period in childhood rely entirely on information from other stimuli hence utilizing their tactile, auditory, olfactory, and gustatory senses (Warren 1978; Heylighen & Herssens, 2014). Subsequently, blind individuals' lifestyles, time management, and space understanding are different from other people. These individuals use icons, signs, and expressions in the external environment at different levels other than the sense of sight. With the help of these various clues, they take their places in urban life and participate in social life (Sürmen, 2004; Marston & Golledge, 2004; Jenkins, Yuen & Vogtle, 2015).

In crowded cities nowadays, urban parks provide physical exercise and relaxation areas for the citizens. In addition to these functions, these urban living areas also offer psychological, social, and cultural services (Lynch, 1990; Francis, 2003; Chiesura, 2004; Walker, 2004). Urban parks conveniently located and accessible to all types of users can promote and enrich social life (Celik, 2013; Siu, 2013). Urban park design is a process that adopts design principles such as accessibility, legibility of space, and its comfort and usability.

In the use of urban parks by visually impaired users, the location of the space in the city and the accessibility of the area are the first concerns. The spatial composition, the placement of the landscape elements, the physical and functional qualities are also important concerns. Sensory clues taken from both the physical environment and the perception of the space by visually impaired individuals are useful in visually impaired individuals' movement in the public space. Therefore, sensory clues in the physical environment is a critical element of open space design.

In urban design, there is need for comprehensive studies, which provide accessible, perceptible, cognizable, and usable implementation of landscape spaces, along with multidisciplinary and sustainable approaches. The urban spaces arranged with the visually impaired sensory space perception references will help to ensure accessibility and perceptibility for all users.

3. Method

The analytical approach of this study involves face to face interviews. The interviews include open-ended, unstructured, and semi-structured questions (Newton, 2010; Cokluk et al., 2011; Cetin, 2017; Creswell, 2014). The inquiries

are related to the tactile, auditory, olfactory, and gustatory senses. We evaluate the sensory references for visually impaired individuals to understand their perception of landscape spaces.

3.1. Participants

In this research, we utilized a 'homogeneous sample' with a purposive sampling technique (Abbak, 2015). A total of twenty-two visually impaired individuals (10 females and 12 male) were involved in interviews. The participants' selection criteria are the following: 1-Lost all or almost all ability to see, 2- Use cane actively, 3- Active participation in urban life, and 4- Able to move independently. The participants were either work at or the member of the following enterprises: ITU Disabled Student Advisory Unit, Boğaziçi University Technology and Education Center for the Visually Impaired, Six Point Blind Association, Six Point Foundation for the Blind, Association of the Visually Impaired, Turkey Association of the Visually Impaired.

3.2. Data collection

The process of collecting data to determine the limits of research involve collecting information through unstructured, structured, or semi-structured interviews, observations, documents, and visual materials, as well as the creation of a protocol for recording the interviews (Cohen et al., 2007; Newton, 2010; Creswell, 2014). In this study, we used a semi-structured interview. There were four open-ended questions at two stages in the interviews. These questions are: (1) Do you go to the city parks in Istanbul? (2) Is there a city park where you go, why do you prefer this park? (3) Could you sort the senses according to the intensity of use during a park visit? (4) Could you explain how your senses provide a reference to you when you visit a park?

The interviews were conducted through follow-up of the questions and without directing the individuals; each interview was 40 to 60 minutes. We took short notes during the interviews and recorded all interviews. Before each interview, we ask the permission of the participants. We follow the time and place preference of the interviewees. We first got permission from the "Istanbul Technical University Ethics Committee for the Social Sciences and Humanities. And then, we mailed the ethics committee's permission to individuals and obtained their consent for recording the interview before the interview.

Table 1. *Demographic characteristics of participants.*

Categories		Frequency	%
Age	21-30	6	27.3
	31-40	7	31.8
	41-50	3	13.6
	51-60	6	27.3
Gender	Female	10	45.5
	Male	12	54.5
Marital status	Single	8	36.4
	Married	14	63.6
Education level	Elementary	2	9.1
	High school	7	31.8
	University or above	13	59.1
Profession	Student	2	9.1
	Housewife	1	4.5
	Teacher	4	18.2
	Lawyer	1	4.5
	Sociologist	1	4.5
	Psychologist and Psychological counselor	2	9.1
	Athlete	1	4.5
	Musician	2	9.1
	Civil servant	4	18.2
	Retired	4	18.2
Total		22	100

3.3. Data analysis

The best way to analyze the collected data is to identify the key themes in the data. Even the short notes received during the interview are beneficial in creating themes. It is not the numbers that are important in reporting the interview data, but what the participants report (Creswell, 1998).

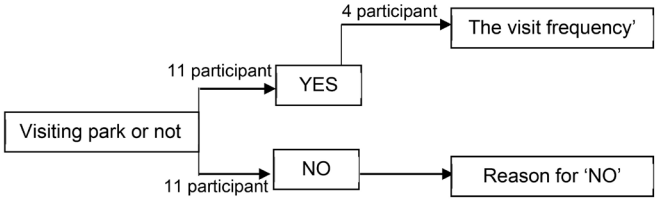
We analyzed the interview voice recordings and transferred the records into text. We classified sensory references under four themes: auditory, touch, smell, and gustatory sensation. Each theme had its own categories; thus, we generated perception-comprehension-usage referrals to the space corresponding to each class. We then created a network map of sensory themes, sensory reference categories, and perception-comprehension-usage to elaborate on the corresponding relationships. We used Graph Commons software for this task. "*Graph Commons is a collaborative platform for mapping, analyzing, and publishing data-networks. It empowers people and organizations to transform their data into interactive maps and untangle complex relations that impact them and their communities.*" (https://graphcommons.com/about).

4. Results

4.1. Demographic characteristics of participants

Among the 22 participants of the study, the respondents' ages range from 23 to 59 years old (mean = 37.54; SD = 10.5). Twenty-one individuals in our sample are actively working in different professional disciplines, and one participant is a housewife. All of the individuals in our sample participate in urban life independently (Table 1).

Almost all respondents, except two, have at least a high school degree (90.9%). Moreover, four of the respondents are currently enrolled in college.



Responses to 'yes'	Responses to 'The visit frequency'	Responses to 'Reason for 'NO'
"I'm trying to go to green areas, especially." (9)	"I often use a coastal park close to my house." (5)	"There's no park around where I live that I can comfortably go." (3)
"Not much, though. If I go, I usually prefer parks around the neighborhood where I live." (11)	"I often go with my family, the grove in the neighborhood where I live." (7)	"Our people are not very conscious about the disability; we can feel distressed." (19)
"I go to the park because of its proximity to get air at certain intervals." (13)	"There are several urban parks where I go often."(8)	"In the park, I cannot move safely; I do not know the transportation route; I do not have the safety of the obstacles on the route." (4)
"It is important to be close to my house and to be comfortable inaccessibility. When you leave, it's important not to have too many obstacles." (16)	"Mostly, I go to the grove. Because in these areas, there is a lot of green space and tranquility, and most importantly, the ground is different in the transitions of the wooded area through the walking path." (10)	"It is very difficult in our country for two visually impaired individuals to go to the park. You need to have a person who can see next to you, otherwise it is not suitable to use the area." (21)
"To be close, to be a pleasant area, and to be newly arranged." (18)		"I can't find my way, and there are lots of stairs, which prevent me from going to some parks." (8)
"Very close and accessible. I can go away in terms of having a large size, a lot of green space, where we can enjoy and play safely." (15)		"I don't think the parks are accessible. If I'm going, I compulsorily have to go with my friends who can see." (12)
"I go to the nearby parks to relax and do the walk." (14)		"I can't go alone and often, because space is not very large, there is no direction and controlled route." (6)
		"Since it is not close to where I live, it is difficult for us to go and return in terms of transportation, because you are visually impaired." (22)

Figure 1. *Responses of participants to questions about their park experiences.*

In our sample, twelve of the participants of different ages are congenitally blind; 5 of them lost their sight when they were young, and 4 of them gradually lost their sight when they were adults (e.g., with only 10% visual activity).

4.2. Responses of participants to questions about park experiences

The main obstacle encountered for a visually impaired person in experiencing the urban environment is the danger of safety. The following table (Figure 1) provides some quotations from two open-ended question-answers about participants' urban park experiences.

The results show that 54.5% of the respondents go to a city park frequently or occasionally, and 18.2% of the participants visit city parks very rarely, while 27.3% of them never go to a park. 5% of the frequent visitors emphasize that they prefer these parks because they are near their houses. This finding shows that the accessibility of the urban parks by visually impaired users are affected by the neighborhood where s/he lives. Besides, the location of the participant's residence, transportation route, type of transportation, and the availability of different modes of public transport (such as pedestrian use and various public transport: bus, subway and such) is critical. Participants prefer the areas frequently experienced more because they know well.

Seventy-five percent of participants (6/8) who don't visit a city park state the following issues: The transportation network of the place is not readable, the presence of multi-step stairs, the disappearance of the direction to go in some areas, and the safety concerns in the incident of accident. For these reasons, respondents declared that they prefer using a sighted guide instead of visiting city parks alone. Additionally, they have accessibility concerns within the parks.

4.3. Senses used for conceiving the urban park

The weakness or absence of sight requires the use of alternative senses other than vision. The individual's character and his/her social and cultural values are highly influential in the perception of a place (Morval, 1985; Gezer, 2014; Fuda, et al., 2015). As in every individual, these different physiological and socio-cultural characteristics affect visually impaired people's orientation to the senses of auditory, touch, olfactory, and gustatory (Table 2).

Ten participants state that they first use their sense of auditory when they enter a city park, and they determine the sensory reference mostly in a space with the help of this sense. Ten participants state that they mainly focus on the olfactory sense in the same experience process.

Table 2. *The ranking of the senses used by the participants in park visit.*

	The sequence of using the senses			
Participant	**1.**	**2.**	**3.**	**4.**
1	Olfactory	Tactile	Auditory	-
2	**Auditory**	Olfactory	Gustatory	Tactile
3	**Auditory**	Olfactory	**Tactile**	**Gustatory**
4	**Auditory**	Tactile	Olfactory	**Gustatory**
5	**Auditory**	Tactile	Olfactory	**Gustatory**
6	Olfactory	**Auditory**	Gustatory	-
7	Olfactory	**Auditory**	**Tactile**	**Gustatory**
8	**Auditory**	Olfactory	**Tactile**	**Gustatory**
9	**Auditory**	Olfactory-Gustatory	**Tactile**	-
10	Olfactory	**Auditory**	**Tactile**	**Gustatory**
11	**Auditory**	Tactile	Olfactory	-
12	Olfactory	**Auditory**	**Tactile**	**Gustatory**
13	**Auditory**	Tactile	Olfactory	-
14	Olfactory	**Auditory**	**Tactile**	**Gustatory**
15	Olfactory	**Auditory**	**Tactile**	**Gustatory**
16	Olfactory	**Auditory**	**Tactile**	**Gustatory**/meditative
17	**Auditory**	Olfactory	**Tactile**	**Gustatory**/pleasure
18	Olfactory	**Auditory**	**Tactile**	-
19	Tactile	**Auditory**-Olfactory	-	-
20	Olfactory	**Auditory**	**Tactile**	**Gustatory**
21	**Auditory**	Olfactory	**Tactile**	**Gustatory**
22	Tactile	Olfactory	Auditory	**Gustatory**
	%45.5 Auditory %45.5 Olfactory % 9 Tactile	%43.2 Auditory %31.8 Olfactory %22.7 Tactile % 2.3 Gustatory	% 62 Tactile %19 Olfactory % 9.5 Gustatory % 9.5 Auditory	%93.3 Gustatory % 6.7 Tactile

Table 3. *Participant categories of auditory cues.*

	Categories of sensory references	Representation of reference in the use of landscape space
Auditory	Tapping the cane onto the ground (8 participants)	Road tracking and direction Defining different ground material Grip the width of the walking path To be able to determine the separation of road
	The sound of the cane crashing into urban furniture (4 participants)	Locating and identifying urban furniture Defining the materials of urban furniture
	Applause (2 participants)	Define objects in the environment
	Sound of water (8 participants)	The presence and location of the water element Orientation and positioning
	The acoustics of space/distribution of sound (10 participants)	Understanding the size of space Feeling the ambiance of the surroundings
	The sound of the bird (13 participants)	Plant presence, location, and density
	Diversity of bird sound (3 participants)	Plant diversity Different and more plant species Understanding the likelihood of insects Presence of the water element
	Human voice (12 participants)	Definition of human existence, intensity, and activity Areas where plants are common
	The sound of children's sound and play equipment (6 participants)	The presence of children Determination of children's playground and its location
	Rustling of trees (6 participants)	Understanding the presence and location of trees in the area; direction determination
	Traffic sound (5 participants)	Directing and locating the location of the entrance gate Understanding the park's distance to the street
	The sound of the teaspoon (2 participant)	Detection of the drinking facility and its location
	Activity sound (7 participants)	Defining the place and activity

As the second input, ten participants (43.2%) use the sense of auditory, eight of them (31.8%) use the sense of olfactory, five of them (22.7%) employ the sense of tactile, and finally (2.3%) use the sense of gustatory. Overall, the participants use auditory sense followed by olfactory, tactile, and gustatory senses (Table 2).

Some factors play a significant role in the perception, comprehension, and use, and cognitive mapping of the space for our research participants; these include the location (e.g., distance to motorway and buildings) and the basic sounds of the climatic features (e.g., sounds from plants under the influence of the wind). Besides the temporary sounds that have a surprising or sudden effect (e.g., birds singing) and the typical sounds (e.g., the sound of water, equipment, human or child, activity) shape their auditory references, hence affecting the preference of the space, activity, usage frequency and length.

4.4. Sensory reference points of participants using parks

Visually impaired individuals identify specific sensory cues for their independent mobility in urban parks. These sensory references have a particular purpose and meaning. The participants indicate the sensory references of each sense that they detected during the use of a city park. Tables show the spatial references collected under each sensory reference category.

4.4.1. Auditory sense

The audible references provide many clues about the space to the visually impaired user. Human voices, external voices coming from the surroundings (such as traffic), the sound of the cane hitting the object, and the echoes of these sounds are very helpful to these individuals. With these references' help, the participants can define/ comprehend the city park, determine the direction of movement, and confirm their location within the space (Table 3).

Auditory references, both external sounds coming from the surroundings of the space and the sounds within the space, are useful in defining the space. For example: "*I'm listening, I wonder if there are different bird sounds, is it too crowded, whether people are scattered or together, wherein the park where the human voices are more intense, and I try to understand more or less whether the park is small or large*." (2nd participant). The majority of the participants (13/22; 59.1% of participants) identify the user sounds, space acoustics, and bird sounds as relevant auditory references for a city park. A human voice heard in the area is the second basic auditory reference (12/22; 54.5% of the participants).

Visually impaired persons try to define the fiction of the space, determine the activity areas, understand their position, and determine the direction of movement in the space with the references perceived with the sense of hearing. For example; "*The sound produced by the cane touching the material used on the floor is different. The choice of flooring has importance*." (14th and 18th participant). They also recognize the spatial diversity and distribution of different parks by following the sound of the activities'. Some of the auditory references give clues about the turning points in the park. For instance, a water feature located at the juxtaposition of the walking paths can tell a person that he/she is at an intersection. In conclusion, auditory references usually support im-

paired person orientation and independent movement in the space.

4.4.2. Olfactory sense

The results showed that the most critical olfactory reference is the smell of the plants for visually impaired users in a city park (Table 4).

Participants emphasize that especially the plant scent is an essential factor in their choice of the city park. For example; "I understand where I am if there is a plant that gives an intense fragrance, such as spindle tree. We can benefit a lot from plants." (19th participant). The plant scent provides references, such as the size of the area allocated to the green, the location of this area in the overall space, the identification of the plant species, and the perception of its diversity. For instance; "You can perceive how much green space there is by scent. You can perceive if there are too many people." (16th participant).

With the sense of smell, the most important reference that visually impaired individuals (21/22; 95.5% of participants) perceive in a city park is the plant smell. The perceived plant smell is useful in defining the plant location, density and size, user density in the place, the location of the site in the city, and the plant species found in the area. The participants have emphasized that especially the smell of plants is an important factor in choosing a city park to visit. This result shows the importance of quality, quantity, and plant species used in urban park for visually impaired users' perception of space.

Table 4. *Participant categories of olfactory cues.*

	Categories of sensory references	Representation of reference in the use of landscape space
Olfactory	The smell of plants (21 participants)	The presence of plants in the field Identity of green space Type of plants in the field Size of green area and human density Location and frequency of plants in the area The location in the area / identifying the space Direction determination The identity of the place earned
	The smell of garbage (2 participants)	Location of trash The cleanliness or pollution of the area
	The smell of fresh air (7 participants)	Location of the park in the city The size of the vegetative and soil area
	The smell of food from eating facilities (5 participants)	Existence of food facilities in the area
	The smell of food from the sales counter (1 participant)	Understanding the presence and location of workbenches in the area
	The scent of plant species (2 participants)	Distinguishing shadow and sunny area
	The odor from the toilet (2 participants)	Presence and location of the toilet
	The smell of human (2 participants)	Human existence and intensity The size of the green area
	The smell of the sea (1 participant)	Direction determination
	Climatic fragrance (1 participant)	Raining and perception of soil odor
	The smell of water (1 participant)	Determining the presence of water element
	The smell of the space (1 participant)	Determining the general smell of the park Understanding the division of space / usage

Table 5. *Participant categories of tactile cues.*

	Categories of sensory references	Representation of reference in the use of landscape space
Tactile	Touch of the cane (13 participants)	Determine the route with the help of border stone/direction determination Understanding the material and width of the walkway Understanding the fiction of the park and finding the seating area Identifying and accessing urban furniture Getting general information about the field Determination of concepts such as size and depth
	Touch with foot base (12 participants)	Identification of the tissue (softness, hardness, thickness, fineness, roughness, slope, etc.) The difference of ground material Defining the type of walking path Perceived of the slope in the walkway Determining the type of area / green area Saving the cognitive map of the place Don't memorize distances Discovering the turns
	Hand touch (10 participants)	Defining and understanding urban furniture Identification and understanding of plant species Controlling the use and defining the sports equipment Defining children's play equipment and game space
	Touch with body (6 participants)	Defining soil area and feeling the soil Understanding the shadow, width, and depth of the tree Hitting obstacles encountered in the area Identifying seating material
	Heat and light of the sun/ Drop shadow (5 participants)	Distinguishing shadow and sunny area Identify the place To be able to think of the plant species that can be grown
	The touch of the wind (3 participants)	The location of the smell it brings Feeling in the body Learning about climate
	Touching the water (2 participants)	Feeling in the body

Seasonal evaluation of the edited vegetative landscape and even thinking of the vegetation area on the wind tunnel of the space will be effective in the individual's easy perception. Apart from the smell of plants, some other scents (e.g., food, toilet odors) help locate the facilities and services in the park. Such as; "*If we are passing by a cafe, we say there is a place to eat here in the park, but if we do not know the place, we can find it by smelling it.*" (7th participant).

4.4.3. Tactile sense

Participants stated that tactile references were the use of a cane (touching the cane), feeling with the soles of the feet, and touching the hand (Table 5). In tactile perception, touching with a cane (13/22; 59.1% of the participants), feeling with the sole of the foot (12/22; 54.5% of the participants) and touching with hands (10/22; 45.5% of the participants) are references that come in the front row.

The most effective tactile reference perceived are elements that function as boundary elements. The boundary element on the roadside in large areas such as city parks enables visually impaired individuals to walk straight without leaving the walking axis. Such as; "*Am I on the main road or a footpath or at the entrance of a place, or am I climbing downhill? I feel it all with my feet.*" (9th participant). The roadside boundary element can be a curbstone, vegetative fence element, or railing element applied at the edge of the walking axis. With this application, individuals have emphasized that they can be more independent and comfortable in their accessibility in urban space. References have been perceived by touch make a different contribution than definition. For instance; "*I am trying to guess, according to the shadows of the trees falling on me, where is the forested part and where it is suitable for sunbathing.*" (5th participant) or "*I entered the park, went 30-40 meters, and for example, I came across a slightly hollow area or a sloping area, so when I notice this place on my return, I can say I am at the right point.*" (12th participant). On the other hand, tactile references provide spatial references such as locating/identifying urban furniture, specifying materials, and using activity equipment in the park area. For example; "*I'm touching, is it a slide, a swing or a seesaw, I say okay, this is a children's playground.*" (15th participant).

4.4.4. Gustatory sense

Gustatory information reminds the places and makes the spaces perceivable (Gezer, 2012;2014). Most of the participants stated that the gustatory and the other senses play a significant role in the space perception-comprehension process while experiencing the place (Table 6).

Table 6. *Participant categories of gustatory cues.*

	Categories of sensory references	Representation of reference in the use of landscape space
Gustatory	The smell of plants and oxygenated fresh air (6 participants)	Being a place that makes you feel hungry Feeling the presence of the wind
	A case of tea-bagel (5 participants)	Being a case-specific to the park
	The gustatory of the plant (2 participants)	Discovering the gustatory of plants
	Memory of gustatory (3 participants)	Becoming a well-known place with the park The park is in a high position in the city
	Eating-drinking activity (4 participants)	Purpose of visiting the place The purpose of having a picnic The association of flavors that come with its scent
	Planting of fruit trees (3 participants)	Fruit-eating desire and enjoyment
	Metaphorical gustatory of space (8 participants)	The emotional connection between space and user The intensity of use of space Being a peaceful place Meditative / mental rest The energy of plants and colors Providing socialization opportunities Decrease in traffic noise The smell / sound / pleasure of the place
	The unpleasantness of space (1 participant)	Failure to use space and having experienced an accident

For some of the participants, the gustatory references are related to eating and drinking activity. Gustatory senses become active in the fresh air and trigger the feeling of hunger. For instance; "*In fact, the taste is something that goes with odor because our senses of smell and taste work together, so often it's very likely to be what it evokes. I eat when I go to the park because the smell of plants and getting plenty of oxygen while walking makes me hungry.* " (2nd and 9th participants). The behavior is attributable to cultural habits. In Turkey, it is common to drink tea accompanied by Simit (a traditional Turkish bagel) while enjoying a sunny day outdoors. For example; "*Turkish bagel is sold in the park where I frequently go. When we go there, we eat it, we won't go back without eating it.* " (6th participant). Besides, gustatory references create opportunities for social interaction. For others, gustatory references construct intangible qualities such as tranquility, peacefulness, and positive energy from the plants. For instance, one of the participants declare; "*It is meaningful to me when the crowd and taste come together. Park means chatting / feeling of the crowd.*" (3rd participant) or another respondent state: "*The sense of taste is that the park is human, it is crowded, it has animals, that is, there is such joyful laughter, there are children, people walking their dogs, or children who are under the supervision of their parents at that time. Taste is like that for me.*" (11th participant).

4.5. Relationship sensory themes, between sensory reference categories and spatial references of participants

The relationships of sensory themes, sensory reference categories, and space perception-comprehension-usage references present a network map (Figure 2).

The network map reveals that a sensory reference help in identifying different attributes of the outdoor space. For instance, a tactile reference provides different spatial references, such as identifying the objects encountered on the walkway (the tactile reference with the cane), recognizing its function and material, and discovering its use (the tactile reference with hands). The network map also shows that the visually impaired uses multiple sensory to detect a spatial reference. For instance, the scent from the plants (olfactory reference) helps determine the presence, location, and frequency of the plant, while the sound of birds (auditory reference) gives information about the direction and the va-

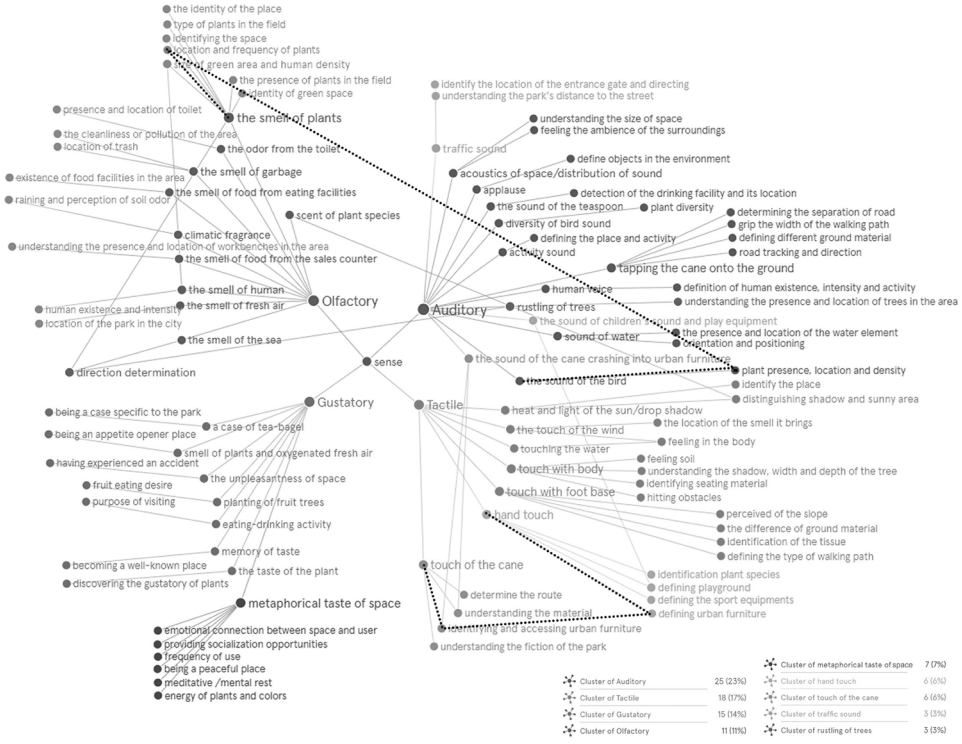


Figure 2. *Network map of the relationship between sensory themes, sensory reference categories, and spatial references of participants.*

riety of plant groups. All of these inputs affect the user's position and orientation because it signals a turning point for a particular zone in the park.

5. Discussion

Examining and understanding the dynamic interaction of visually impaired users with the city's urban open spaces is essential to ensure their participation of this user group in recreational activities and social life, hence supporting their well-being. The sensory cues that individuals receive from the physical environment support the perception, comprehension, and independent use of space in the urban environment (Sürmen, 2004; Marston and Golledge, 2004; Jenkins, et al., 2015). The visually impaired individuals use their senses other than a vision at a personal and unique level for independent and comfortable use of the urban physical environment. In the light of the references they perceive with these senses, they shape their independent movements in public spaces. If sensory references are perceived easily and effectively, visually impaired individuals will be able to move independently in the space.

Defining the sensory interaction of visually impaired users with the public space will be effective in creating sensory cues in urban landscape design. Individual characteristics and social and cultural values are influential in perceiving a place (Morval, 1985; Gezer, 2014; Fuda, et al., 2015). Different physiological and socio-cultural characteristics of visually impaired affect their tendency to utilize auditory, tactile, olfactory, and gustatory senses. If visually impaired users with different characteristics are taken into account in the design process, it would provide a deep clarity to the sensory references. Moreover, providing the input of multi-layered sensory cues into design would provide design solutions in the 'universal design' role of the urban environment.

This study provides concrete ideas for the inclusion of functional sensory references in the urban park design process. All participants in this study express the significant impact of sensory references on independent access to transportation, navigation, access to different activities, and services in the space in their participation in the urban environment. Subsequently, adding these references to design would support natural perception of the area, independent and safe mobility, correct orientation, and easy access to the activities and services in urban public green spaces (Table 7).

Table 7. *Summary of sensory references in a park experience.*

Independent transportation and finding direction	Edge tracking lines /the cane path /the sound of the cane on the ground (*tactile or auditory*) Voice guidance plates (*auditory*) Finding parking gates (*tactile, auditory, olfactory or gustatory*) Providing a reference to the location (*tactile, auditory or olfactory*) Stimulating references /road turns and intersection (*tactile, auditory, olfactory or gustatory*) Information and guidance /using braille (*tactile*) Specifying strategic points (*tactile, auditory, olfactory or gustatory*)
Landscaping setting	Perception of space fiction (*tactile, auditory, olfactory or gustatory*) Using the moving water (*auditory*) Location /number /frequency of urban furniture (*tactile or auditory*) Increasing audible references (*auditory*) Providing ground material difference (*tactile or auditory*) Determination of the difference of transportation axles /main-intermediate road (*tactile or auditory*) Ensuring perceptible slope on the road (*tactile*) Planting design layout and care Greenfield size and plant diversity (*auditory or olfactory*) Using fragrant plants (*olfactory)*
Access to different activities and facilities	Access to urban furniture (*tactile, auditory, olfactory or gustatory*) Access to various activity areas /Sound of ground or little sounds that won't disturb nature (*tactile or auditory*) Finding different equipment and using it (*tactile or auditory*) Finding the introduction of different places (*tactile or auditory*) Finding entries of different areas (*tactile, auditory, olfactory or gustatory*) Finding facilities and utilizing them (*tactile, auditory, olfactory or gustatory*)

With this approach, important suggestions emerge when the urban landscape design criteria are evaluated together with the sensory references.

- In order to provide comfortable and safe transportation to city parks, a design should be made in such a way that public transportation stops, sidewalk arrangements, parking areas and entrance entrances are interconnected. The perception of the doors with different sensory references in large green areas such as city parks will facilitate access to the city from inside the park and within the city. An auditory reference that could be distinguished from other sounds (water sound, a melody, or a bell sound) or an olfactory reference such as a plant would be perceived by its scent can lead entering and exiting into space.
- Considering the usage integrity of the area, the user should be able to easily access all the landscaping services they need. In this direction, the circulation of the space should be in perceptible accessibility. For example, the central circulation axis material could have a different texture than the rest of the paths, hence facilitating the wayfinding in case of being lost. It would also be a good reference if the sound of the cane's hitting changes in different flooring materials. Having a channel or a path where the cane can be attached will also support independent walking.
- In urban parks, there should be a boundary element at the edges of the pedestrian paths to ensure the walking rhythm of the user and support the correct route walking. Also, the design should eliminate any obstacles that endanger safety. For independent access to space, the boundary element should be in proper dimensions, material, and position, appropriate to the sensory feedback in the form of the auditory (sound of touch of the cane) or tactile (feeling of contact with the soles or an obstacle that blocks the cane). Considering this design element in the whole transport network and diversifying it on different walking routes (primary and secondary road axes) might support various uses.
- It is necessary to consider the characteristics of the transportation network and the change points together. In this case, it is essential to employ appropriate sensory warning references when approaching potentially dangerous transitions such as slope change, road junctions, a shift from the walkway to the green area. These cautionary references should utilize different textures and appropriate slope gradients. These references should capture the perception of the users walking on both sides of the road. Besides, extra auditory references could be useful. Incorporating some sensor technologies and new sound systems that do not interfere with the other sounds in the landscape would help. Different water sounds can be used as an auditory reference. For example, a sound of water can be placed at each crossroads; there may be different water sounds: the sound of water coming from the fountain is different from the waterfall.
- There should be different activity areas in city parks that can offer various recreation opportunities, which would serve all age and cultural groups. Different cautionary references should occur in different areas of the park to find, grasp, and perceive the use of these areas. These cautionary sensory references facilitate access to various activities. For instance, an audible stimulus may occur at the children's playground entrance, while a fragrant stimulus may signal access to the resting area. An example would be; perceptible plants which would be planted at the entrances of places with different functions. Its shade, size, and scent will provide different sensory references. The references indicating other functions would encourage the users, mainly due to the fear or concern of safety.
- Landscape spaces such as city parks should have design integrity within themselves. For the independent and effective use of the space, the visually impaired user must perceive and understand the space structure (Giritlioglu, 1991; Por-

teous, 1996; Pallasmaa, 2006). A tactile map written in the Braille alphabet should be at the entrance of each park. It should include information related to the site, the circulation network, different activity and service areas, slope transitions, etc. Also, the map and information sheets in this format should be perceivable as auditory and tactile in different locations of the space. Placing these will positively affect the learning, understanding, and utilization of visually impaired individuals while preventing their disorientation in the park environment. It may also prevent these users from being lost in such broad open spaces. We also recommend placing auditory cues such as sprinklers that give distinctive sounds.

- The location, area and climatic characteristics of the park can contribute to the design and planning of the landscape, which is perceived as multidisciplinary. For the visually impaired users of a city park, many odors in the place (such as human, garbage, food, toilet, material scents) may provide a reference; thus, the seasonal climatic conditions might make a difference in the user experience of the space. One of the most pleasant olfactory sensory comes from plants. In urban park design, the planted areas provide airflow, increase air quality, and provide microclimate. The type, location, and scents of plants contain many references to the users of the park. It would be useful to consistently place these variable olfactory references at strategic points within the space while developing design and management strategies to emphasize their olfactory sensory inputs.
- While urban park vegetation areas have many different functions and factors, they can also contribute to space perception. The use of fruit trees, aromatic and edible plants in the space will increase both olfactory and gustatory references' power. At the same time, it will be a good source of education for children, such as having a diversity of plants, recognizing them, knowing their names, knowing their smells, and growing with them. Taste references have a positive contribution to the perception of space. Subsequently, the eating and drinking facilities, peddlers, and picnic areas provide many tasteful references in the urban park. Besides, these references will affect the cognitive map of space by the visually impaired. Therefore, the designers should sensibly locate eating and drinking facilities, peddlers, and picnic areas in urban parks.
- All urban facilities in urban parks should be usable in all seasons and nights, with sufficient dimensions and structural features for all users. All these elements located on the side of walkways or in different areas of the space can provide various sensory references. For example, the floor arrangement with the reinforcement with different material can be considered a tactile reference. Besides, the placement of the reinforcements will create different acoustics in their environment and will be an essential reference source in the space.
- Urban parks should suit different users' socio-economic structure and cultural characteristics and their expectations and demands from open and green spaces. Hence these areas deserve a socially responsive design and a balanced manner with sensory references. In this way, the input of sensory references of the visually impaired users to the design principles will support the universal design (Mace, 1988; Imrie, 2012; Jenkins, et al., 2015) hence facilitating public places, events, and services without discrimination.

The multi-sensible perceptible city park design will add a positive effect to the use of the space for visually impaired users. In addition, considering sensory references under landscape design criteria will support the use of space without separating different user groups. The designer should be aware of the perception of sensory references and should consider diversifying the references in line with the use of different senses. In addition, while the designer balances the different sensory references in the whole

space, s/he should avoid any uncomfortable effects for the user. Collaboration with the participating visually impaired individuals included in the design process will have a reinforcing effect on the multi-sensory perceived space design.

6. Conclusion

In this study, we explore the sensory references of visually impaired persons in defining landscape space. We also investigate the effects of multiple sensory perceptions in the design of an urban park. One to one interviews elaborate on how visually impaired individuals perceive various sensory reference signs to understand the spaces and to position themselves in and around of an urban park. Our findings show that the participants refer to their auditory and olfactory senses equally while experiencing the landscape. The participants secondarily utilize their tactile sensory, followed by the taste. Despite this, we conclude that the senses work in cooperation.

Accessibility of urban transportation is vital for a visually impaired individual to go to a city park. In particular, the distance between the place where the individual would visit and the area where he/she lives, the type of transportation to be used, and the proximity of the transportation network to the place of destination affect the individual's preference. Besides, the accessibility to and within the site affects the frequency of the trips to urban parks. A visually impaired person's previous acquaintance with the place is a critical factor in choosing and enjoying a park, hence the availability of adequate green spaces in each neighborhood. Subsequently, we emphasize that the visually impaired urban landscape relies on holistic urbanism that promotes sustainable transportation system, accessibility, and equity.

A sensory reference can have more than one meaning in space usage representation. Different sensory references that are perceived by different senses respond to the same space usage representation, accentuating space perception. Since it also supports the use of multiple senses for visually impaired individuals, it also facilitates perception of space. In addition, the use of other senses or references in terms of whether a reference is temporary or under-perceived will be highly effective in the individual's use of independent space. In all of these four sensory references, the references significantly impact the comfort of use of the visually impaired users in terms of their location, quality, and quantity in landscape design.

As a result, it is crucial to support multi-sensory perceived physical spaces in terms of an independent, effective, and comfortable use of visually impaired people in an urban environment. The transfer of multi-sensory perception to urban green space design decisions will be an essential solution for improving the comfort and satisfaction of these individuals' space use.

Urban parks contribute positively to the ecology, character, and image of the city. They have a high potential for recreational use to enhance the quality of life in city dwellers. They are landscape spaces promoting the balance between function, aesthetics, and ecology in the city. This study has identified three perceptual design features that must be improved in developing sensory references for urban park design: independent transportation and finding direction in the parks; landscape design and management of the park; access to different activities and facilities inside the parks.

The adoption of a design concept that promotes a multi-sensory urban landscape is essential for universal design. Finally, the cooperation of all design disciplines, all relevant institutions and organizations, visually impaired individuals, and all users are vital to integrating universal design principles in urban parks' design process.

References

Abbak, C.A. (2015). Sample Selection in Qualitative Research Methods. Retrieved from https://www.slideshare.net/canabbak/ntel-aratirma-yntem-lernde-rneklem-sem

Akcalı, S. (2015). Examination of Architectural Places Due to Accessibility Standards in Which Designed for Visual Impaired: Libraries for Visually Impaired People. (Master's thesis). Dokuz Eylül University, Izmir, Turkey.

Belir, O. (2012). Determination of The Parameters That Affect The Spatial Legibility of The Visually Impaired People. (Doctoral dissertation). Department of Architecture, Yıldız Technıcal University, Istanbul, Turkey.

Bruce, I., McKennell, A., & Walker, E. (1991). Blind & Partially Sighted Adults in Britain: the RNIB Survey. *British Journal of Visual Impairment, 1*, 327.

Çelik, M. (2013). Visual Landscape Perception of Urban Parks Case of Investigation Denizli. (Master's thesis). Department of Landscape Architecture, Süleyman Demirel University, Isparta, Turkey.

Çetin, O. (2017). A Qualitative Research Technique: Interview. Personal web site. Retrieved from http://oguzcetin.gen.tr/nitel-bir-arastirma-teknigi-gorusme.html

Chiesura, A. (2004). The Role of Urban Parks for The Sustainable City. *Landscape and Urban Plannin*g, 68, 129-138.

Clark-Carter, D.D., Heyes A.D., & Howart, C.I. (1986). The Efficiency and Walking Speed of Visually Impaired Pedestrians. *Journal of Ergonomics*, 6, 779-789.

Creswell, J.W. (1998). *Qualitative Inquiry and Research Design: Choosing Among Five Traditions.* Thousand Oaks, California: SAGE.

Creswell, J.W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches-4th ed. Printed in the United States of Amer*ica, 239-240.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education* - 6th Edition. ISBN 0-203-02905-4 Master e-book ISBN.

Cokluk, O., Yılmaz, K., & Oguz, E. (2011). *A Qualitative Interview Method: Focus Group Interview.* Theoretical Education, 4(1), 95-107.

Francis, M. (2003). *Urban Open Space: Designing for User Needs.* Island Press, Washington, DC, USA.

Fuda, S., Aletta, F., Kang, J., & Astolfi, A. (2015). Sound Perception of Different Materials for The Footpaths Of Urban Parks. *Energy Procedia*, 78, 13-18.

Gaunet, F. (2006). Verbal Guidance Rules for A Localized Wayfinding Aid Intended for Blind-Pedestrians in Urban Areas. *Universal Access in The Information Society*, 4(4), 338-353.

Gurkan, K. (2012). An Object Detection and Identification System for Visually Impaired People. (Doctoral dissertation). Istanbul University, Istanbul, Turkey.

Gezer, B. (2014). The Problems of Solutıon Analysıs, Physıcal and Vısual Dısabled People Faced with Traffic. (Master's thesis). Gazi University, Ankara, Turkey.

Gezer, H. (2012). Components of Perception During the Process of Space Perception. *Istanbul Commerce University Journal of Social Sciences,* 21, 1-10.

Gezer, H. (2014). Experiencing The Architecture. *Istanbul Commerce University, Journal of Science and Technology*, 26, 227-258.

Giritlioglu, C. (1991). *Urban Space Elements and Design.* Istanbul Technıcal University-Faculty of Architecture Publication, 1459. ITU Faculty of Architecture Print Workshop, Istanbul, Turkey.

Heylighen, A., & Herssens, J. (2014). Designedly Ways Of Not Knowing: What Designers Can Learn About Space From People Who Are Blind. *Journal of Urban Design*, 19(3), 317 – 332.

Imrie, R. (2012). Universalism, Universal Design and Equitable Access to The Built Environment. *Journal of Disability and Rehabilitation*, 34(10), 873–882.

Jacobson, R.D. (1998). Cognitive Mapping Without Sight: Four Preliminary Studies of Spatial Learning. *Journal of Environmental Psychology,* 18, 289-305.

Jenkins, G. R.; Yuen, H.K., & Vogtle, L.K. (2015). Experience of Multisensory Environments in Public Space Among People with Visual Impairment. *Journal of Environmental Research and Public Health*, 12(8), 8644– 8657.

Kıncal, Y.R. (2015). *Scientific Research Methods, 4th edition.* Nobel Academic Publishing Education Consultancy, Ankara, Turkey. ISBN: 978-605-133-512-4.

Lynch, K. (1990). The Openness of Open Space. *City Sense and City Design: Writings and Projects of Kevin Lynch*, Cambridge, MA: MIT Press, 396-412.

Mace, R. (1988). *Universal Design: Housing for the Lifespan of All People.* Orignially printed by the U.S. Department. Department of Housing and Urban Development: Rockville, MD, USA.

Marston, J.R., & Golledge, R.G. (2004). *Quantitative and Qualitative Analysis of Barriers to Travel by Persons with Visual Impairments and Its Mitigation Through Accessible Signage.* In Proceedings of the 10th International Conference on Mobility and Transport for Elderly and Disabled People, Hamamatsu, Japan.

Morval, J. (1985). *Introduction to Environmental Psychology.* Translated by Nuri Bilgin. Ege University Publications, Izmir, Turkey.

Newton, N. (2010). *The Use of Semi-Structured Interviews in Qualitative Research: Strengths and Weaknesses.* Retrieved from https://www.academia.edu/1561689/The_use_of_semi-structured_interviews_in_qualitative_research_strengths_and_weaknesses

Pallasmaa, J. (2006). *Eyes of The Skin: Architecture and The Senses*. Architect, 95, 28–29.

Porteous, J.D. (1996). *Environmental Aesthetics: Ideas, Politics and Planning.* Routledge, London.

Rocque, S., Langevin, J., Chalghoumi, H., & Gorayeb, A. (2015). *Universal Accessibility.* International Conference, The Future of Education: 4th edition, Canada.

The Republic of Turkey Prime Ministry Administration for Disabled People (2010). *How Society Perceives Persons with Disabilities.* Ankara, Turkey. Retrieved from http://psikiyatriksosyalhizmet.com/toplum_ozurlulugu_nasil_anliyor.pdf

Turkoz Sarp, F. (2013). Visual Perception of Hearing-Impaired Individuals. (Master's thesis). Istanbul Arel University, Istanbul, Turkey.

Stankiewicz, B.J., & Kalia, A.A. (2007). Acquisition of Structural Versus Object Landmark Knowledge. *Journal of Experiemental Psychology: Human Perception& Performance,* 33(2), 378-390.

Siu, K.W.M. (2013). Accessible Park Environments and Facilities for The Visually Impaired. *Journal of Visual Impairment & Blindness,* 103(11), 766–772.

Sürmen, S. (2004). *I was injured...: articles on disability and disability.* Nüans Arma Publications, Istanbul, Turkey.

Walker, C. (2004). The Public Value of Urban Parks. The Urban Institute, Research Report. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.537.205&rep=rep1&type=pdf

Warren, D.H. (1978). "Perception by the Blind." *In Handbook of Perception*, 65–82. New York, NY: Academic Press.

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Mental images and congruence strategies: An investigation of congruence between residents and private open spaces in three dominant housing patterns of Yazd

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Abstract

Residents usually try to establish congruence between their own needs and the affordances of the open space in order to satisfy their needs and achieve a better living environment. This congruency, being affected by some differences between the residents' mental ideal images of open space and the actual open space, can be achieved by different strategies. The present study aims at investigating how congruence is established between residents and open spaces in tree dominant housing patterns of Yazd, as a traditional city in Iran. This study is a qualitative research, adopting an ethnographic approach. The results revealed that when the residents' actual open space is more similar to their desired and ideal open space, they establish a two-way relationship with the space, adapt their behaviors to the space or change the space according to their needs. However, the more the open space is different from the residents' ideal of open space, the more their relationship becomes one-way and the residents are obliged to change their needs and behavior according to the affordances of the environment or move from their houses to another one having their ideal open space.

Keywords
Congruence, Housing, Mental image, Open space, Resident.

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1. Introduction

Open space is considered as one of the main elements of a building in the traditional architecture of hot and dry climates. A perfect organization of this spatial element as well as the other elements of a house provides residents with a secure and peaceful atmosphere to be convenient and suitable for performing various activities. In recent years, several factors in Iran, including particular governmental policies, development of modern technologies regarding iron and glass (Mirhoseini, 2007, 56- 62), the issuance of specific regulations and incentive plans and granting facilities for mass housing (grant and loan) (Falamaki, 1992, 21), have made some specific changes in the housing pattern, increased mass housing and apartment living, decreased the size of houses (Ghanbari & Zaheri, 2010) and led to the obligation of construction in 60% of the land plots in different parts of the country (Aghalatifi, 2012). As a corollary, open space patterns also have drastically been altered such that houses' open spaces moved from the middle to the either side of the house and buildings with central courtyards were almost forbidden. Today, in many cities of Iran like Yazd, the contemporary housing patterns exist alongside the traditional patterns and families with diverse needs and lifestyles reside in them. Notably, these families interact differently with their housing open space. According to Morris and Winter, residents are always striving to establish congruence between their needs and the affordances of the open space in order to satisfy their needs and achieve a more convenient living environment (Morris & Winter, 1975). Many researchers have focused on the concept of congruence and using different strategies to establish congruence between housing and residents (e.g., Omar et al., 2012; Priemus, 1986; Fleury-bahi, Felonneau, & Marchand, 2008; Crull, Bode, & Morris, 1991; Baum & Hassan, 1999; Morris & Winter, 1975). Most of the researchers investigating the resident-housing congruence have studied the congruency methods only with regard to the factors influencing houses and residents in the time span of the study (culture, technology, society, economics, ...), while mental ideal images of the residents formed during their whole life and since their childhood have not been taken into consideration in these studies.

On the other hand, resident-open space interaction is mostly investigated in studies conducted on the resident-housing interaction (Omar, Endut, & Saruwono, 2012), (Jusan, 2010). However, the studies specifically dedicated to scrutinizing the congruence between residents and their private open space are rare. Considering the importance of open space as one of the main elements of a building in satisfying qualitative and quantitative needs of the residents highlights the importance of conducting further studies specifically on this topic.

In this regard, the aim of the current study was to answer this question: "How do the residents' ideals of open space affect the resident-open space congruence in the three dominant housing patterns of Yazd?". As this study is informed by the premises of qualitative research, adopting an ethnographic approach (Groat & Wang, 2002), first the concept of congruence and mental ideal image were explored and the theoretical model of research was proposed. Then, based on the theoretical model, the residents' strategies to establish congruency between their own needs and the affordances of private open space in three dominant housing patterns of Yazd were studied.

2. Literature review

2.1. Person- environment congruence

In psychology, congruence means a proper coordination and correspondence between a person's needs and priorities and the affordances of the environment. Tinselly refers to it as a suitable relationship between the environmental supplies and demands (Spokane, Meir, & Catalano, 2000; Edwards & Shipp, 2007, Tinselly 2000). As the same way, Lynch (1981) defines congruence as coordination between the physical characteristics of an environment and activities performed in that environment. Moore also (2005) describes congruence as the level of conformity of human needs with the capacity of the environment. Regarding the residential

space, Festinger (1962) defines congruence as coordination between the mental desired image of a living environment built in the residents' mind (ideal environment) and the actual residential space. Most of the researchers consider congruence as the degree of compatibility between human being's needs and environmental affordances (French, Rodgers & Cobb, 1974). In this connection, Lawton and Nahemow believe that people seek out coordination between personal needs and environmental resources (Lawton and nahemow, 1973 in Moore, VanHaitsma, Curyto, & Saperstein, 2003). In addition, Moore also believes that people feature a set of competences, and the environment also has a demand character (Moore, 2005, 331-333). Gibson (1979) interprets the environmental resources and demands as Environmental affordance (Lang, 2007). If there is person-environment congruence, the environment provides individuals with affordances; thus, they can express their values and needs and feel more satisfaction with their lives. However, when environmental affordances are superior, inferior, or incompatible with human being's needs, people experience incongruence (Musiol & Boehnke, 2013, 57). Our focus in this research is mainly on the congruence strategies. As a matter of fact, these strategies refer to the actions and reactions of the residents for adapting their needs to their environmental affordances or adapting environmental affordances to their own needs". In this regard, the strategies of establishing person-environment congruence are different and may be subsumed under one of the following categories:

1. Adapting the environment to one's needs: modifying the affordances of the environment (Omar et al., 2012, 329; Galster & Hesser, 1981; Steggell et al., 2003, 8; Fleury-bahi et al., 2008, 670; Brown & Moore, 1970; Shin, 2016, 16),

2. Adapting one's needs to the environment: changing behaviors (Spokane et al., 2000, 142; Priemus, 1986, 41; Omar et al., 2012, 329; Galster & Hesser, 1981; Shin, 2016, 16), adapting mental image of an ideal environment to the actual current environment (Fleury-bahi et al., 2008, 670; Brown & Moore, 1970), changing values, norms and priorities, to adapt to the environment (Steggell et al., 2003, 8; Shin, 2016, 16).

3. Abandoning the environment or moving into a different environment (Omar et al., 2012, 329; Galster & Hesser, 1981; Steggell et al., 2003, 8; Fleury-bahi et al., 2008, 670; Rossi, 1955, 10; Brown & Moore, 1970; Eichner, 1986).

2.2. Residents' mental image

Mental imagery is a *quasi-perceptual experience which* resembles a perceptual experience, but occurs in the absence of the appropriate external stimuli. It can be considered as a form of representing reality (Colombo, 2012). Therefore, mental image is the re-creatio of perceptual experience (Kosslyn, Ganis, & Thompson, 2001; Pearson, 2007).

Residents attribute different values and concepts to their living environments and create a mental image out of it as their ideal living environment, which highly affects their relationship with that environment. Notably, different factors are involved in the formation of these mental images such as past memories, culture, values, norms, tradition, family structure, household size, lifestyle, etc. (Priemus, 1986, 36). It is worth mentioning that these mental images are usually making people's needs and expectation of the environment. Studies conducted in this connection have revealed that residents constantly compare their housing with their mental image of their ideal house and their satisfaction is contingent upon the extent of similarity between their ideal and actual living environments (Galster, 1987; Mridha, 2015, 43; Shin, 2016, 19). The more residents' ideal house is different from their house in reality, the more the anxiety and incongruence are observed in resident-housing relations (Mohit, Ibrahim, & Rashid, 2010), (Sirgy, Grzeskowiak, & Su, 2005). In this condition, residents attempt to make congruence between their needs and the affordances of their current living environment (Priemus, 1986, 37) to bring their ideals of an environment and the reality closer.

According to the theoretical foundations, one model is proposed for the resident-housing congruence process (Figure 1). In this model, the following issues are taken into account:

- Residents' actual open space and their ideal image of housing open space are affected by common factors including economy, politics, technology, culture, family structure, household size, Lifestyle, etc. Each factor is, in turn, affected by various factors depicted in Figure 1. The study of these factors is beyond the scope of this study.
- The difference between the ideal open space in residents' mind and their actual private open space determines the extent of observed incongruence and the type of relationship between the residents and open space.
- Residents' mental ideal image of a housing open space determines their needs and expectations of the open space. To provide congruence, residents should establish congruence between their needs and open-space affordances.

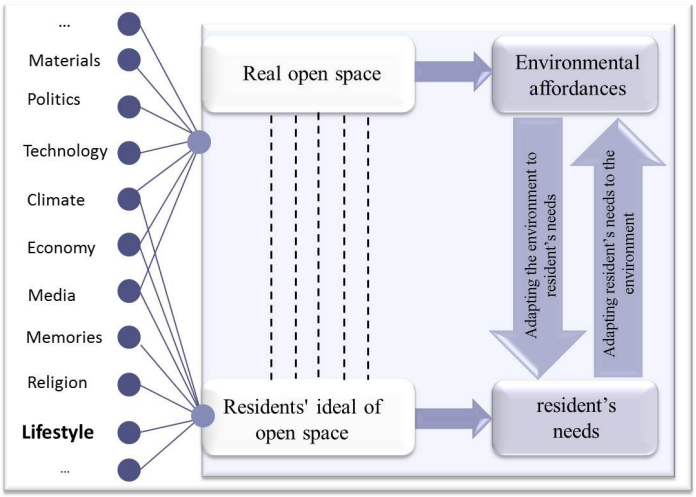


***Figure 1**. Theoretical model of resident-housing congruence.*

3. Case study

The region under investigation in this study is the city of Yazd, a traditional city in Iran. An attempt is made to investigate the congruence between the residents and houses' private open space in the contemporary era of this city. Here, open space includes not only the courtyards but also balconies and terraces. In fact, private open space refers to any open spaces belonging to a single unit. Thus, public open spaces in apartments and residential complexes used by all members are not considered as housing open space here.

Studies on housing patterns in the city of Yazd indicate that the following three dominant housing patterns could be distinguished with different open space patterns[1]:

The First housing pattern: This housing pattern dates back to the first Pahlavi era, lasted for hundreds of years. Having a central courtyard in a rectangular shape have made them substantially different from their subsequent patterns. Other elements surrounding the courtyard also follow its geometry. Thus, in addition to having a specific structure, the courtyard can be envisaged as an element that organizes its surrounding spaces. Furthermore, other spaces are defined, and characterized with different qualities and functions according to their position in the courtyard: summer living quarter (back to the sun), winter living quarter (facing the sun), the western front and the eastern front (Memarian, 2006, 15). These spaces are directly connected to the courtyard and even are named based on the number of their doors opened to the courtyard: se-dari (three-door rooms) and panj-dari (five-door rooms). The main spaces of a house and porch are placed at the northern and southern end of the courtyard. These spaces could be connected to the courtyard by big windows which were extended to the ceiling (Ghazizadeh, 2011, 68). In these houses, the courtyard, besides organizing other elements of the house, provides residents with a peaceful and safe space to perfom different activities (Daii Poor, 2014, 52). In traditional houses, the porch or Tallar is mostly located on the south side of the courtyard. Given its depth and location, the porch provides residents with a safe space for gathering the family members together, sleeping or even doing manufacturing activities during the day (Khaghani Poor & Shah Rezaii, 2017, 100). This element can be considered as an interface or a spatial filter interacting between open and closed space (Nazif, 2013, 66) which can be connected to the interior or exterior space and extend the interior space to the exterior space (Ghazizadeh, 2011, 66) (Figure 2 & Table 1).

***Figure 2**. Open space in the first housing pattern (left side and center: the courtyard, Right side: Tallar), (2017). Source: Author.*

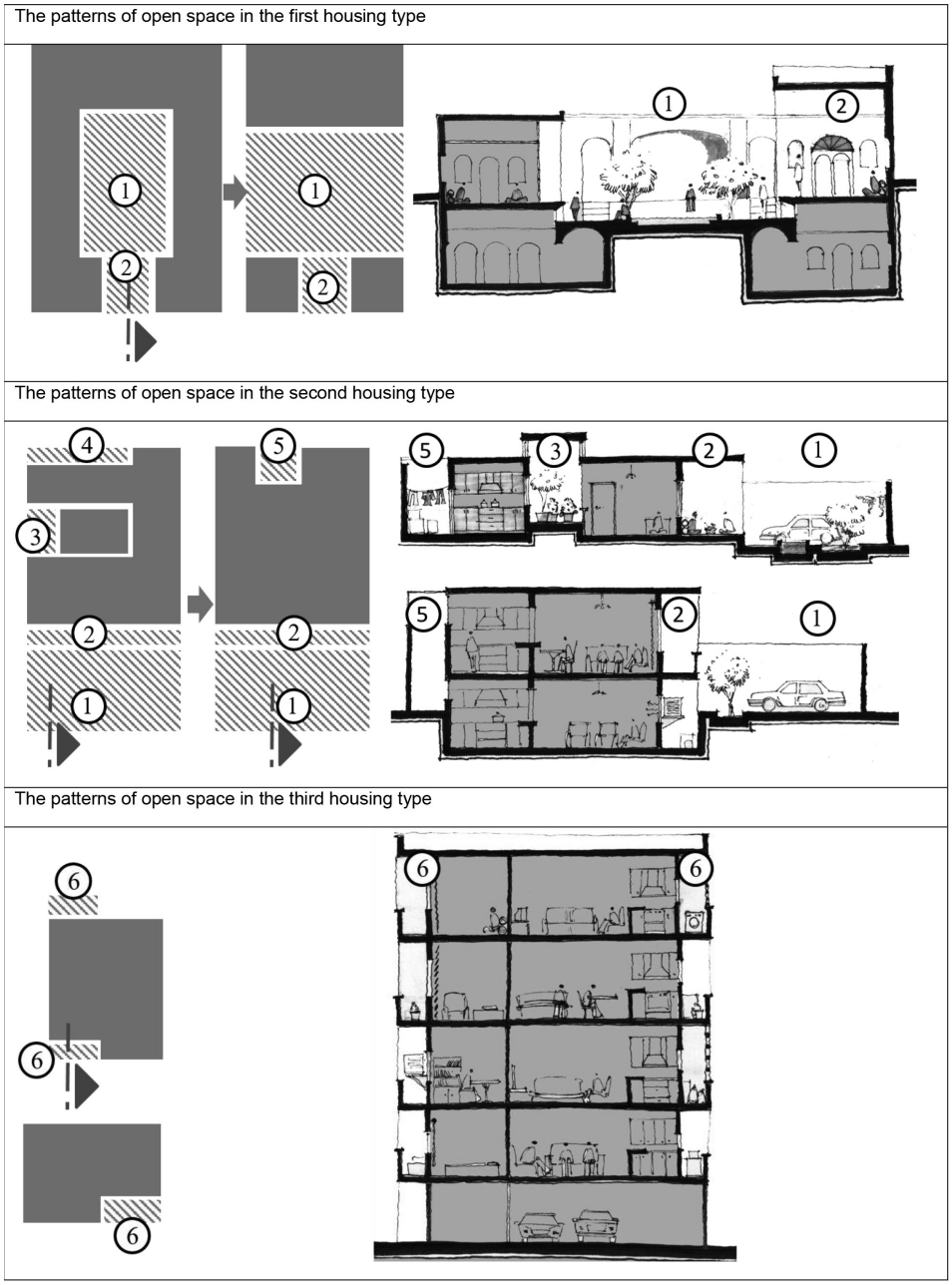
***Figure 3**. Open space in the second housing pattern (right side: the courtyard, center: patio, left side: backyard), (2017). Source: Author.*

***Figure 4**. Open space in the third housing pattern, (2017). Source: Author.*

The second housing pattern: In this housing type, affected by the rule of obligatory construction in 60% of the building lands, the courtyard is moved from the central part to one side of the house and is usually connected to a closed space by a semi-open porch place. In these houses, the courtyard, besides providing a place for family members to be gathered during some hours of the day, is sometimes used as parking area. Notably, while obeying the municipality laws and regulations, these houses are often built according to the residents' taste and, therefore, allow having the semi-traditional lifestyle. This housing pattern was formed at the end of the second Pahlavi era and is still being built with some small changes. In the first models of these houses, the omission of the central courtyard and the residents' need for having a central area led to the formation of the central halls (central enclosed spaces connected to all rooms). Moreover, the need for light and a place for keeping the plants inside the houses led to designing patio next to the central hall. In addition, backyards were located next to the kitchen, at the end of the house, to provide the kitchen with suitable light and services. The main courtyard, as it was stated, was located on one side of the house and was adjacent to the alley or to the neighboring house by a wall. In the recent examples of this housing pattern, which are still being constructed, backyards are replaced with skylights and patios are omitted. (Figure 3 & Table 1)

The third housing pattern: Apartments or multi-floor buildings with a common open space for residents constitute the third type of house patterns. They are nowadays built in all cities with almost the same pattern. In these houses, the private open space is the balcony which is a small roofed space constructed for each housing unit so that the residents have access to it from the inside of their house. (Figure 4 & Table 1)

Table 1. *Patterns of open space in the housing of Yazd (1.Yard, 2. Tallar or porch, 3. Patio, 4. Backyard, 5. Sky light, 6. Balcony), (2017). Source: Author.*



3.1. Method

As it was stated, the present study is a qualitative research that adopts the ethnographic approach (Groat & Wang, 2002). At this stage, the samples were selected by purposeful sampling. The sample selection process continued until data saturation and theoretical saturation were achieved. As for data collection, in-depth and semi-structured interviews, and non-participant and participant observations were used. For each housing pattern, five samples were selected and their residents were interviewed. As the samples were owner-occupied houses, all of the selected participants were the owners of the houses. The interview questions were organized into three sections. The first part was concerned with the personal information of the interviewee and his/her family members. The second part relied primarily on questions trying to clarify how the residents interact with the open space, by emphasizing the behavioral patterns and lifestyles of the residents. The third part, finally, included some questions that tried to identify the residents' mental image

of ideal open space, the changes that they have made in their open space, the changes in their ideals or behaviors, the reason behind these changes, and the interviewees' level of satisfaction or dissatisfaction with their open space. In this research, we studied the lifestyle of residents to find their congruence strategies. In this regard, the researcher accompanied the residents and participated in their ceremonies and activities, observing their lifestyle directly (participant observation). The data collected from the interviews and observations were coded and analyzed in three main categories: space functions, residents' mental ideal image and congruence strategies.

3.2. Results

In this section, in order to better understand the open space in three housing patterns of Yazd city, first the current functions of these spaces were studied. Then, the mental ideal images of the residents of mentioned three patterns were examined through doing interviews. In another section, residents' congruence strategies were evaluated through observing their lifestyles and interviewing them.

3.2.1. The functions of open space in three housing patterns

As it was stated, the open space in the first pattern includes a central courtyard and a Talar located next to it. This courtyard is a place where trees and flowers are planted (rather than merely keeping them), in that the residents consider planting trees or caring for flowers as one of the activities which have to be done in a courtyard. In all of these houses, the courtyard provides a place for family members to gather together and perform collective activities such as religious ceremonies, wedding ceremonies, etc. in addition, talar as well as the traditional bed gardens in the courtyard are also the place where family gathers together and rests during the evenings and nights of spring and summer. (Figure 5)

In the second housing pattern, the courtyard has been moved to one side of the house. Although the courtyard is still used for planting trees or flowers; its other functions such as being a place for collective activities, children's playing, gathering together, and resting have not been common anymore. The main function of the courtyard in these houses is mostly providing a car parking area. In the first examples of these houses, built about 30 years ago, the porch was the same as talar in the first housing type; however, in more recent examples of this housing type, the porches have lost their former functions. As mentioned, some examples of these houses have a backyard and patio. The backyard provides the kitchen's light and is sometimes used as a warehouse for keeping kitchen's equipment. The Patio, likewise, provides the house's light and is used for keeping plants and flowers[2]. (Figure 6)

In the third housing pattern, there is usually a common open space for all units (Figure 4), and the dedicated open space of each unit is just its balconies far removed from the concept of courtyard in traditional and middle housing (Figure 2 & Figure 3). In fact, the lack of the main elements of the courtyard, such as flowers, trees and howzes, along with its very small dimensions and overlooking of the surrounding buildings have made them considered not seriously as before. In most houses, balconies only meet the basic needs of residents for open spaces, such as drying clothes, washing and lighting the house (Figure 7).

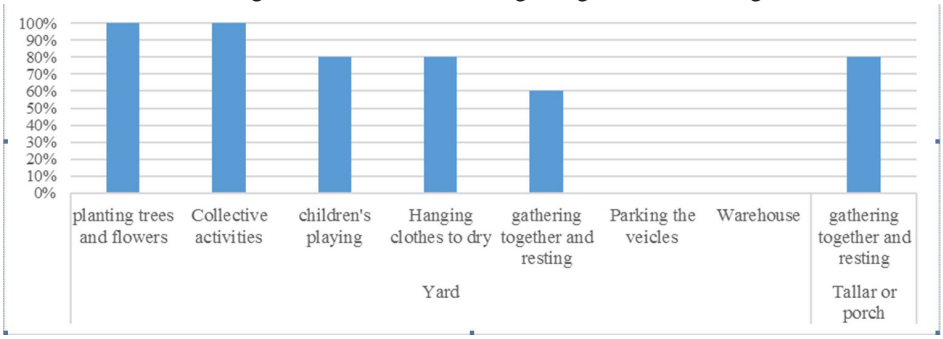


Figure 5. *Frequency of open space functions in the first housing pattern.*

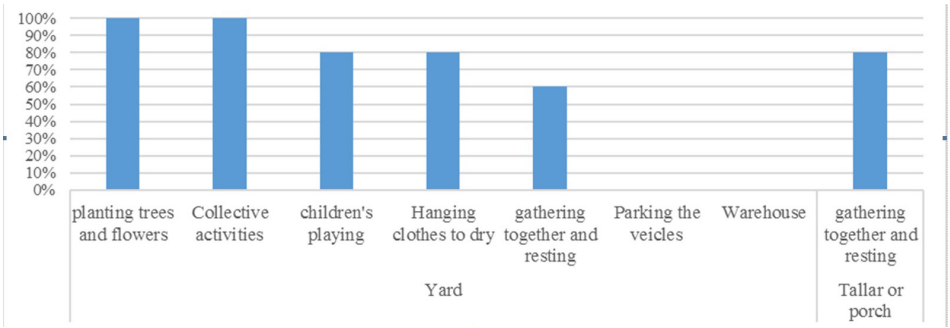


Figure 6. *Frequency of open space functions in the second housing pattern.*

Figure 7. *Frequency of open space functions in the third housing pattern.*

3.2.2. Residents' mental ideal image of housing open space

In the residents' imagination of an ideal open space, the residents referred to gardens, trees, flowers, a porch, and a howz (pool). Regarding the main functions, likewise, the residents of these three patterns referred to some activities such as gathering together in the open space and playing children. The residents of the first housing pattern considered the open space of their houses as being ideal. Notably, in depicting the characteristics of an ideal open space, they referred to their own courtyard's features. However, the residents of the second and third housing pattern, did not consider their houses' open space as being perfectly ideal or close to their mental image of an ideal open space (Table 2).

Another important point is the fact that, to understand the residents' mental image of the ideal open space, direct questions are not enough. For this reason, the researchers asked the interviewees to describe the desired open space that they have experienced so far. In this description, the residents of all three housing patterns pointed to such elements as gardens with trees, large howzes and porches. In fact, in all three patterns, the residents described a desired housing open space as a large space with lots of gardens and trees, a large howz and a porch (Table 3).

3.2.3. The congruence strategies

As mentioned, one of the most important concepts in relation to the congruency in housing studies is housing satisfaction. Satisfaction or dissatisfaction with housing is determined as a result of the residents' qualitative assessment of housing characteristics, and indicates the degree of adaptation of the users' needs and requirements with the facilities and affordances of the environment. In this regard, Musiol & Boehnke have mentioned the relationship between the users' needs and living environment and, using quantitative methods, proven the positive relationship between the congruence of residents' needs and residential environments and their satisfaction with that place (Musiol & Boehnke, 2013).

Therefore, to assess the extent of congruency with the open space, people's satisfaction or dissatisfaction with their housing open space was studied.

With regard to satisfaction with the houses' open space, the results showed that one of the residents of the first

Table 2. *Mental image of open space for the residents of the three housing patterns.*

Housing Type	Case study	Physical elements				functions		
		Gardens and trees	Flowers and green space	howz	The porch or a place for gathering together	Providing a place for gathering together	Providing children's playing space	Providing Parking space
third	P_1	*			*			
	P_2		*	*	*	*	*	*
	P_3	*	*	*	*	*		
	P_4	*	*	*	*	*	*	
	P_5	*	*	*	*		*	
Second	P_1	*		*	*		*	
	P_2	*		*	*	*	*	
	P_3	*	*	*	*		*	
	P_4	*		*	*	*		
	P_5	*	*	*	*	*	*	
First	P_1	*	*	*	*	*		
	P_2	*	*	*	*	*	*	
	P_3	*		*	*	*	*	
	P_4	*	*	*	*	*	*	
	P_5	*		*	*	*	*	*

Table 3: *Experienced ideal open space for the residents of the three housing patterns*.

Housing Type	Case Study	Physical elements				Functions		
		Gardens and trees	Flowers and green space	howz	Tallar or porch and a place for gathering together	Providing a place for gathering together	Providing children's playing space	Providing Parking space
third	P_1	*		*				
	P_2	*	*	*	*	*		*
	P_3	*		*	*	*	*	
	P_4	*	*	*	*		*	
	P_5	*			*	*		
Second	P_1	*			*			
	P_2	*		*	*	*	*	
	P_3	*		*		*		
	P_4	*	*	*				
	P_5	*	*	*			*	
First	P_1	*	*	*				
	P_2	*	*	*	*	*	*	
	P_3	*		*	*	*	*	
	P_4	*	*	*	*	*	*	
	P_5	*		*	*	*	*	*

housing pattern was slightly dissatisfied with his house. He reasoned that having access to different parts of the house is difficult during the winter, since the courtyard is located at the center of the house and having access to other parts of the house requires crossing the courtyard. Most residents of the second pattern were satisfied with their housing open space. Undesirable features of open spaces of the second housing pattern include: the limited connection between open and closed spaces, narrow porches and open spaces overlooked by their neighboring buildings. The residents of the second pattern believed that these undesirable features prohibit adopting a lifestyle previously existed in the courtyard of the first housing pattern. Regarding the third housing pattern, all respondents were dissatisfied with their housing open space. The residents referred to the narrowness of the balconies and being viewed by strangers as the undesirable character-

istics of these houses. They believe that these disadvantages hamper bringing life to the balconies. Given that other houses overlook the balconies, the windows to the balconies are always covered by curtains and open spaces, instead of providing a private space for family members, intervene between the interior and exterior spaces of the house (Table 4).

In this section, three strategies are studied to achieve person-environment congruency, namely modifying affordances of environment, changing behaviors and abandoning the environment or moving (Table 5). Of course, there are other strategies to achieve congruency such as adapting the mental image of an ideal environment to the current environment, changing values, norms and priorities to adapt to the current environment, which are mentioned in the literature. Since these strategies are not easy to be examined and are not important for the results of this study, they have not been considered here.

Modifying affordances of the environment: Until now, substantial changes have been made to the first mentioned housing pattern to strengthen the building and adapt it to today's needs. However, the residents of the second housing pattern have not made considerable changes to their houses. The residents of the third housing pattern, likewise, have made some small changes to their houses so that most of the changes have been made to increase the safety, security and privacy of their balcony. They have not made considerable changes in the open space of their houses to adapt its affordances to their needs. In fact, when they are asked "what do you intend to do to make your space more desirable?", they mention that they just attempt to keep it clean. They believe that an ideal open space is a courtyard. However, in mentioning the necessary elements of a balcony, they do not refer to the elements such as trees, flowers, and pools. They believe that these elements belong to a courtyard and balconies are very different in terms of function and physical features. One of the residents said: "every change made to a balcony makes it a better balcony; however, it can never become a courtyard" (Table 5).

Changing behaviors: Almost all residents of the first housing pattern have adjusted their behaviors with the affordances of the space. For example, one resident said: "Our courtyard is not accessible to cars. That's why I park my car in the neighborhood car parking area." "Because of the location of the courtyard in the center of the house, we changed the reception area for our guests. Many of our parties are held in the courtyard, and we don't use the rooms too much when the weather is good," said another resident. The residents of the second pattern have also changed some of their behaviors to fit the space capability. For example, one resident said, "The porch of these houses is very small. That's why we don't use the porch anymore to get together." In general, because the residents of the sec-

Table 4. *Undesirable features of housing open space and the exerted changes.*

Cases	The most undesirable features of the house	Exerted changes
Residents of the first housing type	- Having difficulty in accessing to different spaces of the house Having difficulty in cleaning the big yards	- renovation - changing the functions of the Tallar - moving the kitchen and the bathroom from the courtyard to the closed space - making the howzes smaller or omitting the howz and gardens changing the entrance of the courtyard to make a parking area
Residents of the second housing type	- smallness of the porch - The high difference between the height of porch and courtyard - being viewed by strangers limited connection between open and closed space	- making the gardens smaller to provide a parking space for cars increasing the number of gardens
Residents of the third housing type	- balconies are viewed by strangers - low-quality walls - not having a scene and a good view smallness of the balcony	- building fence in front of the balcony to ensure safety building coverings in front of the balcony so that it is not viewed by strangers

Table 5. *Congruence strategies of the residents' satisfaction in three housing patterns.*

Housing Type	Case Study	Congruence strategies			Satifaction
		Adapting the Behaviors	Modifying the Affordances	Moving to new house	
First	P_1	*	*		*
	P_2	*	*		
	P_3		*		*
	P_4	*	*		*
	P_5	*			*
Second	P_1	*		*	
	P_2		*		*
	P_3	*		*	*
	P_4	*	*		*
	P_5	*	*		*
Third	P_1	*		*	
	P_2	*	*	*	
	P_3	*		*	
	P_4	*		*	
	P_5		*	*	

ond pattern are involved in the design and construction of their houses, they have made the open space as appropriate as possible. In the third type of housing pattern, the change in behavior has been such that the residents have limited their connection to the balcony or used it just as a warehouse.

Abandoning the environment or moving into a different environment: The residents of the third housing pattern believe that we will soon move into a house with a courtyard; however, most of the residents of the first housing pattern have all been living in their houses for a long time and they do not intend to move into another house (Table 5).

3.3. Discussion

Considering the residents of all three housing patterns, analyzing the results obtained from the questionnaires shows that their mental ideal images of the open space are relatively similar to each other. Notably, this image is showing a space known as the courtyard in the first and second housing patterns. It is a spacious, roofless space with a howz in the middle and gardens around in which fruit and flower trees are planted. This open space is separated from the closed space of the house by a covered porch. The porch is, in fact, a place for gathering family members on spring and summer nights. These features are all seen in the first housing pattern. In describing the ideal open space, the residents of this housing pattern have also pointed to their courtyards and considered them desirable. Of course, today's lifestyle in traditional houses is different from that of the past, and the residents of these houses have changed some of their behaviors or made limited changes to their open space to satisfy their needs. However, there is still a good interaction between the residents and open space.

Developments in housing in recent decades have changed the spatial and physical characteristics of open spaces. In the second type of housing, the courtyards, that were in the middle of the house in the first housing pattern, have been moved to one side and connected to the alley through a door. Since some part of the courtyards has been allocated to car parking area, the size and number of gardens has been reduced, and the howzes have become smaller or been totally removed. The porches have also been narrowed, and because the surrounding buildings overlook, they no longer have enough privacy for the family. Therefore, the quality and functions of the courtyard in the second housing pattern is somewhat different from that of the first pattern. This point is quite evident by comparing figure 5 and figure 6. Open space in the second housing pattern has generally the same structure as the ideal image of open space in the minds of residents, but also qualitatively different. For example, the desirable open space

in their minds is larger, with more trees and flowers. In this housing pattern, the residents have made some changes or adapted their behaviors to the current space in order to bring their courtyards closer to their mental ideal image.

In the third pattern of housing, open spaces have lost their main elements, including trees, howzes and porches. As shown in figure 7, in this type of housing, balconies have only practical functions[3]. Notably, balconies have a completely different structure and quality compared to the desired open space in the minds of the residents, because they do not have gardens, howzes and porches, they are very small and the surrounding buildings overlook it. The residents of the third pattern, to adapt to the open space, have completely changed their behavior in relation to this space and have even been forced to ignore or change most of their needs in relation to the open space and reduce them to some practical needs. Therefore, they do not make much changes in their open space to adapt to the affordances of the open space with their needs. They hope that they will soon move from this house to courtyard housing. In addition, they believe that this open space will not be able to be changed or approach their mental ideal images of an open space.

4. Conclusion

People always attempt to establish congruence between their needs and their living environment to make an optimal and desirable resident-housing interaction. Congruence between residents and housing can be established by different strategies. It is, in fact, a function of the physical and psychological environments as well as the past experiences of an individual. The results of this study revealed that residents, at first, compare their actual current environment with their mental ideal images and the extent to which the open space of their houses is similar to their ideal mental image determines the type of the strategy establishing congruency between residents and houses.

All the generations living in the city of Yazd have experienced living in or having interaction with open spaces of the first and second types of houses. Therefore, some elements such as tree, garden, porch (or talar), and howz are involved in these people's conception of housing open space. They generally use the word "courtyard" to refer to the open space of the house, which has some specific qualities and physical characteristics in their minds. When one open space has these characteristics and is similar to the mental image of an ideal open space formed in their minds, they establish a two-way relationship with their environment. Moreover, to establish more congruency, they adapt their behavior to their environment and adapt the environment to their needs, in a two-way interaction. However, when the open space does not have elements which are construed as being the necessary elements of open spaces, residents do not consider it as the yard and to establish congruence they change their behavior towards this open space, and are even obliged to ignore some of their needs. Given that the existing open space is a far cry from their ideal open space, they do not make any attempt to change it to make it more compatible with their needs. However, they have an ideal image of open space in their minds and hope to move from their present house to another house with an ideal open space (Figure 8).

In the present study, the mental ideal images and the congruency-inducing behaviors of the generations who have the experience of living in the courtyard housing of the city of Yazd were studied.

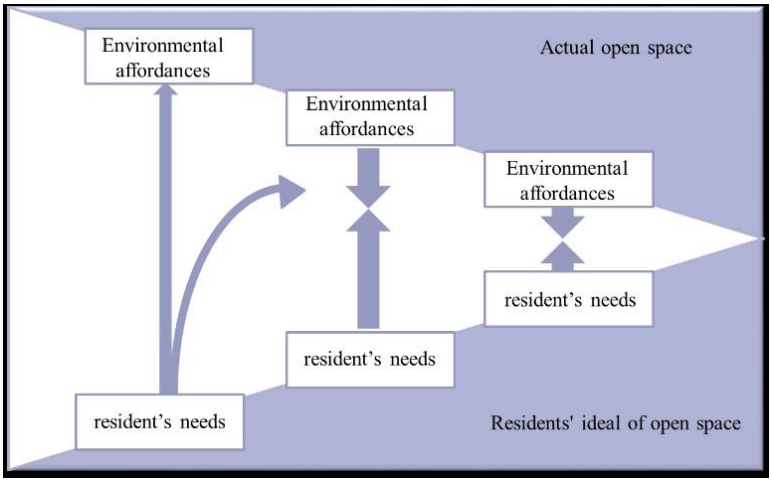


Figure 8. *The effect of the extent of similarity between residents' mental ideal images of the open space and the real space on the congruence strategies between residents and houses' open space.*

However, the next generation whose experience of the open space is based on the balconies of the apartments or open spaces of the residential complexes might have a different conception of the open space. Accordingly, the results of the present study can be of different consequences in different places and time periods. Furthermore, the theoretical model proposed for the congruence process between residents and housing is the other achievement of the present study which can be adopted in future studies conducted in this connection.

Endnotes

[1] Housing patterns of Yazd have been studied in the first Elham Fallah's thesis, in details. Notably, the patterns introduced in this section are the result of her extensive studies in Ph.D. thesis.

[2] Due to the small number of house patterns with backyards and patios in the samples, the related results are not presented in the charts.

[3] Practical functions are related to the application of architecture as a tool to meet human needs. These functions have neglected many of the transcendental needs and desires of human being in relation to building environments. (Gharibpour, 1392, 65)

References

Amani R, Etemadi O, Fatehi Zadeh M, Bahrami F. (2012). The Relationship of Attachment Styles and Social Adjustment. *CPAP, 2* (6), 15-26

Aghalatifi, A. (2012). *Man and house, explaining the pattern of interaction between man and the contemporary house in Iran*. Phd Thesis, Tehran university

Ann Lodi, K., & Raedene Combs, E. (1989). Housing Adjustments of Rural Households: Decisions and Consequences. *Housing and Society*, 16(3), 13–22. https://doi.org/10.1080/08882746.1989.11430041

Baum, S., & Hassan, R. (1999). Home owners, Home renovation and Residential Mobility. *Journal of Sociology,* 35(1), 109–117. https://doi.org/10.1177/144078339903500102

Brown, J. and E. Moore. (1970). *The Intra-Urban Migration Process: A Perspective*. Geografiska Annler 52, 1-13.

Colombo B. (2012). Mental Imagery. In: Seel N.M. (eds) *Encyclopedia of the Sciences of Learning.* Springer, Boston, MA.

Crull, S. R., Bode, M. E., & Morris, E. W. (1991). Two tests of the housing adjustment model of residential mobility. *Housing and Society,* 18(3), 53–64.

Daiepour, Zeinab. (2014). The relationship between the presence of nature and the increase in the sense of belonging in the Iranian traditional houses. *Baghe- e- Nazar,* 11 (30), Pp. 58- 39

Eichner, M. M. (1986). *A model of household housing adjustment : confronting analytical issues.* Iowa State University.

Edwards, J. R., & Shipp, A. J. (2007). *Perspectives on organizational fit*, 209–258.

Falamaki, M. (2006). *Formation of architecture in the experiences of Iran and west*, 2 nd edition, Faza publication.

Festinger, L. (1962). *A Theory of Cognitive Dissonance,* Stanford, CA: Stanford University Press.

Fleury-bahi, G., & Felonneau, M.-L., & Marchand, D., 2008. Processes of Place. E*nvironment and Behavior,* 40(5), 669–682. https://doi.org/10.1177/0013916507307461

French, J. R. P., & Jr., Rodgers, W., & Cobb, S.(1974). Adjustment as person–environment fit. In G. V. Coelho, D. A. Hamburg,&J. E. Adams (Eds.), *Coping and adaptation*. New York: Basic Books

Ghanbari, A., & Zaheri, M. (2009). Evaluation of Housing Policies in Pre and Post-Revolutionary Plans, *Journal of Housing and rural environment,* No. 123, 77- 90

Gharibpour, A. (1392). Terminology of Architectural Function, *Journal of fine arts,* Vol. 8, Issue. 1, 57- 68

Ghazizade, N. (2011). *The Effect of Outdoor Design of Residential Complex in Creating the sense of Place Attachment Case Study: Selected Residential Complexes in Tehran.* Ph.D thesis, Tehran university

Galster, G. C., & Hesser, G. W. (1981). Residential Satisfaction. *Environment and Behavior,* 13(6), 735–758. https://doi.org/10.1177/0013916581136006

Groat, L., & Wang, D. (2002). *Architectural research methods.* New York: Wiley

Jusan, M. (2010). Means End Chain, Person Environment Congruence And Mass Housing Design. *Open House International,* 35(3), 76–86.

Kahana, E. ,1982. A congruence model of person-environments interaction. In *Aging and the environment: Theoretical approaches,* 97–121.

Khaghanpour Shahrezaee, R. (2017). The Relationship between the Past and the Present in Some Contemporary Residential Architecture in Tehran. *Journal of Fine Arts*, vol. 22, No. 1, Pp. 89- 104.

Kosslyn, S.M., & Ganis, G., &Thompson, W.L., (2001). *Neural foundations of imagery, Nature reviews neuroscience,* 2 (9), PP. 635- 642.

Lang, J. (2007). *Creating Architectural Theory,* van Nostrand Reinhold, New York.

Memarian, Gh., & Brown, F. (2006). The Shared Characteristic of Iranian and Arab Courtyard House .In Edwards B. (Ed.) *"Courtyard Housing: Past, Present and Future",* Abingdon, Oxon; New York, Taylor & Francis.

Mohit, M. A., Ibrahim, M., & Rashid, Y. R. (2010). Assessment of residential satisfaction in newly designed public low-cost housing in Kuala Lumpur, Malaysia. *Habitat International,* 34 (1), 18- 27. https://doi.org/10.1016/j.habitatint.2009.04.002

Morris, E. W., & Winter, M. (1975). *A Theory of Family Housing Adjustment,* 37(1), 79–88.

Moore, K. D. (2005). Using Place Rules and Affect to Understand Environmental Fit: A Theoretical Exploration. *Environment and Behavior,* 37(3), 330–363. https://doi.org/10.1177/0013916504272657

Mridha, M. (2015). Living in an apartment. *Journal of Environmental Psychology,* 43, 42–54. https://doi.org/10.1016/j.jenvp.2015.05.002

Musiol, A., & Boehnke, K. (2013). Person-Environment Value Congruence and Satisfaction with Life. *International Journal of Humanities and Social Science*, 3(9), 57–65.

Nazif, Hassan. (2013). The sustainability of Iranian architectural elements throughout the Islamic era. *Bagh- e- Nazar,* No. 24, pp. 57- 68

Omar, E. O., Endut, E., & Saruwono, M. (2012). Personalisation of the Home. *Procedia - Social and Behavioral Sciences,* 49, 328–340. https://doi.org/10.1016/j.sbspro.2012.07.031

Pearson, D.G. (2007). Mental imagery and creative thought, *Proceedings of the British Academy,* 147 pp. 187-212.

Priemus, H. (1986). Housing As a Social Adaptation Process: A Conceptual Scheme. E*nvironment and Behavior,* 18(1), 31–52. https://doi.org/10.1177/0013916586181002

Rossi, P. (1955). *Why Families Move: A Study in the Social Psychology of Urban Residential Mobility Glencoe,* The Free Press.

Shin, J. (2016). Toward a theory of environmental satisfaction and human comfort: A process-oriented and contextually sensitive theoretical framework. *Journal of Environmental Psychology*, 45, 11–21. https://doi.org/10.1016/j.jenvp.2015.11.004

Sirgy, M. J., Grzeskowiak, S., & Su, C. (2005). Explaining housing preference and choice: The role of self-congruity and functional congruity. *Journal of Housing and the Built Environment*, 20(4), 329–347. https://doi.org/10.1007/s10901-005-9020-7

Spokane, A. R., Meir, E. I., & Catalano, M. (2000). Person–Environment Congruence and Holland's Theory: A Review and Reconsideration. *Journal of Vocational Behavior,* 57(2), 137–187. https://doi.org/10.1006/jvbe.2000.1771

Steggell, C. D., Binder, S. K., Davidson, L. a, Vega, P. R., Hutton, E. D., & Rodecap, A. R., 2003. Exploring Theories of Human Behavior in Housing Research. *Housing and Society,* 30(1), 3–32. https://doi.org/10.1080/08882746.2003.11430480

Tinsley, H. E. A. (2000). The Congruence Myth: An Analysis of the Efficacy of the Person–Environment Fit Model. *Journal of Vocational Behavior,* 56(2), 147–179. https://doi.org/10.1006/jvbe.1999.1727.

Tomas, N.J.T. (1999). Are theories of imagery theoris of imagination? An active perception approch to conscious mental content. *Cognetive science* 23: 207- 245

Location of Yazd in Iran: https://commons.wikimedia.org/wiki/File:Yazd_in_Iran.svg,

(Accessed, 10 June 2018)

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Mapping relations as a design strategy, physical attraction forces correlation for design thinking

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Abstract

Architectural design is an iterative research and discovery process. The architect learns through investigation and experimentally develops his/her ideas, builds and evaluates the space, and continuously reforms it. Although this is a subjective process, there are design tools and methods that provide objective criteria for evaluating potentials of the designed space and iterating with feedback. Tools for measuring space in network thinking allow visualization of architectural decisions and developing potentials for architectural programming and restructuring design scenarios. This study evaluates the use of graph theory-based thinking and Space Syntax in architectural design, emphasizes the experimental and cognitive qualities of the design process, and investigates how scientific data and processes can be transferred into design. In other words, it explores the potentials for using Space Syntax related methods that provide real-time information in the design process. The argument is exemplified with the design strategies of the project "Login Park" for International Bandırma Park Competition. By utilizing an 'animated relational mapping' as a generative tool during the site-plan investigations, the designer could iteratively assess potential relations and their metric ranges between the required buildings and programs and examine various scenarios through the graph theory-based tools. The authors suggest that these dynamic tools and thinking lead to powerful instigation, management and assessment of configured spaces. By providing an evidence based design environment this is very much similar to the design processes of the landscape architect and urban designer.

Keywords

Algorithmic design, Creative design process, Design thinking, Relational mapping, Space syntax.

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1. Introduction: Designerly thinking with spatial relation mapping

The origins of deploying network thinking and graph-theoretical tools in architectural design date back to the 1960s. C. Alexander (1964) in his pioneering book, *Notes* on the S*ynthesis of Form*, is talking about the complexity of the design problem and reveals some notes that deal with the "process of design; the process of inventing physical things which display new physical order, organization, form, in response to function". He indicates that in dealing with the design problem, we have to meet a set of complex and interrelated requirements. As these set of relations become too complex, they are difficult to grasp intuitively. Alexander (1964) states that we need a way of setting out the problem which makes it perspicuous. By doing this, he tries to understand the process of design analytically and reveals some notes to describe a way of representing design problems which make them easier to solve (Alexander, 1964).

In the process of representing design brief, Alexander's main interest lies in the search for a kind of *"logic"* which is concerned with the form of abstract structures. According to him these abstract structures "involve the moment we make pictures of reality and seek to manipulate these pictures so that we may look further into reality itself" (Alexander, 1964). He points out the use of this logic as a tool to explore the architectural form rather than as a tool to describe the form directly.

Based on this theoretical understanding he tries to make this logic visible and discussible by using the idea of diagram, or *"pattern"*. Here, he talks about an abstract *"pattern of physical relationships"* which resolves "a small system of interacting and conflicting forces" (Alexander, 1964). In his following book, A Pattern Language, he presents a language for buildings and cities which is derived from the collection of these patterns. These patterns are ordered, each pattern connected to other patterns, one can grasp the collection of patterns as a whole, as a language which one can create an infinite variety of combinations (Alexander, 1977). In the article this pattern is treated as the logic behind spatial configuration settings.

Essentially, Alexander presents a kind of design and problem-solving strategy/logic in order to organize and coordinate design in a way to adapt to the present and future situations based on the relationships between design variables. Relationships form a design language through different patterns. Bringing together endless patterns, networks of patterns with his/her priorities, the designer can create an infinite number of combinations. Thinking with relations, making the design problem and solution visible analytically capacitates to evaluate and to restructure the whole design process. The intellectual features of the designer are emphasized in this statement rather than a mechanical-systematic process (Alexander, 1964). Therefore, completely intuitive design strategies and tactics give way to reasonable and debatable design operations.

Hungarian-American physicist Barabasi (2016), in his book *Network Science,* mentions the existence of complex network structures in many areas, from the social structures we live in to the communication infrastructure of computers, from the working principles of the nerves in our brain to biological and metabolic processes. Barabasi (2016) states that "it is difficult to derive collective behavior of complex systems from a knowledge of the system's components". According to him "behind each complex system there is an intricate network that encodes the interactions between the system's components" (Barabasi, 2016). Barabasi mentions that in order to understand complex systems, we need to analyze the network-like structures behind them and he introduces the mathematical tools that can be used to measure these network structures.

Latour (2005) adds another layer to the idea of network. In the theory of the Actor Network, structure is defined as an open system which is dynamic, unfinished, and constantly deteriorated. Latour (2010) uses the word network "not simply to designate things in the world that have the shape of a net but mainly to designate a mode of inquiry that learns to list, at the occasion of a trial, the unexpected beings necessary for any entity to exist." Latour's network concept differs from Barabasi's concept

of network built with real actors. He mentions a conceptual network concept in which non-human beings can become actors (Latour, 2005). According to Latour "whenever you wish to define an entity (an agent, an actant, an actor) you have to deploy its attributes, that is, its network. Here, network is the concept that helps you redistribute and relocate action" (Latour, 2010). In fact, this conceptual structure can be considered as an approach not to look for what is existing but to search for what might be. It shows dynamic, transformable features based on exploration: "Network is a concept, not a thing out there. It is a tool to help describe something, not what is being described" (Latour, 2005).

The design method as a model described in this paper is to question how each and every element in the design domain is positioned in relation to one another. This relation may also be from an element to a group, to the whole or between groups. "Position" on the other hand is initially physical in reference to anthropometric data such as how many steps away, or how far in terms of visibility. Furthermore, positioning may instigate virtual positioning in terms of the qualities that the designer attributes to the elements: secure, cozy, etc. This a semantic and syntactic mode of design, that is very much linked to the network thinking and pattern based design.

2. Architectural design in network thinking mode

Architectural design is a complex, cognitive, intellectual process that progresses by making, architects mainly learn from what they do (Cross, 2001, 2007). It includes a kind of discovery, research, probing, learning process which is practiced by doing (Dursun, 2007). It aims not to find an optimal one-off solution (Simon, 1996), but a spatial meaning by interpreting many variables by interconnecting the data, reinterpreting and interpreting them, and looking for possible spatial solutions. In this sense, dynamic, non-linear, complex relationships derived from "action in reflection" (Schön, 1987) involve a performative process. The architect, who thinks with different design tools (Dursun Çebi and Kozikoğlu, 2017), develops a distinctive approach, a designerly way of knowing, thinking, and acting (Cross, 2001, 2007). In other words, the architect is an intellectual person who can masterly utilize different design tools and information sources and can produce new design concepts by gathering and interpreting different data and information in relation to one another (Dursun, 2007).

Alexander's language based on patterns is about the relationships between variables. He uses a mathematical and graphical language to understand the complex relational structures and tries to design the built environment with this language. Barabasi also discusses the complex structures around us and the network-like structures behind them, refers to a common set of fundamental laws, common organizing principles in the process of analysis, and expresses them in numerical, mathematical measures. The dynamics qualities of the networks can be discussed through these data. These approaches are important when the design is purely conceptualized as a practice of making configurations. The ability to grasp the spatial meaning of the network-like patterns mentioned by Alexander and Barabasi, and the ability to speak clearly about these patterns with mathematical, graphical tools allow us to see what kind of social results such spatial networks produce. As Dade-Robertson (2011) indicates that topological description of space can account for aspects of architectural experience by constraining or generating the possibility of human social interaction (Dade-Robertson, 2011). Patterns in spatial configurations constitute the potentials of encounters for the users through connections and borders. They are decisive in defining both "active and latent functional routes and indicating spatial proximities and neighbors" (Kozikoglu and Dursun Cebi, 2015). To deploy relational design thinking in architecture and to explicitly represent and engage with that mode of thinking open new horizons for architects.

Latour's description of the network as an unfinished, dynamic, open system with heterogeneous (human, non-human) actors is valuable for the practice of architecture in the act of setting up spatial configuration in multi-relation-

al dynamic disposition. To read and engage with the dynamics of the context, and the needs, and possible new scenarios mean a complex and individual process which is non- systematized. Similar to Latour, it is crucial to understand, explore and design the space through the interrelated components, the influencing components - actors such as function, distance, direction, size, quality of light, way of life, user profile, etc. and the variable relations between them.

This study focuses on relational thinking and mapping in the design process as one of the tools used by architects in the phase of discovery. This paper instigates from the assumption that tools for building and measuring space via network thinking allow visualization of and provide structure to architectural decisions and developing potentials for architectural programming and restructuring design scenarios. This study treats architectural design as a research process and searches the potentials of analytic, scientific, graph-theoretical tools in design not only for determining the problem and evaluating the space, but also exploring the problem and generating the spatial set-up. In doing so, it focuses on Space Syntax as a graphical-theoretical approach and explores deployment of network thinking as a productive design tool providing real-time information in the design process. Thus, the study questions how scientific data and processes can be used in the design process as a creative and informative tool that enriches design thinking.

The Space Syntax theory is based on the following argument underlined by Alexander and Barabasi as well: "The built environment functions as a spatial / social network. In this network the main interest is about relational characteristics of spaces rather than individual ones. Space is experienced through these spatial networks or relations. Spatial networks also create potentials of movement and describe a living pattern. Based on this network structure spatial configurations embody social or cultural meanings and generate or inhibit social interactions, movement patterns in built environments" (Dursun, 2012; Kozikoğlu and Dursun Çebi, 2015).

To explore the idea of network in architectural design, to talk about the logic of this network in scientific ways cannot reduce the architect's intuition. It makes it reasonable, questionable, and searchable. The Space Syntax theory (Hillier, 1996), which focuses on network thinking in architecture, demonstrates that the way in which spaces are brought together and put forward a specific interaction model among users, demonstrates certain social-cultural meanings (Hillier, 1996). "Space Syntax research is reason based, and more rigorous than most, but it has effectively led to the study of architectural intuition through its creations. In practice, design proceeds by mixing intuition and reason. Space syntax makes the deployment of non-discursive intuition more rational and therefore more discursive." (Hillier and Hanson, 1997).

Recent research and experiments on linking metric data to position elements in a syntactic manner have been evolving with the advance of coding in the architectural design platforms such as Rhinoceros Grasshopper. The work of architect Frano Bazalo and Tane J. Moleta (2015) are one such example where they investigate the early computational processes in architectural design and they argue that complexity in design problems can be addressed simultaneously through algorithmic methods. Bazalo and Moleta suggest that computational design provides the power of iteration and has the potential to capture the subjective input of the designer. The Plugin Syntactic developed by Nourian (2016) and his colleagues on the other hand have presented a relational design tool and measurable space syntax methodology. These design models differ in terms of what they refer to as "early stage design" whether it is a conceptual model or a schematic design, they all deploy a network based understanding.

3. Case study: Bandırma design park competition project

"Relation" is not only of the physical that is metric but can refer to subjective measures like private/public, and have gradiencies of interactivity and security qualities that the architect may require. Therefore, the design approach needs to handle the multiplicity of design in-

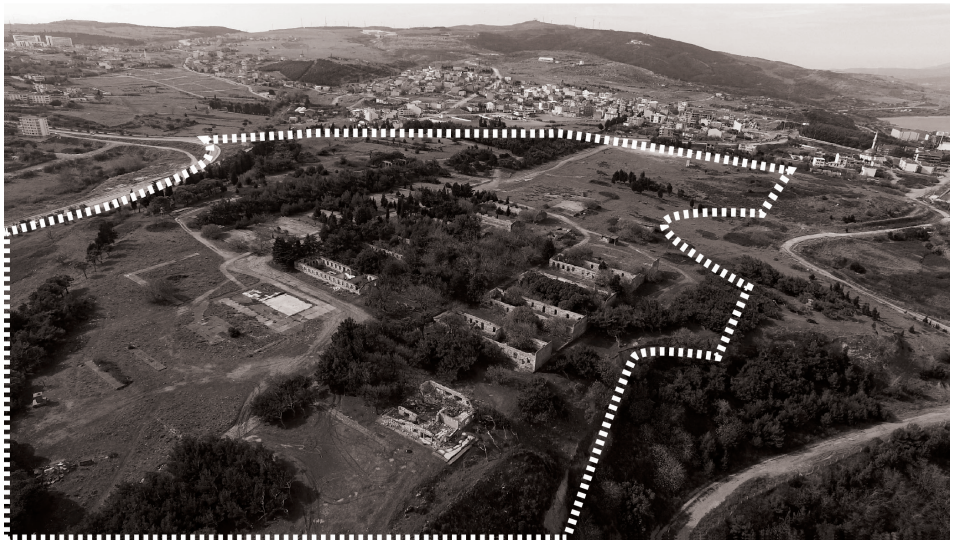

Figure 1. *Aerial photo of the existing site.*

put, some of which may be conflicting, simultaneously and provide the potential for permutation and iteration. The design approach in the prize winner project in the International Bandırma Design Park illustrates the nested relational incorporation in the process explicitly. Project space is a dynamic canvas of relations in and in between scales and design takes place in that multi-scalar order of potential pairwise relations; building, invigorating, mitigating or breaking them.

The brief for the competition is deliberated by the international jury members, Odile Decq, Louis Becker, C. Abdi Güzer, Martin Rein-Cano, and Günther Vogt administered the re-design of a 25 hectares military base in the Bandırma Port City of Marmara Sea into a new genre of public park cultivating the notion of spatial design and planning as well as creating a recreational center at the regional scale (Kozikoglu et al., 2017). The program included a design institute, curatorial voids, a 4-star, and a 5-star hotel as well as a convention center and a retail space, major emphasis being on the design facility and the general quality of "park" as a design space. The existing ruins from the military and the existing fabric of the flora, the picturesque pine and olive trees, would all be preserved as the historical identity of the place (Figure 1).

The competition clearly addressed the quest for solutions that interconnected the site to its history and its environs both spatially and socially to the port and enacted as an integrator for the city in its links to the hinterland, the large Marmara area and beyond (Figure 2). Three disciplines needed to work in collaboration: architect, planner and

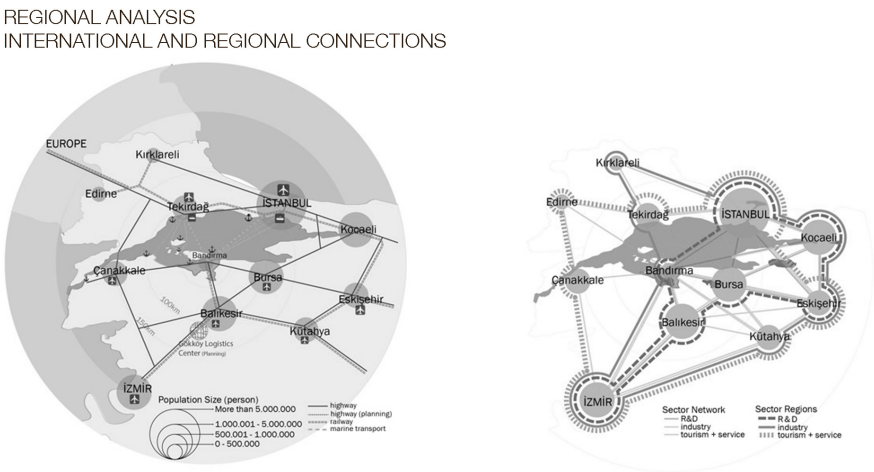

Figure 2. *Connectivity maps in regional and city scale created by the project group.*

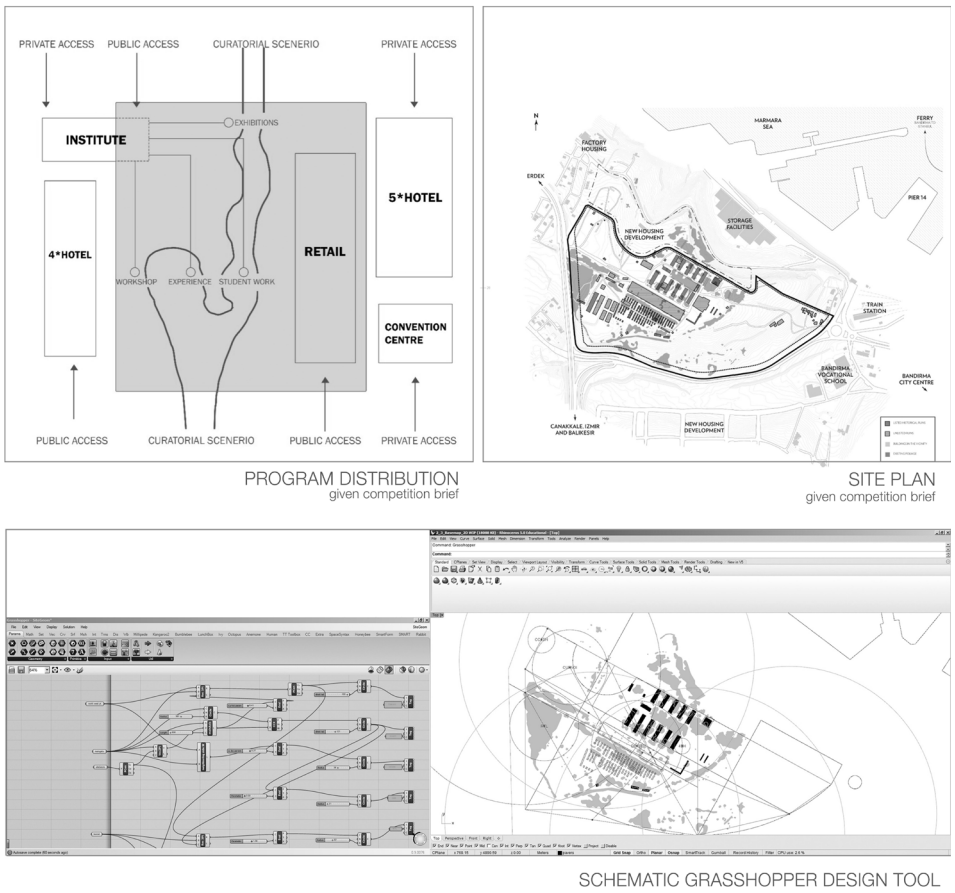

Figure 3. *Grasshopper design tool for schematic design.*

landscape designer. Major interconnector in terms of program as well as spatial elements revolved around the concept of logistics in all three disciplines. Therefore, the movement of people and goods as well as information and processes constituted the major design guidelines for existing and potential relational mapping of prevalent networks (Figure 3).

The schematics of the diagram presented by the competition brief is translated into a dynamic model for the replay of potential layouts mapping into the axis and access nodes of the site (Figure 3). The coded schema interpreted the rationale of the competition requirements and the design motives as a syntactic model for iterative design exercises. Certain programs were modeled as clusters interacting with the other programs as one body rather than individual. Intrinsic qualities and added qualities as well as introduced programs and contextual inferences like main road, view, central axis etc., are also inserted to the dynamic design model.

The solution promoted the retail space to be close to the major possible access points, and the 5-star hotel-convention center pair intermediating between the port and the retail. Among the possible solutions, access closer to the city center was favored for its relation in terms of the city dweller in favor of the retail cluster. On the other hand, the design institute orbited by the 4-star hotel in its close relation to the curatorial voids anchored to the axis that connected the city to the park and the suburb (Figure 4). An overall connectivity to the university, the city bus terminal and the neighboring residences were sketched out with varying qualities of vehicle and pedestrian access routes. Apart from the contextual and programmatic connections intangible constituents such as the web application augmented the connectivity among and outside role players of the project.

The major overriding principle was to leave most of the land to open-air park, therefore to build minimally and to enable the park form in a self-organized manner as is possible, outdoor

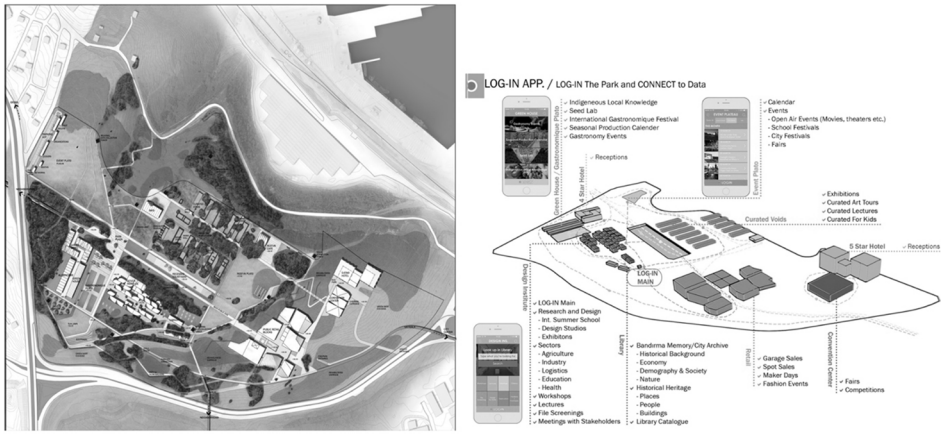

Figure 4. *Project site layout and the web application diagram with programmatic distribution.*

areas like plazas, terraces, resting and exhibition spaces, festive areas interconnected with the closed spaces were also introduced to the dynamic syntactic tool to allocate them on the footpaths between the network of buildings and attractions points (Figure 5).

The design methodology describes two major questions answered by the designer. What are the differentiable spatial constituents of the project including the context? And secondly, how are they linked? These spatial constituents were not limited by the architectural programs i.e. buildings but also spatial organizers such as the existing axis, the view represented as the port. And moreover, temporal activity areas were introduced like an event plateau and the web application was considered as a social space that served as a connection and represented as a node itself.

Both of the questions required the mapping of the network specifically elaborated with the design criteria of the designer that overlap and surpass the requirements of the brief. This criteria involves metric as well as non-metric qualities, in both the prerequisites of the jury as well as the designers own agenda.

To further illustrate the following is an excerpt from the brief of the competition:

Figure 5. *Rendered scenarios. From left to bottom: event plateau with existing watchtower and vegetation, curatorial space with remnant military barracks, a visitor with proposed application on hand-held device, retail space for local production as well as brands, cafe with bay view.*

"The jury will be looking for creative solutions which are based on integrative, coherent and rich design proposals that will stimulate a new focal area accommodating a diverse set of activities and uses (i.e. recreation, retail and accommodation) in the service of the city and the region. With this regard, the major concerns of the jury are, ensuring the integration of the project site with the city, creating a focal area to act as the generator of the future transformation, developing a sensitive approach to existing landscape context; site ecology, historical and cultural heritage and devising spatially open, publicly accessible and socially inclusive organization on the site" (Bandirma Park Competition).

The given scheme of programs, accorded with the above set of conceptual criteria are interpreted by the design team as connectivity, temporality and multiplicity. This conceptual framework corresponds to various added programs in the proposal as well as the non-metric event/phenomena constituents that are spatially viable. Such constituents are for example the web application that is considered as a social space, as well as zones that are mapped to a physical space for allocation to temporary events or weekly and yearly activities for example, the set of event based programs defined under ecological interventions: a temporal spatial element like organic food bazaar from the environs, walks and bicycle paths that trace the trails of the conservation of the phrygana (garrigue) family and the calligraphic coniferous tree groups, following the effects of the wind and time, watching the passage of the seasons.

Metric relationships between programs are defined by distance especially by foot, but also by bicycle. For example, the distance between the 4-star hotel and the design institute is coded as approximately 50-100 meters, this made them a couple, where the 4-star hotel is orbiting the institute. Whereas the retail is distanced to the 4-star and institute couple around 300m (10 minutes walking distance). This is a scenario playing method: In the given distances for example the institute is a center that invites experts, artists and

INITIAL RELATIONS

	CC5SH	4SH	RTL	DINST	CURVOI	ECOINT
CC5SH			2	1	1	
4SH	1		2	2	2	
RTL	2			2	2	2
DINST		2	2		2	2
CURVOI	2	2	2	2		1
ECOINT		2		2		

unrelated 1 related 2 closelyrelated

DISTANCE RELATIONS

	CC5SH	4SH	RTL	DINST	CURVOI	ECOINT
CC5SH	20		100	300	300	
4SH	600	50	300	100	300	
RTL	300		300	300	300	600
DINST		100	300	250	100	300
CURVOI	300	100	100	300	250	600
ECOINT		300		300		300

distance (m)

CONVENTION CENTER 5 STAR HOTEL (CC5SH) 4 STAR HOTEL (4SH) RETAIL (RTL) DESIGN INSTITUTE (DINST) CURATED VOIDS (CURVIO) ECOLOGICAL INTERVENTIONS (ECOINT)

Figure 6. *Matrix used for laying unsymmetrical relationships between the required programs.*

tutors from around the world, student groups visiting for events and workshops, all staying in the 4-star hotel denotes the distance prescribed. Similarly, the convention center and the 5-star hotel are thought to be adjacent sharing facilities like parking, shuttle, etc. The model is then coded with scenarios on how the whole group gets configured: The retail is in walking distance to the 5-star hotel, and the curatorial voids. People who visit the curated areas or stay in the hotel will show up in retail areas. An added scenography is that not only the convention center (a showcase for the industry in the region) and the curatorial spaces (a showcase for the innovative and the artistic world) but also retail becomes a showcase for the design institute, an instant arena to share and voice design.

Furthermore, relational mapping is schematized between elements of the site and constituents of the program, and the added programs. For example, the potential access points and the route as an axis become a node that is linked by distance to the retail and the design institute. The fact that the retail has to have direct relation to automobile access gets played out as options in the modeling scenarios. The existing remnants of the military base is closely linked to the curatorial voids mapped directly on them. An added event plateau is linked directly to automobile access; this is then attached to vista points, etc.

This is similar to a game of linking, unlinking, re-linking and even defining the links as nodes between the

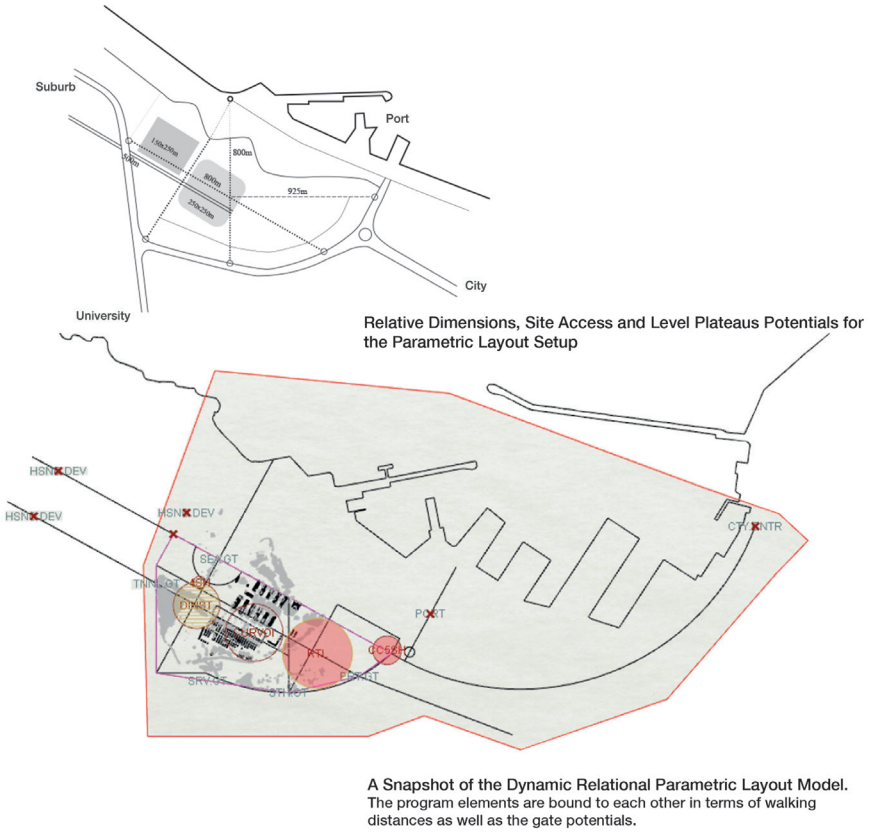

Figure 7. *Algorithmic modelling.*

role players of the project (Figure 6). When the designer links the program elements, the links have specific qualities that correspond to the immediacy in terms of proximity. The links may refer to being adjacent, or being in a 10 minute walking distance, being in a visibility range, or being in a wireless bluetooth connectivity. These links are not symmetric, when considering the relation of a mall to hotel, or a convention center to a hotel they are not symmetrical. A hotel may be preferably close to park but a park does not need to be close to a hotel. The coded digital model plays out these scenarios on the site model similar to the designer black box, correlating the relations between design elements as pull and push springs. (Figure 7).

4. Syntactic analysis and interpretations

Space Syntax is a graph theory-based approach which is developed to decode and talk about architectural space with its mathematical, graphical and scientific tools. Space Syntax instigates from the assumption that the built environment works as a spatial / social network and these spatial networks create potentials of movement and describe a "living pattern" (Dursun, 2012). Here, space is treated as a configurational whole that is constructed by mutual, complex relations. It aims to clarify a kind of "logic" or "pattern" hidden in that spatial network. Decoding characteristic properties of these spatial networks is valuable both to talk about existing living patterns in that particular space and to restructure the possible future scenarios.

In this study, the architectural design process is regarded as a process of probing, exploring that an architect internalizes with his / her own interpretations, feeding back data and information. Here, the main intention is to search about potentials of Space Syntax as "a tool to think with" during this process.

Syntactic analyses are used in the case of an "urban park" design in three steps:

1. Discussions on the "requirement of the jury" as a network visualization that

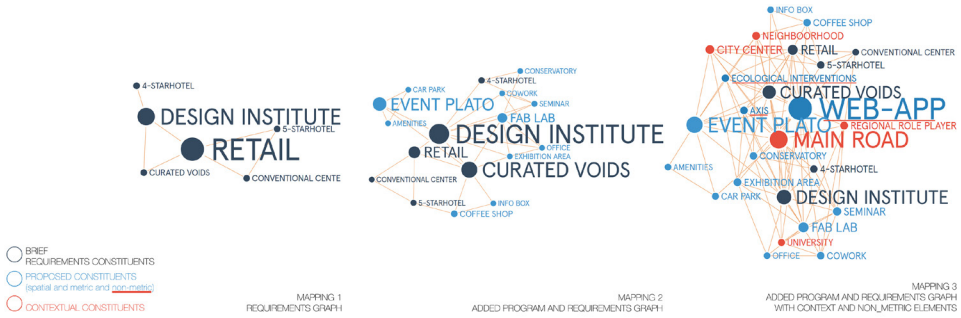

Figure 8. *Mappings various scenarios of the competition project.*

is constructed by the architect based on the given requirements list and diagram (Figure 3 and 8).

2. Examinations on the "solution spatial set network" which is developed by new scenarios and additional spatial qualities (Figure 6 and 8).

3. Readings on the "augmented spatial networks" which reflected the notion of Latour with its non-spatial ingredients such as regional role player, neighborhood, web and mobile application, ecological interventions, city center, pedestrian axis, university, main road (Figure 8).

The logic of these network visualizations that are constructed as outcomes of three steps is analyzed in mathematical, graphical syntactic metrics utilizing Syntactic (Nourian, 2013a; Nourian, 2013b; Nourian 2016), which is a Space Syntax tool. Here, spatial networks or configurations are examined based on four main syntactic measurements: Measure of "control" which discusses the networks mainly by their local properties, measure of "entropy", "choice" and "integration" which investigate the networks mainly by their global properties.

Integration value aims to measure the degree of depth of structures and quantifies the pattern of depth in a system (Hanson, 1998; Hillier and Hanson, 1984). Entropy is a measure of dispersion (Mohajeri, et al., 2013), "a measure of the distribution of locations of spaces in terms of their depth from a space" and "can give an insight into how ordered the system is from a location" (Turner, 2001). Measure of control deals with the relations between a space and its immediate neighbors and expresses "what degree of choice does each space represent its immediate neighbors as a space to move to" (Hillier et al., 1987). Finally, "the degree of choice each space represents how likely it is to be passed through on all shortest routes from all spaces to all other spaces in the system." (Hillier et al., 1987).

The initial setup which was constructed for the competition's requirement network can be seen in Figure 8. Here, the six program components: convention center, 4- star hotel, 5-star hotel, curated voids, design institute and retail, are linked in a simple network pattern. In this elementary pattern, most distinctive spatial components are retail and design institute. Retail and design institute appear as most integrated spaces in the whole with the values of 3.49 and 1.745 respectively. These spaces are followed by curated voids (1.163). These integrated spaces tend to draw the entire configuration towards the root with shallow justified graphs (Figure 10). At the same time, retail and design institute are strong control spaces. Their entropy values are low (retail: 0.821, design institute = curated voids: 1.028). This means that many locations are close to these spaces. In terms of choice, they have the highest values, retail (23), design institute (19). This means that these spaces have the highest total values of accumulated flow.

In the second network visualized for an augmented scenario solution set, the number of spatial components increases to 17 (Figure 8 and 9). Here, most distinctive spaces are design institute and curated voids. Design institute and curated voids are most integrated spaces with the values of 4.181 and 3.252 respectively. These spaces are followed by the fab-lab

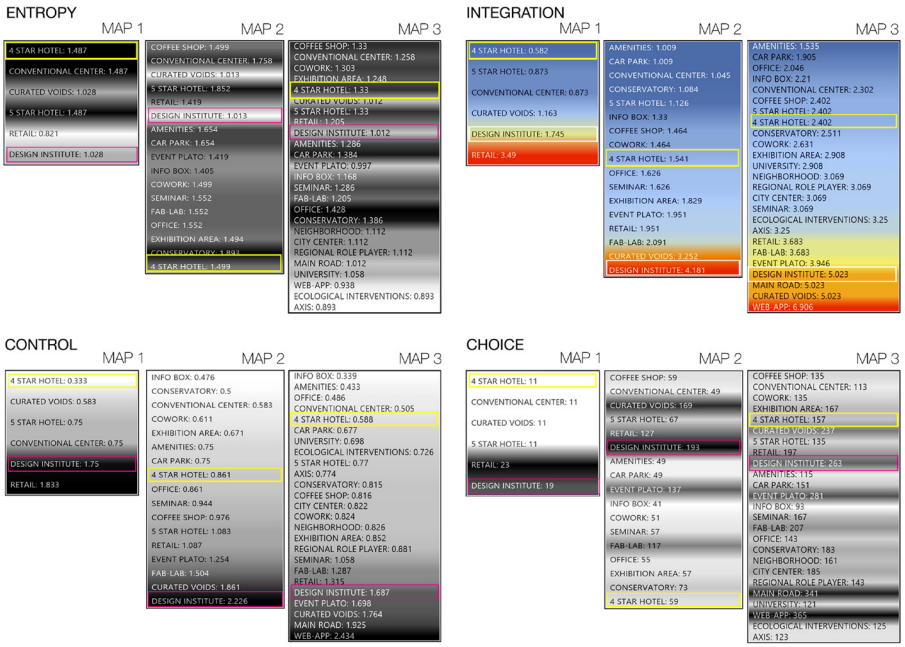

Figure 9. *Syntactic values of the scenarios mapping of the competition project.*

(2.091) and retail and event plateau (1.951). On the other hand, amenities (1.009), car park (1.009), conventional center (1.045), conservatory (1.084), 5-star hotel (1.126) are the most segregated spaces. It is suggested that justified graphs from these segregated spaces tend to have considerably deeper structures (Figure 10). At the same time, the design institute, curated voids and fab-lab are strong control spaces with the values of 2.226, 1.861, 1.504 respectively. With their low entropy values, design institute and curated voids get close to the many locations in the spatial whole. Conversely, many locations are far from the conservatory (1.893), 5-star hotel (1.852), conventional center (1.758), with their high entropy values. In terms of choice, the design institute, curated voids, event plateau and retail have the highest values, 193, 169, 137, 127 respectively. These are spaces with the highest total values of accumulated flow.

In the third network model the scenario is boosted, number of nodes increases to 25, including both spatial and certain non-spatial components. Here, the striking point is that the most distinctive node appears as the mobile application, a non-spatial node, which is developed as a part of the design concept (Figure 4). This node is the most integrated node in the spatial whole (6.906). Among the other nodes curated voids, design institute, event plateau, fab lab and retail take the values above the mean, once again they appear as the most integrated nodes. The node named as "main road" represents the connection to the city center, a link which is considered as a zone and appears more as a concept rather than an exact architectural program denoting space is also one of the most integrated nodes in the whole (5.023). On the other hand, the most segregated node is amenities (1.535). This is followed by the carpark, office, info box, conventional center, coffee shop, 5 and 4-star hotels and conservatory. Web application together with main road, curated voids, event plateau and design institute are strong control nodes. They take the values of 2.434, 1.925, 1.764, 1.698, 1.687 respectively. These nodes have significant potentials in terms of their presented modes of movement and their strong relations with their neighbors. The nodes such as info-box, amenities, office and convention center are weak spaces in terms of presented modes of movement and they don't have strong relations with their neighbors. They also appear as weak control nodes with the values of 0.339, 0.443, 0.486, 0.505 re-

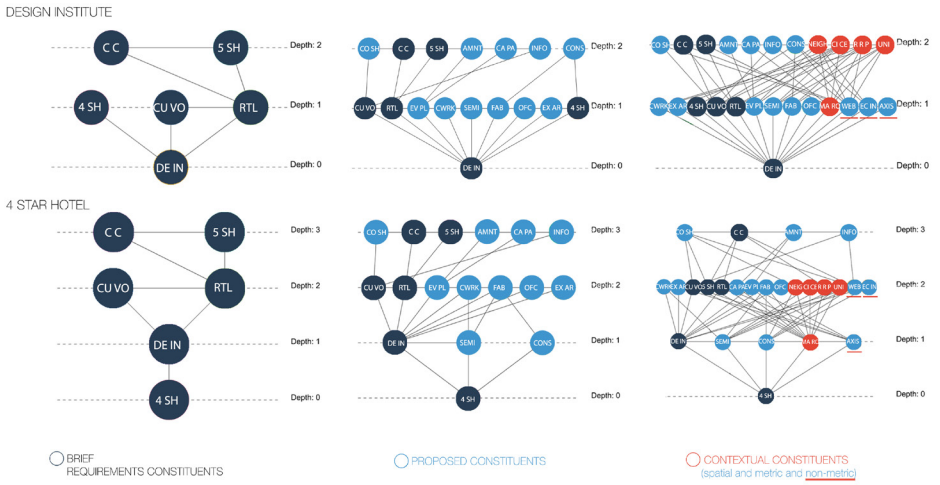

Figure 10. *Justified graphs for various constituents of the competition project.*

spectively. Entropy values support this finding. Many locations in the system are close to "axis" that represents the pedestrian link as a node, the "ecological interventions" which is a time and zone based events platform, and "web application" which is a web platform for research and sharing as well as activity media platform, "main road" that represents site connection to the city, "curated voids" and "design institute" having the lowest values for the entropy. On the other hand, the locations in the system mostly tend to be far away from the office, car park, coffee shop, 4 and 5-star hotels. Similarly, web application, main road, event plateau, design institute and curated voids are the most visited nodes with their high values of choice. They take the values of 365, 341, 281, 263, 237 respectively.

Figure 10 summarizes the justified graphs from one of the most integrated spaces, design institute and the most segregated spaces, 4-star hotel. Although the total depth changes from 3 to 4 for the second case, justified graphs for the two cases preserve their compact forms in their three like formations with many branches.

5. Conclusions: Projecting as mapping the domain

The project and the thinking in the article imply designerly thinking as a triaxial mode of operandi, playful and malleable on one axis, moldable and adaptable in the other, strict and regulated at the final. The paper suggests that mapping and animating a domain that communicates the existing and the promoted relationships in both iterative and variating design paths serve to evolve a sense of place with active scenarios. Active scenarios are played out to create the domain of the project on the design platform of the architect for negotiating criteria and the constituting elements. A domain is referred to as all those criteria that relate to the realization of a scenario (scenarios of existence).

This is understood as a design role of interpretation and propositions as opposed to a deterministic design role. The technique is of course presented without any bias on which relationship is to be favored, however as a communicative tool for the designer and other role-players it provides a consistency check diagram as well as a tool for sheer simplicity.

"Mapping is the point in the decision process where divergence and diversity are key. You are not looking for consensus in this phase; you are looking to expand the range of possible factors (and, ultimately, decision paths). The challenge of mapping is getting outside our intuitive sense of the situation in front of us" (Johnson, 2018).

The paper lays out the design methodology used to explore the potentials in a masterplan for a competition project in Turkey and investigates the resulting set of relationships between spaces and elements of design in terms of Space Syntax criteria. This is not only to understand how close the requirements fall in with the solution set, but

also to try out the possibility of mapping relational metric and non-metric elements in one graph. Systems thinking and mapping and simulation tools already exist such as Vensim where scientists can assess values to intangible and subjective concepts together with physical elements. The role of the designer is essential in these generative diagrammatic tools in the assessment of the existence (is there a relation or not) and the effectual outcomes of the relationship (how much and in which trajectory). This vision requires a strong reading into the program, the site and the society's tendencies. The paper suggests that graphing the relationships are significant in the assessment of the potential scenarios.

Design is an individual process, each instance is unique, no two buildings or master plans are or can be exactly the same. Therefore, as a decision making process the tools correspond to this particular uniqueness of project domain. Mapping relationships allow the designer to understand, interpret and reevaluate uniqueness during the process and relate to the context in a particular manner.

It should also be emphasized that this study, which unusually incorporates non-metric contextual components into spatial analyzes, draws inspiration from Latour's Actor Network Theory and thus presents an experimental work on Space Syntax.

Acknowledgements

The relational design process and tools utilized in the case study LOG-IN bandırma Design park Competition entry is conceived and run by the architect Nilufer Kozikoglu, however the total log-in and interconnected layering and as a result the project is an outcome of the collective design sessions so we would like to acknowledge the project Design Team:

Nilüfer Kozikoğlu, Architect, Team Leader

Azime Tezer, Urban Planner, Leader of Urban Planning and Design Team

Ebru Erbaş Gürler, Landscape Designer, Joint Leader for Landscape Design Team

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Relational mapping as a design tool has been part of the practice at Agency for Architectural Design, NK Tuspa since 2008. It was first utilized at Bakırköy Psychiatric Hospital master plan design by Nilüfer Kozikoğlu, generated with TopSolid by Gözde Küçükoğlu in 2008.

References

Alexander, C. (1964). *Notes on the Synthesis of Form*. Cambridge: Harvard University Press.

Alexander, C. (1977). *A Pattern Language: Towns, Building, Construction.* Oxford: Oxford University Press.

Barabasi, A. L. (2016). *Network Science.* Cambridge: Cambridge University Press.

Bandırma Park Competition (https://competitions.archi/competition/bandirma-park-competition/).

Bazalo, F., & Moleta, T. J. (2015). *Responsive Algorithms An investigation of computational processes in early stage design.* Paper presented at the meeting of the 20th International Conference of the Association for Computer Aided Architectural Design Research in Asia CAADRIA 2015, Daegu, South Korea.

Cross, N. (2001). Designerly Ways of Knowing: Design Discipline Versus Design Science, *Design Issues,* 17(3), 49-55.

Cross, N. (2007). *Designerly Ways of Knowing*. Basel: Birkhauser.

Dade-Robertson, M. (2011). *The Architecture of Information Architecture, Interaction Design and the Patterning of Digital Information.* New York: Routledge.

Dursun, P. (2007). *Space Syntax in Architectural Design.* Paper presented at the meeting of 6th International Space Syntax Symposium, ITU Faculty of Architecture, Istanbul, Turkey.

Dursun, P. (2012). Dialog on Space, Spatial Codes and Language of Space, *ITU A|Z*, 9(1), 104-119.

Dursun, Ç., P., & Kozikoglu, N. (2017). *Network Thinking Architectural Design: Experimenting and Working with Relational Models.* Paper presented at the meeting of 11th International Space Syntax Symposium, Lisbon, Portugal.

Hanson, J. (1998). *Decoding Homes and Houses.* Cambridge: Cambridge University Press.

Hillier, B. (1996). *Space is the Machine.* Cambridge: Cambridge University Press.

Hillier, B., & Hanson, J. (1984). *The Social Logic of Space.* Cambridge: Cambridge University Press.

Hillier, B., & Burdett, R., & Peponis, J., & Penn, A. (1987). Creating Life: Or, Does Architecture Determine Anything?. *Architecture et Comportement/Architecture and Behaviour,* 3(3), 233-250.

Hillier, B., & Hanson, J. (1997). *The Reasoning Art: or, The Need for an Analytical Theory of Architecture.* Paper presented at the meeting of 1th International Space Syntax Symposium. London: UCL.

Johnson, S. (2018). Farsighted, *How We Make the Decisions That Matter the Most,* New York: Riverhead Books.

Kozikoglu, N., & Tezer, A., & Gürler, E., & Onuk, T. (2017). LoginPark-Bandırma: Logistics Innovation and Design for Community Transformation. Retrieved from http://www.arkiv.com.tr/proje/2-odul-bandirma-tasarim-parki-yarismasi/7488.

Kozikoglu, N., & Dursun, Cebi, P. (2015). Thinking and Designing with the Idea of Network in Architecture, *ITU A|Z*, 12(3), 71-87.

Latour, B. (2005). R*eassembling the Social, An Introduction to Actor-Network Theory.* Oxford: Oxford University Press.

Latour, B. (2010). Networks, Societies, Spheres: Reflections of an Actor-network Theorist, *Keynote speech for the international seminar on network theory: Network multidimensionality in the digital age,* Los Angeles, USA.

Mohajeri, N., & French, J. R., & Batty M. (2013). Evolution and Entropy in the Organization of Urban Street Pattern, *Annals of GIS*, 19(1), 1-16. Retrieved from http://dx.doi.org/10.1080/19475683.2012.758175

Nourian, P., & Rezvani, S., & Sariyildiz, S. (2013a). *A Syntactic Architectural Design Methodology.* Paper presented at the meeting of 9th International Space Syntax Symposium, Seoul, Korea.

Nourian, P., & Rezvani, S., & Sariyildiz, S. (2013b). *Designing with Space Syntax, A configurative approach to architectural layout, proposing a computational methodology, Computation and Performance.* Paper presented at the meeting of eCAADe 31, Netherlands, 357-365.

Nourian, P. (2016). Configraphics: Graph Theoretical Methods for Design and Analysis of Spatial Configurations (Doctoral dissertation). Delft University of Technology, Netherlands.

Schön, A.D. (1987). *Educating the Reflective Practitioner.* San Francisco: Jossey-Bass, A Wiley Imprint.

Simon, H. (1996). *The Science of the Artificial.* Massachusetts: MIT Press.

Turner, A. (2001). Depthmap: *A Program to Perform Visibility Graph Analysis.* Paper presented at the meeting of 3rd International Space Syntax Symposium, Georgia Institute of Technology, USA.

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User behaviour and circulation in an Indonesian student communal housing facility: Combining space syntax and Actor Network Theory

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Abstract

This paper analyses space syntax and Actor Network Theory (ANT) as explanations of socio-spatial phenomena and presents a case study of an Indonesian *indekos*. Space syntax theory describes the impacts of spatial configurations and spatial quality on social settings. Methodologies derived from this theory utilise the integration of space for analysis. However, since space syntax fails to take into account key factors such as how objects in a given space impacts human use of space, we argue that ANT can serve as a 'complimentary' theory, as it takes up temporal aspects and the presence of such objects. Relying only on space syntax fails to explain socio-spatial phenomena holistically, while using ANT and space syntax together offers a more complete view by presenting space not as just a single entity but a system of user, objects, activity and time. The study will show how an architect can design a more strategic and efficient space arrangement by considering the spatial program along with the system of the objects involved in the space.

Keywords
Socio-spatial Theory, Space syntax, Actor Network Theory.

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1. Introduction

The intangibility and complexity of social relations bring about a debate on the spatiality of the subject. Not only is the debate is stirred by the nature of social relations, but it is further broadened due to the fact that: 1) people and goods today have high mobility, presenting the idea of de-territorialisation and 2) social relations are currently fragmented and, in a way, 'loose' (Osti, 2015). However, social relations themselves, according to some theories, can be derived to explain the mechanism process in which they occur in a more rational, logical way.

Space syntax emerged for the first time in the 1980s as an attempt to explain the socio-spatial phenomenon (Netto, 2016). It developed as a systematic explanation of the social dimension of space (Netto, 2016) and vice versa, that is, the spatial dimension of human social life (Magda, 2003). The explanations were based on the ideas of Hillier and Hanson (1984) who looked for 'the social content of spatial patterns and the spatial content of social patterns' (p.2). The theory is now widely used to analyse the social implications of spatial configuration, ranging from the scope of a built environment to a larger one as seen in urban planning. However, the theory is criticised as being too 'deterministic' (Racu, 2016: p. 1) since it tends to overlook other aspects of human social life. Space syntax theory and its analytical basis are useful ways to determine the social outcomes of design and planning. Nevertheless, the interpretation of results must be done in consideration of social processes as well as human behaviour (Nes, 2014: p. 238).

Actor Network Theory (ANT), on the other hand, revolutionises the way we look at humans' social constructions. Its insistence on seeing non-human agency in social relations pushes the traditional ideas of social composition (Matthewman, 2011). In other words, the theory challenges the traditional view of human relations. Initiated by figures such as Michel Callon, Bruno Latour and John Law. ANT considers both humans and non-humans to be the participants of interaction, and the two have equal capacities to initiate such relations.

The aim of this paper is to discuss these two theories, space syntax and ANT, focusing on the idea that using one in addition to the other helps explain social phenomena within the framework of spatial matter. Space syntax revealed that spatial configuration affects human encounter with others which then affect human interaction in that system of space. ANT on the other hand, revealed that space can also be a system of network. Combining these two raised a deeper and greater look on how space works within and with other spaces as well in initiating human interaction. The structure of the paper is as follows. First, it will explain space syntax as both theory and methodology. Second, it will point out some criticisms and limitations of space syntax. Third, it will discuss how ANT can complement space syntax.

The theoretical studies of combining the two theory is needed as Kärrholm (2010) stated, "the expansive and somewhat paradigmatically space syntax research has seldom been integrated with these theoretical discussions of what is some- times called 'the spatial turn' of the social sciences" (p. 251). Practically, the discussion in relating space syntax with theory like ANT can make space and its materiality some sense in explaining its effects on human's social interaction. Combining space syntax and ANT can be done in the study of architecture to urban studies, even geography and social science, as these studies often consider role of space in social phenomenon. This study then can help raise the discourse among disciplines that sees material and space as the main research topics.

This paper is limited to only evaluate one case study of the use of space syntax and ANT. It will make a better study if an attempt on evaluate several cases to get a better understanding of the utilization of these two theories. That being said, this paper is not an attempt to formulate a new socio-spatial theory. Instead, we will discuss the advantages and limitations of space syntax and argue that ANT can serve as complementary theory to help fill in the gaps in explaining socio-spatial matters. The analysis of socio-spatial matter using space syntax theory will be discussed

to extract the gist of the theory and to extrapolate the disadvantages of using one theory alone. A case study of designed space will also be presented as an example of how space syntax explains one thing but fails to explain another. Incorporating ANT into the analysis will constitute a new step towards understanding socio-spatial matters that space syntax does not account for.

2. Literature study

2.1. Space syntax

Space syntax theory discusses space in terms of physical built environments and architectural and urban spaces (Magda, 2003). It uses a comprehensive approach to understanding society (and all its matters) through space. The theory begins by detecting the social logic of space and then continues on to explain the relation of society to that space. These concepts are used to develop methods for analysing a given space by applying space syntax.

Information planted in a space can further be read by analysing the configuration of that space (Magda, 2003). This information is obtained by 'reading' the plan of the architectural system that shows the relationship among spaces in the system, including both interior and exterior spaces (Thomsen, 2008). Furthermore, social information retrieved from spatial configurations can tell us the social relations of the system's user; their customs and even traditions to a certain level can be understood just by understanding the spatial organisation of a built environment.

Given space's ability to carry information—which further influences social relations—and humans' ability to use this information to draw mental connections, a series of analytical methods have been developed under space syntax theory. In short, space syntax is also 'a set of techniques for the representation, quantification and interpretation of spatial configuration in buildings and settlements' (Hillier, Hanson & Graham, 2006). Configuration seems to be the central notion in research that follows space syntax as an approach. As in social interaction theory, it is said that space configuration, on a scale of built environments to urban planning, might have an impact on social relations (Magda, 2003).

On the methodological side, space syntax has yielded techniques to represent, quantify and interpret spatial configuration. Since its development in the early 1990s, the theory has developed into an extensive research programme and has even inspired computer software combining space syntax theory-based analytic tools with graphical representations. One of the most significant software developments related to space syntax, according to the initiator of the theory, was the one from University College London. Alasdair Turner developed a software called Depthmap to model and run visibility graphs developed from the theory. The software can also perform segment-based axial analysis with angular, metric and topological weightings of the space, and it relies mainly on the spatially guided nature of human movement (Hillier, 2004).

Hillier (2004) constructed this concept by looking at space-to-space permeability and visibility, believing that the analysis of the two could form a basis for a quantitative and statistical analysis of built environments. Observing a space's permeability and visibility, in relation to its integration, can help one understand how a certain function in an environment is 'spatialised'. We should be able to tell how a given space is 'embedded' in a spatial configuration.

The representation used in Depthmap can be broken down into key points that are layered on top of each other. One key point is the use of architectural system modelling. The architectural system is drawn to show space borders and openings, simplified to clarify how one can access a point in the space. Another key point is the use of a grid of a specific size to divide the spatial system into points (Turner, 2004). The size of a square on the grid is usually the size of the individuals that move across the space. The grid is later filled with colours to show the scale of integration value across the system. The colours range from blue to red, reflecting a scale of low to high integration, respectively.

2.2. Actor Network Theory

When space syntax sees social interaction as a product of human movement in a systems of spaces or spatial configuration. A theory called ANT (Actor Network Theory) sees social interaction as a network of actors. In his criticism of experts who only see social interaction as simply interaction between humans, Cerulo (2009) saw ANT as a theory to explain the essence of a society. By looking at the network of social relations, human relationships and various information exchanges that occur in society, the originators of ANT offer a new view of social interactions and who (or what) can participate in them.

The main component that must be identified in an analysis that uses ANT is the actant. Actants are generally divided into two groups, human and non-human actors. Human actors are individuals who are connected directly when interacting or associating in the network with each other at a certain time. Non-human actors are artefacts or objects that cause or are used when interaction takes place. Artefacts that are used as examples by Latour (1991) in his case of returning hotel keys include objects such as hotel keys, cameras and doors. Kärrholm (2013) in Fallan (2008) adds another artefact that is more important and influential in the interaction. He mentioned objects such as crossing roads, markets, parking lots and hotel grounds, which he later calls spatial artefacts.

Furthermore, spatial artefacts in the form of space can act as two components, actant as well as the network itself (Fallan, 2008). Space as an actant can be observed by paying attention to what the artefacts do and their relationship with other actants. Space as a network is observed by looking at space as a result of associations, alliances or translations carried out by actants. This association, alliance and translation is what Callon (1986) called 'action'. The results of the actions that occur between several actions are what is meant by 'network'.

In practice, space syntax has not been able to fully explain social phenomena in the spatial dimension. This is due to the limitations found in the application of the theory (Racu, 2016). Racu (2016) said that there might be other aspects that determine the atmosphere of space and, hence, have impacts on human activities in a given place. Time and meaning of objects are one of the aspects of space that Space syntax seems to neglect (Netto, 2016).

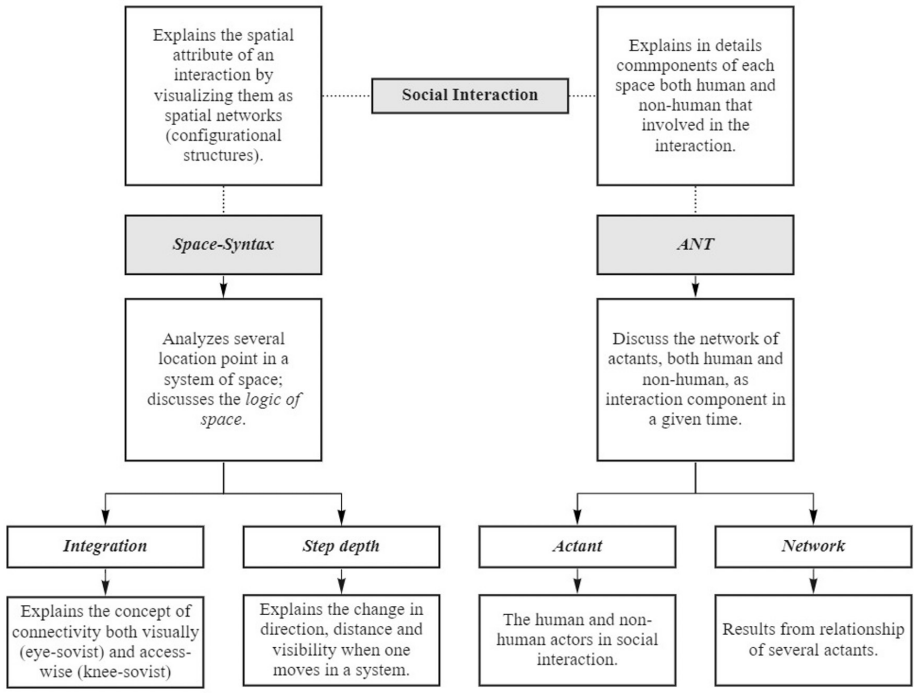

Figure 1. *Relationship between space syntax and ANT.*

2.3. Complementing space syntax with ANT

Therefore, although space syntax is a promising theory to explain the physical or spatial aspects of social interaction, the interpretation of the explanation must still be complemented by an understanding of a more comprehensive social processes and human behaviour (Nes, 2014). Netto (2016) questions how do we link syntactic space with the webs of presence-based interaction and the webs of interaction produced or mediated by networks of objects and tools such as long-distance communication technologies or other non-human entity that facilitates those interaction? (Netto, 2016: p. 25). ANT on the other hand emphasises the role of non-human objects and interaction between humans and objects, including space as a whole (Fallan, 2008). This helps us to understand social phenomena that space syntax has not been able to explain. In other words, ANT can fill in the gaps left by space syntax, which only pays attention to configurational spaces and their connectivity. ANT adds important insights into the process of interaction and the superficial role in space (Law 1991).

Space syntax look at space as a single entity that connects with one another to create a configuration and failed to see that space itself is a network constituted of various individuals. This gap of information in space syntax can seems to be filled by ANT.

3. Methods

The issue of how space syntax ignored the role of objects and their meaning in human interaction is tested with this case study. We then also tested ANT in complementing space syntax in this matter. We carried out a case study that focused on the spatiality of social interaction in a typical Indonesian student communal housing facility called an *indekos*. The *indekos* had a number of communal areas including a parking lot, mini mosque, kitchen, pond, gazebo, study and dining room, guest room and little garden. Located very close to a national university, Universitas Indonesia, the housing facility consisted of 100 rooms, spread evenly among three buildings, out of which 67 were occupied. One building (Building A) was for female students, and the other two (Buildings B and C) were for male students. Typical layouts for these buildings are in Figure 2.

A series of questionnaires was given to 56 participants to obtain information on the socio-spatial conditions of the housing facility. The 56 participants were equally but randomly chosen from each floor from across the three building the questions were actually four groups question. One is to identify respondent, one is to learn the interaction habit of the respondent, one is to learn respondent's perception of the communal space provided in the case, and another one is to learn how respondents perceive space's potential as a place for interaction. The interaction habit was learned by asking frequency of their interaction and their relationship with fellow kos-mate. Respondent's perception of communal space was learned by asking them to rate the quality of the space that includes privacy, safety, crowd, comfort, size, accessibility

Figure 2. *Typical layout for (from left to right) Buildings A, B and C.*

and facilities provided. Respondent' perception on space potential were learned by asking them where in *indekos* they are most likely interact other than the communal space. Among the respondents, 57.9% were male and the rest were female. Then, a series of qualitative observations was made on the basis of space syntax and ANT. These series of qualitative observations include an observation on the movement and circulation of a student in a given range of time: in the morning, noon, afternoon, evening and at dawn

Depthmap was used to examine access to the communal places, taking into consideration three points: angular changes, distance changes and visibility changes. These three points, in space syntax terms, are called step-depth: a measure of change when one is accessing a room. The way *indekos*' inhabitant perceive access to a room can be analysed with this method. A network of activity then drawn by observing the case to see how the interaction constituted.

For the case study, we applied both space syntax theory and ANT. From space syntax, we used integration and the step-depth analysis method to study the spatial configuration of the *indekos*. The analysis was done using Depthmap to break down the architectural system (represented by a plan) into points on a grid. Every point integration was measured and indicated with a distinct colour. Integration measures the connectivity of each point in the space. The analysis also included a step-depth measurement of how many turns one has to undergo in attempting to reach a place.

The second method was derived from Cvetinovic, Nedovic-Budic and Bolay (2017). This was not a method per se, but instead a visualisation of the network. The visualisation was used to depict the complexity of actors, events or artefacts in the *indekos* as patterns of relationships between nodes that can be understood visually (Cvetinovic et al., 2017). Another thing this diagram tried to describe was the active role of non-human objects—an attempt to view interaction in housing as a relationship and an attempt to categorise the network of interaction in a comprehensive category for space and time coverage (Cvetinovic et al., 2017). In addition, visualisation can provide a depiction of the distribution of activities that allow interaction. This is because the ANT analysis only looks at the case as a product of interaction of various actors at only one range of time (Cvetinovic et al., 2017). That said, there is a dynamic in social interaction and space for social interactions that is not captured with the visualisation.

4. Findings

With the help of DepthmapX we visualize the spatial analysis of *indekos*. For the time being, we focus on some of the spaces that provide us information on designed communal space (or the space that is expected to be communal) and the one that is not designed specifically to be one but manage to hold a potential. First we will take a look at the kitchen. Kitchen as one of designated communal space is arguably is spatially poor for interaction. Findings from spatial analysis with space syntax are as follow:

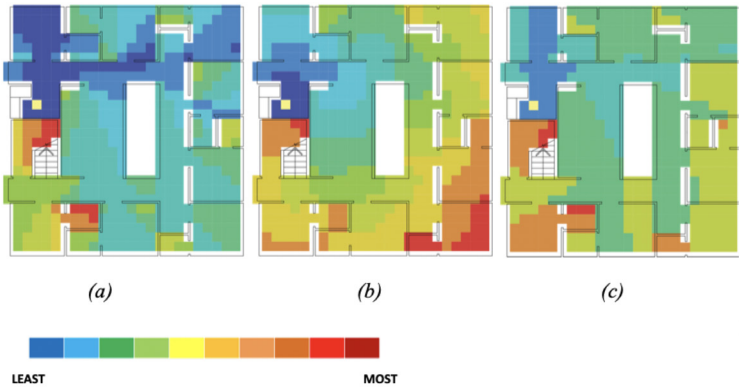

Figure 3. *Angular, metric and visibility step-depth analysis of the space configuration in Building B.*

Take the analysis of step-depth to a kitchen in Building B as an example. Figure 3(a) presents the angular analysis, which shows how many turns one has to do to reach the kitchen. There is a room where a person has to make at least seven turns to go from the yellowish green area to the dark blue area. Figure 3(b) presents the metric step-depth analysis, which shows how

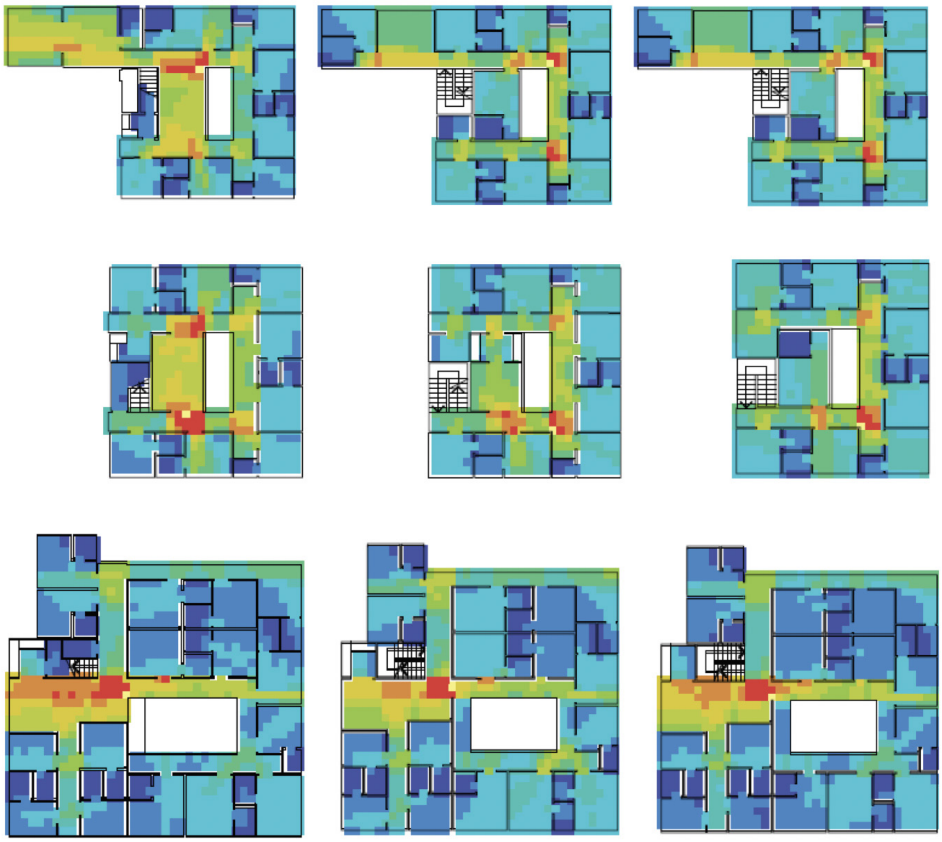

Figure 4. *Integration Analysis of indekos. From left to right is first to third floor. From top to bottom is Building A, B and C consecutively.*

far (in metres, hence the name metric) one has to go to reach the kitchen. There is a room where one has to walk for at least 10 metres to go from the red area to the dark blue area. Figure 3(c) shows the visibility step-depth analysis, where one has to walk a number of distances to be able to see the kitchen. There is a room where one has to undergo five changes in visibility, that is, from the orange area to the blue one. From the integration perspective, the kitchen is indeed poorly integrated in the building as can be seen in Figure 4. Kitchen is coloured blue in all buildings in all buildings which shows low integration.

Concerning the frequency of the use of spaces, 59.65% of respondents claimed to use the kitchen often and 21.05% said they did so with a medium level of frequency. In addition, 47.4% of respondents reported that they used the common room often, and 26.3% said they used it at a medium level of frequency. This finding shows that despite kitchen is poorly integrated spatially and that it takes a little more effort to access it, it is still frequently visited—showing that other aspects than spatial configuration influence user to use and hence interact in it.

Other interesting finding includes the fact that circulation space is the most well integrated space. This can be observed in Figure 4 where in all floor of all buildings, circulation space is coloured in a range of yellow to red, which means these spaces are well integrated. This seems very obvious as the circulation space really is where people are passing and hence potentially meet one another. This corresponds well with 80.7% of respondents that see hallways as a potential place of interaction.

Going back and forth from space syntax analysis and questionnaire. We finally come to observe with Actor Network Theory to settle some contradicting finding or else confirm the corresponding finding. We develop this visualization from from Cvetinovic, Nedovic-Budic and Bolay (2017) as follow:

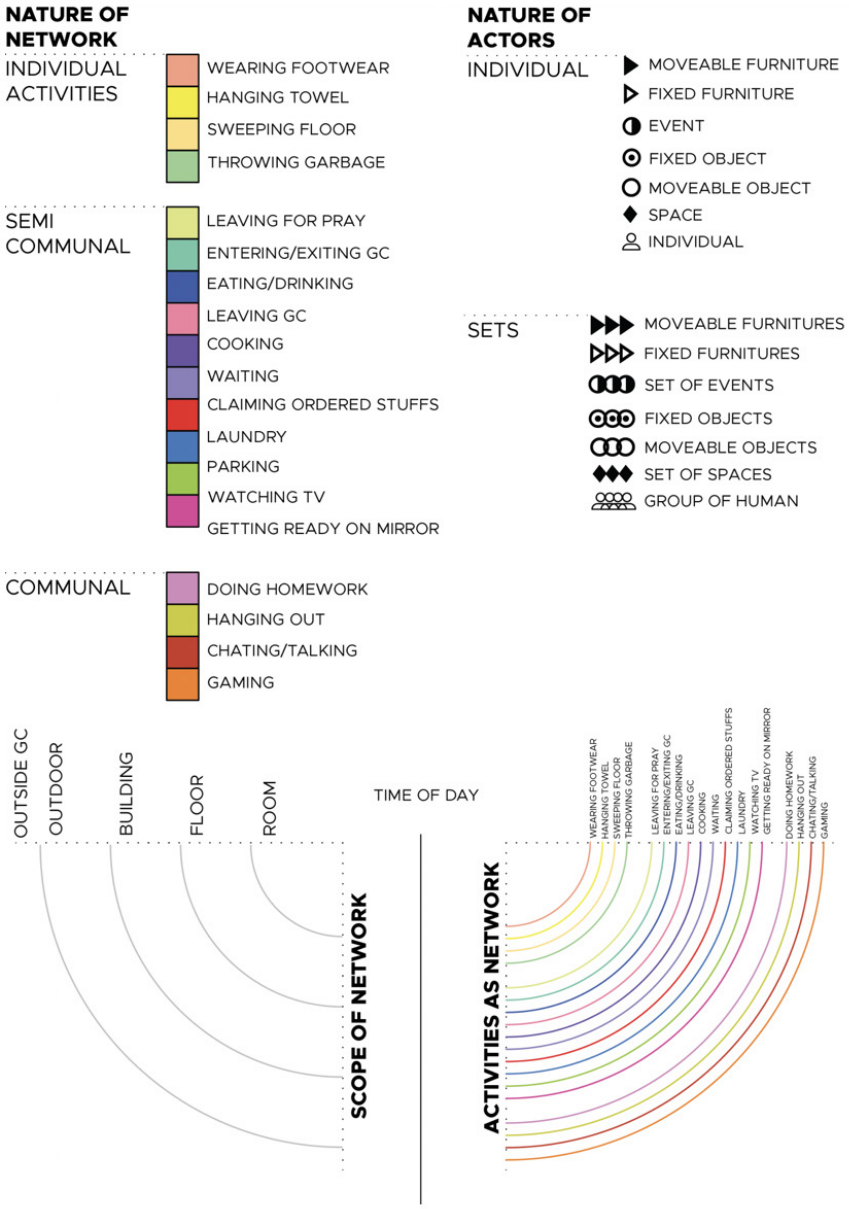

Figure 5. *Actor-Network dimension in indekos.*

In Figure 5, the nature of the network and the actors of the network were determined based on our qualitative measure on activities that occurs in *indekos*. A network can happen in a nature of individual activities, semi communal activities and communal activities. The actors were also determined as to see which and how the actors involved in the network. These network were also examined as to how far the interaction happened: in a scope of a room, inter-room, inter-floor, inter-building or outside.

Figure 6 shows a complete and over-all network that happened in *indekos* in a day. The colored lines are the network of the activities as mentioned in Figure 5. From the smaller circle to the larger one shows the scope of the network. These circles were then divided into six quadrans, showing the time when the network of activities happen.

However we will focusing on some parts of the diagram to confirm the previous findings. We created a network representation as follows (Figure 7) for activity of cooking: an activity taking place mainly in the kitchen. Figure 7 shows the location spread of the actors. Within the scope of a 'room', which in this case is a kitchen, there are cooking utensils, water dispenser, wastafel, gas, fridge and stove. The individual inhabitant and trash

bin during the interaction might move around the room and floor hence their point in the diagram is in the middle of the scope line. The kitchen is a spatial artifacts located within the spatial configuration of the floor. The ingredients and the utensils are usually brought by an inhabitant from their own room in the same floor. 79.6% respondents said to have done this activity on regular basis. When asked why they chose to still use the kitchen provided, they respond by acknowledging the very existence of stove and other cooking utensils in the kitchen attract them to do so. They care not for the distance they have to take or how relatively remote the space is. This corresponds well with questionnaire result in which 77.8% does think that existence of such tools or utensils is considered as a main factor for one to use a space. It can be seen in the diagram Figure 7 how inhabitants across the floor might meet in the kitchen in order to use particular objects. The lines goes from the scope of floor to the room (which in this case is a kitchen).

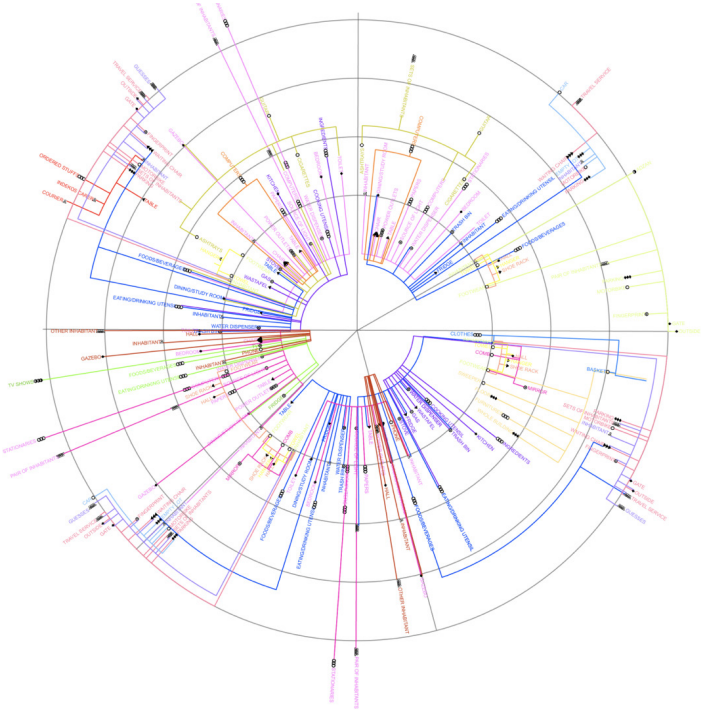

Figure 6. *Actor-Network diagram for social ınteraction in indekos.*

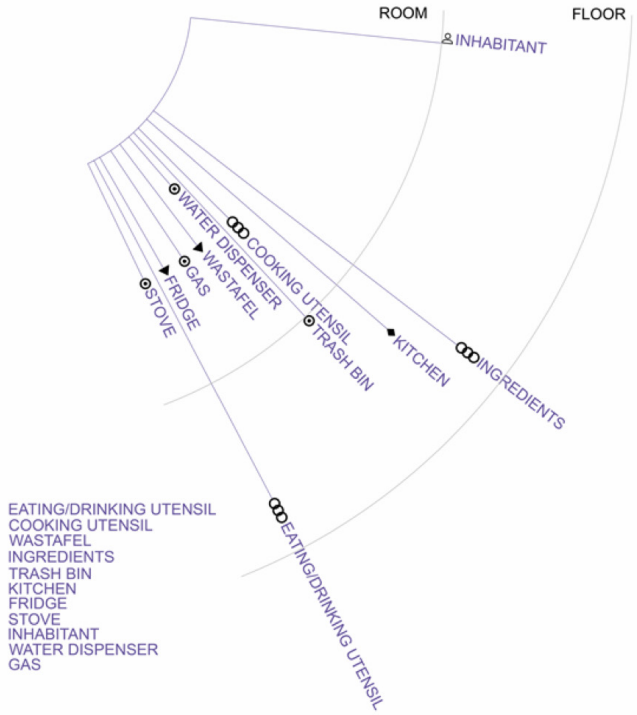

Figure 7. *ANT diagram for cooking activity.*

For the case of circulation space, further analysis with ANT also confirmed that with current set-up of the furniture and shared objects in the hallway is what allows the inhabitants of *indekos* to perceive this space as a potential space of interaction. ANT further explains that shared objects like hangers and shoe racks encourage people to interact in the spaces, in addition to the fact that people frequently circulate in the space. As seen in Figure 8, three different activities are connected with the same actant, creating a network.

Other interesting findings were the fact that interaction happen in a very different manner depending on times of the day. This, interestingly, cannot be observed using only space syntax. This was because the space is relatively constant when observed with space syntax. However, variety can be observed when ANT is involved. The complexity of human interaction really differs at different time. One extreme example is when we try to compare activity in early morning time and in the evening. In figure 7, number of actors present is very limited and hence only a simple network is formed. Totally opposite events happen in night time in Figure 8 when there are more activities and hence more complicated actor-network formed.

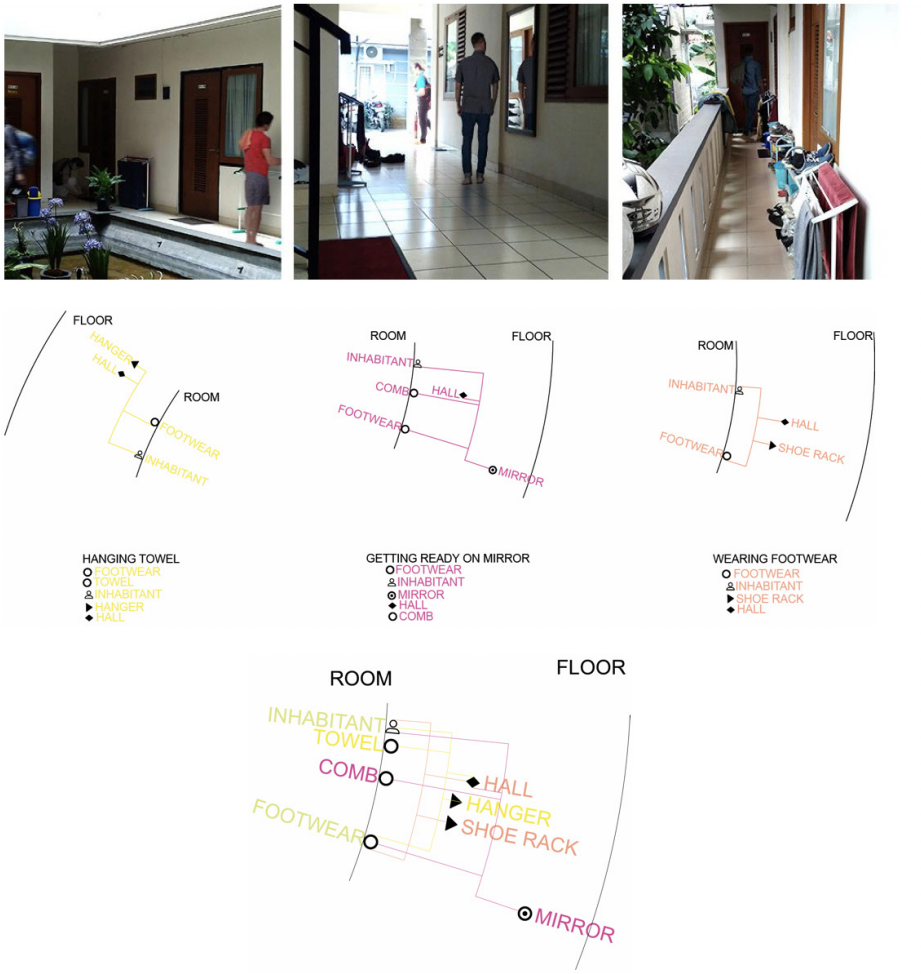

Figure 8. *ANT analysis of some activities that happen in the indekos hallways.*

5. Discussion

Analysis with ANT revealed that non-human objects played a significant role in human interaction. In general, there are certain objects in the space that 'attract' student residents. This means the spaces, despite their poor integration, are still used and traversed and, hence, are potential spaces of social interaction. The objects are non-human artefacts, which, according to ANT, play an equally important role as humans in the social context. Moreover, certain activities can only be done in spaces that contain these non-human artefacts, and these activities form a network of social relations. This encourages communal activities (i.e. interaction) in the spaces.

For example, the facility's only stove is located in the kitchen, meaning that the kitchen is the only place where one can cook. The stove connects residents who want to cook because it brings them to a shared place and, hence, prompts interaction. There is a network of interaction with the stove as the focal actant. This explains why the kitchen is used as often, despite the fact that the kitchen is rather poorly integrated according to the space syntax, as the user from the unit across on the other side of the kitchen might not intuitively know or might have to walk a little further to reach the kitchen.

Furthermore, according to space syntax, the circulation space is obviously well integrated. The spaces are well traversed by residents. ANT further explains that shared objects like hangers and shoe racks encourage people to interact in the spaces, in addition to the fact that people frequently circulate in the space. As seen in Figure 4, three different activities are connected with the same actant, creating a network. Confirming the finding from the questionnaire on how inhabitants might see the circulation space as a potential place of interaction.

Interesting finding that can be found only through ANT observation but not

space syntax is variety of interaction in different time. ANT can address the individuality of the user and it acknowledges that interaction dynamically changing across time. The complexity of interaction can vary but space syntax seems to address this variety based on only the spatial quality of the interaction. Space syntax don't take the specificity of the time of which the interaction happen into account because the nature of the theory to generalized space and its users.

Space syntax has managed to explain how spatial configuration does have an impact on human interaction. By managing space in certain configuration, one can set where people will encounter other people. This can be seen in the findings of *indekos*'s circulation space. It also gives a logical and arguably objective reasoning of how a certain configuration can alter one perception of a space. Space syntax is able to give a whole explaining on how one point in a space can be perceived as distant or closed, as well as how it can be perceived as public or private. All explained by giving a systematic evaluation on metric distance, angular distance and also visibility.

ANT on the other hand focus more on what is in and what happen in the space. This allows us to understand the space better by understanding what the space accommodates and hence the functionality of the space which space syntax somewhat ignore. Moreover, ANT sees space as another network or part of a network rather than a single entity that only connect with other entity of space. Interestingly enough, ANT allows a more subjective interpretation of human interaction, which is contrast in comparison to space syntax but instead of opposing it, it completes it. As seen how in the case study how a phenomenon can be explained by these two theories altogether.

So combining the two theories really is a wise move to bridge the materiality of space with abstract concept like social interaction. The spatial-turn of social science needs an integration of such material and physical perspective of space syntax (Kärrholm, 2010) with a more conceptual network approach of ANT (Sailer and Penn, 2010). This study really sit well with previous studies on combining such two theories. The attempt done by Brien and Psarra (2015) in "synthesizing physical and conceptual artefacts into urban community forms" can be done in a building scale as seen in *indekos* case study. This further confirms that this study is then a possible beginning of a new meta-theory as proposed by Kärrholm (2010).

6. Conclusion

To conclude, both space syntax and ANT are needed as a basis for socio-spatial analysis, to create a more holistic approach in understanding the matter. As the case study illustrated, space syntax theory can explain how space and its configuration, whether consciously or not, affect the behaviour and interactions of space users. This is typically done by altering one movement in space. However, this theory has not been able to explain certain social phenomena occurring in a space other than spatial-configuration framework. ANT can explain how space is used or not used by reviewing the existence of objects that allow social interaction to occur. In addition, ANT can explain the temporary aspects of social interactions that are ignored in space syntax. An overview of temporary aspects in our case study shows that interaction and use of space only occur at certain times. This means that at different times, there may be different findings, for every social relation is unique to its temporality.

Combining space syntax with ANT can make a more holistic socio-spatial analysis by not only looking at space as a place where interaction happen but also as a system of individual function that has role in shaping interaction itself. Understanding that these two theories can be combined should allow a discourse of inter-discipline study—from a discipline of physical and materiality like architecture or urban studies with a more conceptual studies like social science. This also brings us to a realization that architect and designers alike should also now consider not only the configuration of space but also the meaning they want to impose on the objects and subjects occupying the space.

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References

Bradbury, S. (2014). Learning from actor network theory: Bridging the gap between research in science and research by design. *Lusofona Journal of Architecture and Education, 11,* 453-470. Retrieved from: https://revistas.ulusofona.pt/index.php/revlae/article/view/4783

Brien, J. and Psarra, S. (2015) *The Dialogic City: Towards a Synthesis of Physical and Conceptual Artefacts in Urban Community Configurations.* Retrieved from: https://discovery.ucl.ac.uk/id/eprint/1477217/

Callon, M. (1986). *The Sociology of an Actor-Network.* London: Macmillan.

Cerulo, K. O. (2009). Nonhumans in social interaction. *Annual Review of Sociology, 35*, 531-552. doi: https://doi.org/10.1146/annurev-soc-070308-120008

Cvetinovic, M., Nedovic-Budic, Z., & Bolay, J. C. (2017). Decoding urban development dynamics through actor-network methodological approach. *Geoforum, 82*, 141-157. doi: https://doi.org/10.1016/j.geoforum.2017.03.010

Fallan, K. (2008). Architecture in action: Traveling with actor-network theory in the land of architectural research. *Architectural Theory Review, 13*(1), 80-96. doi: https://doi.org/10.1080/13264820801918306

Griffiths, S. (2011). Temporality in Hillier and Hanson's theory of spatial description: Some implications of historical research for space syntax. *Journal of Space Syntax, 2*(1), 73-96. Retrieved from: http://joss.bartlett.ucl.ac.uk/journal/index.php/joss/article/view/58/pdf_38

Hillier, B. (2004). *Space is the machine.* Cambridge: Press Syndicate of the University of Cambridge.

Hillier, B., & Hanson, J. (1984). *The social logic of space.* Cambridge: Cambridge University Press.

Hillier, B., Hanson, J., & Graham, H. (2006). Ideas are in things: an application of the space syntax method to discovering house genotypes. *Environment and Planning B: Planning and Design, 14*(4), 363-385. doi: https://doi.org/10.1068/b140363

Hillier, B., & Netto, V. (2001). Society Seen Through the Prism of Space. *Proceedings of the Third International Space Syntax Symposium.*

Kärrholm, M. (2013). Building type production and everyday life: Rethinking building types through actor-network theory and object-oriented philosophy. *Environment and Planning. D: Society and Space, 31*(6), 1109-1124. doi: https://doi.org/10.1068/d15312

Kärrholm, Mattias (2010). Space Syntax and Meta Theory. *The Journal of Space Syntax, 1*(1), 251-253. Retrieved from: http://muep.mau.se/bitstream/handle/2043/10485/?sequence=1

Latour, B. (1988). *The Pasteurization of France.* Cambridge, MA: Harvard University Press.

Latour, B. (1991). *The Berlin Key, Or How to do Things with Words.* London: Routledge.

Latour, B. (2005). *Reassembling the Social. An Introduction to Actor Network-Theory.* Oxford: Oxford University Press.

Latour, B. (2017). On actor-network theory. A few clarifications, plus more than a few complications. *Philosophical Literary Journal, 27*(1), 173-197. doi: https://doi.org/10.22394/0869-5377-2017-1-173-197

Latour, B., & Albena, Y. (2008). Give me a gun and I will make all buildings move": An ANT view of architecture. *Explorations in Architecture: Teaching, Design, Research.* Edited by Reto Geiser. Basel: Birkhäuser.

Law, J. (1987). *Technology and heterogeneous engineering: The case of Portuguese expansion.* Cambridge, MA. MIT Press.

Law, J. (1991). *A sociology of monsters: essays on power, technology, and domination.* London New York. Routledge.

Magda, M. (2003). *An investigation of the relation of space to society.* MSc Thesis. University College of London Bartlett School, London.

Matthewman, S. (2011). The socio-technical construction of society: Actor-network theory. *Technology and Social Theory,* 104-125. doi: https://doi.org/10.1007/978-0-230-34395-5_7

Montello, D. R. (2007). *The contribution of space syntax to a comprehensive theory of environmental psychology.* Paper presented at Proceedings of the 6th International Space Syntax Symposium, Istanbul.

Nes, V. A. (2014). Space Syntax in Theory and Practice. In: Lee D., Dias E., Scholten H. (eds) Geodesign by Integrating Design and Geospatial Sciences. *GeoJournal Library,* 111, 237-257. doi: https://doi.org/10.1007/978-3-319-08299-8_15

Netto, V. M. (2016). "What is space syntax not?" Reflections on space syntax as socio-spatial theory. *Urban Design International, 21*, 25-40. doi: https://doi.org/10.1057/udi.2015.21

Osti, G. (2015). Socio-spatial relations: an attempt to move space near society. Poliarchie. *Del DiSPes, 4*, 6-24.

Racu, M. (2017). *Limitations, critiques and inconsistencies of the space syntax methodology.* Paper presented at 41st IAHS World Congress.

Sailer, K. and Penn, A. (2010). *Towards an Architectural Theory of Space and Organisations: Cognitive, Affective and Conative Relations in the Workplace.* Paper presented at 2nd Workshop on Architecture and Social Architecture, EIASM, Brussels. Retrieved from: https://discovery.ucl.ac.uk/id/eprint/1342930/

Seamon, D. (1994). The life of the place: A phenomenological commentary on Bill Hillier's theory of space syntax. *Nordisk Arkitekturforskning (Nordic. Journal of Architectural Research), 7*, 35-48. Retrieved from: http://arkitekturforskning.net/na/article/view/719/664

Thomsen, J. (2008). *Student Housing–Student Homes?: Aspects of Student Housing Satisfaction.* Thesis for the degree philosophiae doctor. Fakultet for arkitektur og billedkunst (Faculty of Architecture and Visual Arts). NTNU, Trondheim. Retrieved from: http://hdl.handle.net/11250/231116

Turner, A. (2004). Depthmap 4 | *A Researcher's Handbook.* Bartlett School of Graduate Studies. London: UCL.

Turner, J. (1988). *A theory of social interaction.* Stanford: Stanford University Press.

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Principles of flexibility in design process, with the approach to creativity in design

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Abstract

In recent decades, the design in various fields has undergone remarkable changes that many theoreticians have tried to define and present new models to promote efficiency or provide more creativity during a design process. But most of the time, designers have to apply processes that are restricted to fixed and repetitive steps, unchangeable copy, or an adaptation of what they have learned from other designers during education in the past. From the authors' point of view, one of the main issues is how the design process can sufficiently be flexible to be used in all situations. The concept of flexibility is the capability of being used by both experienced and novice designers or architects, the ability of adaptability to unpredictable conditions and time changes, and the ability to avoid fixed and unchangeable steps. In this article, according to library resources, it has been endeavored to disclose six general principles as a flexible framework for design which has crucial effects on the development of creativity in the design process. Based on Delphi's methodology, the suggested principles are assessed by 20 experts to approve the profound impact of them on improving design process creativity and flexibility. By using these principles and based on the strategies of architects, a wide variety of flexible design process can be organized.

Keywords
Design process, Design thinking, Flexible framework, Creativity, Delphi method.

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1. Introduction

It has been stated that "design research is a bridge between the descriptive and analytic nature of science and the need for an innovative change in teaching practices" (Augustsson, 2018, p.1). A specific design process is not capable of being an efficient prescription for all aspects of a design or being all-inclusive for every individual. For instance, if a teacher teaches a design process to students, it is not clear that all of them can be successful in their design projects. Certainly, there will be differences in students' abilities, contexts as well as the inherent nature of design projects (Van Aken, 2005). As a consequence, the flexibility of each design process is a useful and unique factor. When designers encounter a complicated topic, they probably just know about the totality of the final results. Therefore, they should differentiate between challenging projects which need new approaches to deal with, and conventional problem-solving (Dorst, 2011; Roozenburg and Eekels, 1995).

Novice designers in a wide variety of fields, often select and get accustomed to a specific design process with respect to their interests, experiences, and also under the influence of educational methods in their academic centers. Historically, the design was handed down from generation to generation verbally or implicitly. Also, all artifacts and artificial environments have gradually developed (French, 1994). Having dealt with open complex problems, pioneer designers always preferred to create a framework in their field of practice (Dorst, 2011). Some designers take the design process into account as an intuitive and unjustifiable process; many appraise it as a rational process, and some other designers regard it as an unconscious process.

Regardless of having different ways, the common point between all design processes is to have specific frames in the design method. Van Aken (2005) argued that traditional process design might no longer be answerable to large, complex, and creative design. Because of the inefficiency of the prescriptive design process, a few numbers of design processes with determined steps do not have enough potential to generate exceptional and creative outcomes. In today's world, designers should possess organized mental skills to produce novel and valuable ideas (Johnson and Indvik, 1992; De Bono, 2006). To be creative in design practice, Mahmoodi (2001, p.111) asserted that two fundamental factors should be regarded: "the creative people and creative approaches of dealing with a design problem" that should regard.

In the meantime, top designers perceive planned and helpful strategies that will lead to a specific value to address a complex problem. These strategies involve the development or adoption of a framework (Dorst, 2011). Experienced designers attempt to maintain, develop, and manage the organized frameworks that can adapt to various levels of design practices (Dorst, 2009). Many designers would prefer to employ different strategies during their design process to reach relevant design solutions in a way that this practice will provide flexibility in using all steps of the process. A design process is a guideline to keep designers on the right track (Mahmoodi, 2001). The strategies and principles, as accelerants in the design process, enable designers to refrain from design-by-habit conditions and help them to adopt creativity in problem-solving (Broadbent, 1973; Mahmoodi, 2001).

2. Research context

In this section, this article contributes to a better understanding of the procedure of the creative design process and to an approach to develop the process through analyzing the nature of design knowledge, creativity in design, and design thinking. By combining these three discussed records, the article has a specific orientation towards complex design projects. The present research was conducted based on the information collected via previous research and qualitative records. The aim is to develop a flexible framework for the design process with an intense focus on creativity and design thinking during the process that can be useful for students and designers. The concept of flexibility is the ability of the changeability in the design process in a way that it can be used by both experienced and novice designers, the ability to be adaptable to unpredictable conditions and coordinated with

time factors in design, and the ability which avoid predetermined thinking and fixed or unchangeable steps. To do so, first, the history and necessity of the design processes and their specifications are discussed. Subsequently, based on the literature review, six principles related to increasing flexibility and creativity in the design process will be presented. Then, the Delphi technique will be employed for evaluating the effects and validity of the principles on a design process. In this method, the opinions of experts will be asked to achieve consensus on the proficiency and impact of our arguments.

2.1. Design and its process

On the whole, the design focuses on how things must be accomplished, but natural sciences are about how phenomena are. The difference between design and scientific techniques indicates that the design process is a method showing how things are created (Idi and Khaidzir, 2015; Goldschmidt and Smolkov, 2006). Every decision during the design process can have a direct impact on the efficiency of the project during construction and utilization (Othman and Abdelwahab, 2018). Recently, the design process has been more complicated, and the computer software has presented more and more details about the productions. Nevertheless, this case cannot guarantee its high-quality. A myriad of scholars in various fields has done investigations on the nature of design activity to decipher the design process and introduce it as an appreciation, teachable and, debatable phenomenon (Cho, 2017).

Since the first conference on design methods which has been held hitherto, the purpose of scholars has been to improve the process and results of production. They have made an effort to reach a fixed framework of the design process and its activities (Kowaltowski et al., 2010). For the first time in 1971, French declared a design model with four major phases. Since then, other intellectuals have tried to propose similar linear methods (French, 1998). Though it is beyond the scope of the present paper to explore the details and dynamics of these models, it should be noted that there was intricate disagreement among researchers and theoreticians about the structure of the design process (Goel and Pirolli, 1992). Some believed in a linear process, but others argued that there are co-evolutionary iterations between the progression of researching and reaching from problems to solutions (Maher and Tang, 2003).

Regardless of all, it is generally agreed that a specific organized procedure cannot be repeated for all aspects just for the reason that it was appropriate before (Ozsoy, 2007). The nature of the design process is not a linear sequence of predetermined actions (Chiaradia et al., 2017; Kowaltowski et al., 2010). "Recognition that design is not simply a linear process is seen as a significant milestone in the development of design process theory" (Green et al., 2014, p.528). Overwhelming regularity and restriction of primary models may lead to prevent designers from free progression in design procedures or surpass them from having the freedom of action. In recent decades by rejecting linear theories, designers avoided exerting invariable and cumbersome regulations. Most designers prefer to apply the creative process instead of inflexible ones. While designers need to know the characteristics of a flexible design process rather than a fixed process as a prescription (Van Aken, 2005), they often employ individual viewpoints that are informal to solve wicked problems (Kowaltowski et al., 2010).

"Experienced individual architectural or engineering designers, or small teams of them, tend to use informal procedures for their design processes, which they have developed over time through their initial professional training and through subsequent experimenting and learning" (Van Aken, 2005, p.383). This kind of attitude in the design process can be categorized as an evolutionary and conventional design (Dorst and Cross, 2001; Van Aken, 2005). In the recent process design, some principles should be observed to gain valuable outcomes which most important of these principles are non-linear activities without fixed timing, the ability for interactions and explorations based on designers' thoughts, and also undetailed and large process steps depending on the progress of the design

projects (Roozenburg and Eekels, 1995; Van Aken, 2005) which are consistent with the definition of flexibility. So, designers should regard process design as one of the main parts of a design, not as an optional one for starting the process. It is one of the striking differences between conventional design and evolutionary design (Figure 1). In this case, designers should be aware of the main principles of the design process that bring flexibility; therefore, they will be able to arrange and personalize it. They will have more flexibility in determining which features of the process to be accepted and which ones to ignored (Goel and Pirolli, 1992).

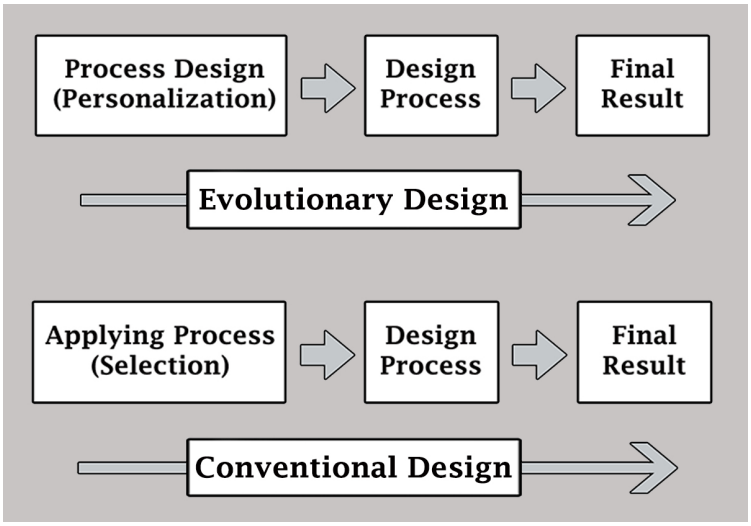

Figure 1. *Difference between the process of conventional design and evolutionary design.*

2.2. Creativity in design

When the results of an idea became original, operational, and novel, then we can define creativity (Elton, 2006; Amabile et al., 1999). In many sciences, we can succeed through analysis and description; even so, they are not enough in design. Designers need imagination and synthesizing to find novel situations of problem-solving. There is even a gap even between design and pure art because design is related to the implementation of predetermined functions for users (Williams et al., 2010; Alexioua et al., 2009). Therefore, without considering the function and utility in design, creativity will not be made. It is commonly referring to creativity to the four main domains in researches: creative process, creative product, creative person, and creative environment (Howard et al., 2008). In this article, it will be attempted to study several perspectives related to process and product, not person and environment.

As the engineering design process has numerous similarities to the creative processes (Howard et al., 2007), creativity is the cornerstone of design and an integral part of the engineering design process (Danaci, 2015; Amabile, 1996). It is a broad term that means abilities or skills for solving problems with a new notion. (Cho, 2017). Taura and Nagai (2013) described creativity in design as a value in which ideas will be conceptualized. In this context, they discussed two kinds of creativity. "The first is related to the process of designing, whereas the second is related to the products that represent the outcomes of the first" (Eilouti, 2018, p.181). As experiences of designers have a profound impact on how to utilize a design process or change its procedure to fulfill innovation and creative results (Couger, 1995), creative performances in process of design are under the influence of several factors namely individual abilities, use of technology, nature of decision task and, the level of experience or prior practices of designers (De Bono, 2006).

Creativity enables designers to overcome irrational thinking and reach new levels of efficiency and satisfaction. By innovative solutions, creativity is a powerful tool to work out problems (Daemei and Safari, 2018) and produce unique ideas to improve life (Rahmann and Jonas, 2010). Casakin (2007) discovered that creativity allows designers to search for new concepts and ideas to solve wicked problems by surpassing common domains. So, to face complex and unusual design, creative skills require a flexible design process, adaptable thinking, risk-taking, and the acceptance of openness in the process (Boden, 1991). Some considered creativity as a factor in outcomes and products (Antoniades, 1992). Others categorized it as a process of design (Seggern, 2008). The term 'fixation' which often resulted from prior knowledge includes some types of obstacles that can impede insight. It is said that fixation can prevent more creativity (Smith, 1995). The majority of fixations occur in the early of a design process, whereas it some-

times could be started in all stages. So, we need to produce innovation and ideation at every step of the process (Crilly and Cardoso, 2017).

Cognitive sciences illustrated that there is not timing and pattern for production of creativity because it relates to the mentality of every designer (Rahmann and Jonas, 2010). Antoniades (1992) asserted that the base of creativity is the relationship between fantasy and imagination in reality, so they need artistic (uncertain) and scientific (quantitative) views together. Limited conception and imagination in repetitive and inflexible frameworks will not result in not obtaining a suitable output of creativity, either scientific or non-scientific. A distinct design process must possess the flexibility to react in various conditions, create acceptable and innovative outcomes, challenge previously accepted ideas to reach new and valuable results, and also be adaptable enough to lead designers toward creativity (Gero, 2000; Dorst and Cross, 2001; Crilly, 2015).

2.3. Design thinking

Design thinking is a new paradigm for facing dilemmas in many design practices. This term is used by Rowe for the first time in his book in 1987 (Dorst, 2011; Rowe, 1987). "Design thinking can also be defined as how a designer sees and how s/he consequently thinks" (Akpinar et al., 2017, p.151). Some researchers conspicuously illustrated that the study of the human mind and thinking process help to understand the facts of the design process (Lawson, 2006). In a design project, to analyze and synthesize and evaluate the obstacles, designers should benefit from thinking skills (Mahmoodi, 2001). Flexible thinking was required to avoid fixation and attain creativity (Crilly, 2015) because design thinking has different shapes in nature (Roy and Brine, 2013). The scholars asserted that design strategies should contain two different phases of decision making: sequences of decisions in analysis, synthesis, and evaluation on the one side, and detailed design-oriented stages on the other side (Lawson, 2006). These two spaces should have mutual capabilities, so each phase needs a distinct mentality.

As a matter of fact, a design process is a dual approach divided into two continuous negotiations: problem-solving with cognitive abilities and concept generation with intangible elements (Nagai et al., 2009). Although these two types of approaches are against each other, both are complementary. These dual dimensions of thinking between problem and solution, which no one can define without the other one, will continue to achieve the goals. This feature does not indicate any starting and finishing points and does not follow the direction of going from one predetermined action to another (Lawson, 2006). Creative achievement stems from the result of two types of mental processes: generative (in solution space) and exploratory (in problem space). To produce new concepts, designers apply divergent thoughts in generative mode. On the other hand, in exploratory mode, they apply convergent ways of thinking to compare the concepts with rational principles and conclude appropriate answers (De Bono, 2006).

Maher in 1994 proposed co-evolutionary design as a new mechanism in problem-solving of design via two separate dimensions that affect each other. The model includes two dimensions for the problem in parallel with design solutions (Maher, 2001). Another characteristic of the co-evolutionary model is the relation between problem requirements and available solutions in two different spaces. In this two-way interaction, firstly the transitions will be evaluated concerning to alterations of problems and then concerning to solutions' changes (Maher and Tang, 2003) (Figure 2). "The focus of the search is based on the problem requirements when searching the solution space and based on the solutions when searching the problem requirements space" (Maher and Tang, 2003, p.48). The variables transfer from the problem category to the solution category and vice versa, in which the flexibility of the design process will be improved. In each stage, some of the problems will be solved and, some new requirements will appear. Then designers find more requirements for solutions and change the previous one to shape final results

regularly. The transitions will continue until outcomes include solutions for all problems or at least a high percentage of them (Maher and Poon, 1996; Maher and Tang, 2003).

3. Results and discussion

Design of design-process means to organize the design process. In practice, some designers intend to employ general or total approaches for process design. Nevertheless, professionals usually use a specific design process which is a copy or adaptation of a previous one with some changes according to the context of a new design, analyzing formal features, and prescriptive design knowledge (Van Aken, 2005). Also, the role of creativity and innovation cannot be denied. Designers use mental imaginary as a tool to present novel ideas and solutions. They evaluate and change the mental image to figure out challenges (Idi and Khaidzir, 2015).

To understand the complex nature of the design process, we should realize that they have been developed in response to rectify a specific problem or a special need (Dorst, 2011). In this article, flexibility or adaptability are our requirements. A versatile design process should adequately be manageable, flexible, and adaptable so that it can encounter a series of problems and make a correct context for designers to generate various kinds of solutions (Van Aken, 2005). Based on our definition of flexibility in the previous section, it helps the design process to be appropriate for numerous designers with different personalities and futures because its levels are changeable enough to be manageable. In this case, designers will possess freedom of action in thinking, time management, expression of creativity, and decision making. This characteristic adapts to unpredictable conditions and avoids fixed steps in the design process. According to the aforementioned materials, literature review, and assessments, a flexible design process which formed on the designer's demands, project requirements, and unexpected conditions should have some principles. These extracted principles can be categorized into the following features:

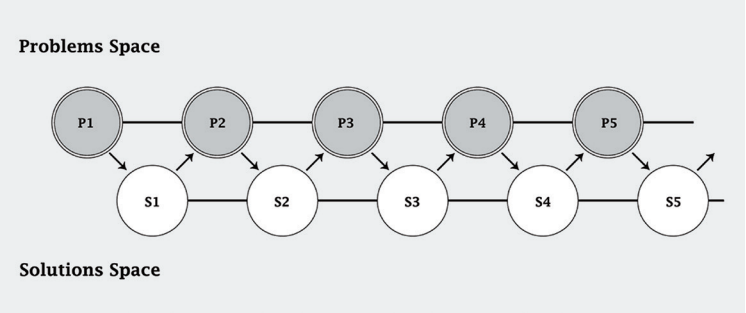

Figure 2. *Sweep between two spaces in the co-evolutionary design.*

1. Primary insight: Usually, the first phase of the design process for all participants is fuzzy and vague. And the high percentage of fixation happens in the early stages of a design process (Crilly and Cardoso, 2017). Designers often go into the design process with this phase, which does not have a distinct time frame and can help them to concentrate on problems, interests, and similar previous contrivances. Also, it provides the necessary time to review all aspects of challenges and more development on primary initiatives. Hence, this stage is an inevitable part of the process (Khurana and Rosenthal, 1997). In this stage, individuals use their content thinking based on acquired knowledge. During this phase, they apply information learned during educational courses, professional work experiences, or gained from the environment in their life (Mahmoodi, 2005). This part of the process helps designers to follow new notions with a creative mind to avoid repetitive solutions which have seen formerly.

2. Dual space process: The design process can be divided up into two inverse spaces: problem-oriented space and solution-oriented one. Design problem solving can be multipurpose based on this distinction (Goel and Pirolli, 1992; Kroes, 2002). Indeed, the design process as a compound process contains two distinct categories of intellectual activities to avoid predetermined thinking or unchangeable steps. This is one of the criteria of flexibility. The first intellectual activity is a conscious mental activity which is about logical reasoning and rationality of the designer by concentrating on problem requirements. The second is unconscious mental activities related to the creative abilities of a designer to the solution's requirements and features (Mahmoodi, 2005; Maher

and Tang, 2003; Abo et al., 2016). In the first part, designers applied different types of thinking based on analysis and logic, which help to aware of problems: Critical thinking, Serialistic thinking, Reflective thinking, and Convergent thinking. In the second part, their thinking is according to a holistic and intuitive approach that helps to create innovative solutions: Creative thinking, Holistic thinking, Impulsive thinking, and Divergent thinking (Mahmoodi, 2005; De Bono, 2006). Designers must figure out design-related problems to create efficient solutions and eliminate current problems. Cognitive theory during the first part of the design process is obligatory to innovate and solve problems in the second part (Kalin and Barney, 2014). This feature of flexibility in design process causes intellectual freedom for designers.

3. Iterative approach: Regarding unexpected and perplexing conditions during the design process of new challenges, designers must be prepared to apply flexible and new strategies to solve the dilemma ahead (Kowaltowski et al., 2010). Because when creativities associated with the project are developing, the designers are not aware of all the imminent opportunities, circumstances, or forthcoming problems. In the meantime, design thinking requires new attitudes toward the process. So, examining the problems and approaches toward solutions need to review during the design process (Roberts et al., 2006). Design thinking also needs new viewpoints and reactions during the process. When problems are appraising from several aspects, we can avoid partial attitudes and wrong results. Accordingly, the iterative design process assists designers to modify probable existing problems or develop solutions (Roberts et al., 2006). They have many chances to review problems and solutions from different aspects and apply the required changes.

4. Holistic approach: Design steps are not deterministic rules or essential propositions for the determination of circumstances or relationships. They are substructures for guiding design operations (Broadbent, 1973). It would be better to follow a simple procedure in complex product design processes and have relatively no detailed steps in an overall framework (Lessio et al., 2009). These processes are not designed for robots, and during the process, the designers themselves should organize and control some details (Van Aken, 2005). To diminish the restriction of a design procedure, and to guarantee freedom of action in design for both experienced and novice designers, the design process should have an adjustable framework in order to allow them to apply changes in their thoughts during the design process and it cannot be based on overly deterministic steps. Rather it should just show an outline or a general policy of the process to keep its flexibility.

5. Open-ended process: "There is no natural end to design process" (Lawson, 2006, p.55). Designers never can claim that it is the final solution or result. They stop the process when the time is up, or there are no new ideas in their mind to continue with, or they think the result is valid for the target user group. This is the definition of time flexibility that provide better personalized time management for designers. It is a skill for designers to realize a suitable solution for their design, which can gain this experience by practices. Consequently, the end of the problem-solving process is not a specific point but a specific bound. The radius of the bound can be defined depending on the individual situation and time (Lawson, 2006; Chiaradia et al., 2017).

6. Elastic process: Top or experienced designers to deal with complex challenges prefer to use much more systematic and efficient strategies and normal regulations which they have developed and adapted over time. In this case, they will create creative and useful outcomes. (Dorst, 2011; Van Aken, 2005). Regarding the differences between a young designer and an experienced one, based on their practical knowledge, skills, promptitude, and their experiences, the amount of their efforts and intellectual distance from problem-solving is completely different (Van Aken, 2005). In this case, the starting point of design processes and the needed time to complete design will be varied. As a consequence, the process must enjoy the flexibility to be used by all types of designers on the manner of starting the process from the closer or farther point

of the final solution.

As pointed out above, the six principles in a design process can improve the flexibility of the process, increase the chance of creativity, and enhance freedom of action for users. In the following, the authors purpose to evaluate the validity of the claim. As the Delphi technique can be used for qualitative research that is exploratory to identify the nature and fundamental elements of a phenomenon (Habibi et al., 2014), it is selected for this article. The main aim of the Delphi technique is to acquire the dependable consensus of a group of experts' opinions about a topic by a series of questionnaires combined with controlled feedbacks (Dalkey and Helmer, 1963). In this respect, one of the most important phases in the Delphi technique is the selection of eligible members as a panel who are aware of the knowledge and expertise of the studied subject. These people are known as the Delphi panel. According to the number of the panel, Dalkey (1971) asserted that it would be sufficient to involve more than 10 persons as a group of specialists in every Delphi study. Also, Delbecq et al. (1975) and Ludwig (1997) recommended that it will be better if the number of experts in the panel is between 10 to 20 experts.

Accordingly, in our study, 20 experts in various fields of design from top-ranked universities in Iran were chosen. To select the members of the expert panel, Zainudin (2012) introduced some criteria that have been considered in this research such as the number of papers that have been published in journals and international conferences, their publications' productivity, and citation impact (h-index), and their level of education (Irdayanti et al., 2015). This assessment has been accomplished in three rounds. In this manner, we sent a questionnaire including a description of the questions, aims of the research, and an explanation of the six principles through E-mail to the members of the panel. After taking their feedbacks in the first and second rounds and consider their opinions on the features and nature of the principles, the consensus was obtained in all sections after the third round. It was a five-point Likert scale (Habibi et al., 2014) so that each expert could rate each principle from 1 to 5, whether paying attention to this case in design process enhances the flexibility and creativity or not (Every rate, in turn, represents to what extent an expert either agree or disagree with the statement: 1: Extremely disagree/ 2: Disagree/ 3: Neither agree nor disagree/ 4: Agree/ 5: Extremely agree). The average of the rates (Table 1) for each principle was more than 4 which approves the consensus of experts on the application of principles. It means, experts have accepted that these features of the design process can result in the growth of flexibility and adaptability of the process, the creativity of designers, and their freedom of action during the design. In the third round of Delphi techniques, the highest point was for the second principle (4.65) and the minimum averages were for the fourth (4.15) and the third (4.2). The rest principles had middle positions with 4.5, 4.4, and 4.3 rates. Also,

Table 1. *The rates of experts to the principles in the third round of the Delphi method.*

Principle	Extremely disagree (1)	Disagree (2)	Neither agree nor disagree (3)	Agree (4)	Extremely agree (5)	Average
First (Primary insight)	0	1	1	7	11	4.40
Second (Dual space process)	0	0	1	5	14	4.65
Third (Iterative approach)	0	0	4	8	8	4.20
Fourth (Holistic approach)	0	2	2	7	9	4.15
Fifth (Open-ended process)	0	0	2	6	12	4.50
Sixth (Elastic process)	0	2	1	6	11	4.30

none of the experts extremely disagreed with the principles. The rate of each principle from 1 to 5 and the average rates of them are provided in Table 1.

4. Conclusion

A design process can be defined as a framework of a changeable organization or as holistic instructions for the process of creation. It is a human-oriented system toward creativity, made for the broad spectrum of designers, and not for robots, to produce creativity. Therefore, the process of producing creativity cannot be defined by some continuous fixed and immutable phases. By reduction in changeless steps and decreasing the details, as well as an increase in flexibility of the process in different situations, the efficiency of the design process, will improve. A flexible design process provides many advantages most notably for compatibility of the process with time schedules (start point and endpoint), topic features and question's specifications, rules of design thinking, and the most important of all, the designers' abilities, thoughts, and knowledge. The application of given six principles in the discussion (Primary insight, Dual space process, Iterative approach, Holistic approach, Open-ended process, Elastic process) as an overall framework of the flexible design process can develop compatibility and as a result, creativity. The principles promote freedom for designers to act during their works, as though they can shape details of the design process in complex and unpredictable circumstances based on their strategies and thoughts in design. To approve the accuracy of the constructive impacts of the principles, based on Delphi techniques, the opinions of 20 experts in this field were asked. Finally, at the end of the third round of this method, all came to a consensus. It was a firm conviction of the vast majority of experts that using these principles during the design process resulted in improvement of the mentioned criteria, including flexibility and adaptability of the process, freedom as well as creativity of designers. It is noteworthy that these statements and their elaborated theoretical knowledge can be supported more in future researches with some original and practical design studies such as a comparative analysis of novice and experienced designers' processes under the influence of applying the principles. These principles can be examined through case studies research in academic design studios to determine the amount of the values of each principle on the efficiency of students on their design projects.

References

Abo, W., Eman Sabry, A. & Osama Khalil, M. (2016). *Design Process and Strategic Thinking in Architecture.* In proceedings of the 2nd International Conference on Architecture, Structure and Civil Engineering (ICASCE'16), London.

Akpinar, A., Xu, M. & Brooks, K. R. (2017). Design Thinking: A Model Development Based on Archived Documents. *METU Journal of the Faculty of Architecture,* 34(1), 151-169.

Alexioua, K., Zamenopoulosa, T. & Johnson, J. H. (2009). Exploring the neurological basis of design cognition using brain imagining: some preliminary results. *Design Studies*, 30(6), 623-647.

Amabile, T. M. (1996). *Creativity in context.* Colorado: Westview Press.

Amabile, T. M., Conti, R. C., Lazwnby, J. & Herron, M. (1999). Assessing the work environment for creativity. *Academy of Management Journa*l, 39(5), 1154-1184.

Antoniades, A. (1992). Poetics of Architecture: *Theory of Design.* Toronto: John Wiley and Sons.

Augustsson, D. (2018). Collaborative Media in Educational Settings: Teaching as a Design Profession. *The International Journal of Design Education*, 13(2), 1-19.

Boden, M. (1991). *The creative mind - myths and mechanisms*. London: Wiedenfeld & Nicholson.

Broadbent, G. (1973). *Design in Architecture: Architecture and the Human Sciences.* London: John Wiley and Sons.

Casakin, H. (2007). Metaphors in design problem solving: implications for creativity. *International Journal of Design*, 1(2), 21-33.

Chiaradia, A. J., Sieh, L. & Plimmer, F. (2017). Values in urban design: A design studio teaching approach. *Design Studies*, 49, 66-100.

Cho, J. Y. (2017). An investigation of design studio performance in relation to creativity, spatial ability, and visual cognitive style. *Thinking Skills and Creativity*, 23, 67-78.

Couger, J. D. (1995). *Creative Problem Solving and Opportunity Finding.* Danvers: Boyd and Farser.

Crilly, N. (2015). Fixation and creativity in concept development: The attitudes and practices of expert designers. *Design Studies*, 38, 54-91.

Crilly, N. & Cardoso, C. (2017). Where next for research on fixation, inspiration and creativity in design?. *Design Studies*, 50, 1-38.

Daemei, A. B. & Safari, H. (2018). Factors affecting creativity in the architectural education process based on computer-aided design. F*rontiers of Architectural Design,* 7(1), 100-106.

Dalkey, N. & Helmer, O. (1963). An experimental application of the Delphi method to the use of experts. *Management Science*, 9(3), 458–467.

Dalkey, N. C. (1971). *Studies in the quality of life: Delphi and decision-making. In the Delphi method: An experimental study of group opinion.* Lexington: Lexington Books.

Danaci, H. M. (2015). Creativity and knowledge in architectural education. *Procedia - Social and Behavioral Sciences*, 174: 1309-1312.

De Bono, E. (2006). *Thinking Course: Powerful Tools to Transform Your Thinking.* Harlow: Pearson Education Limited.

Delbecq, A. L., Van de Ven, A. H. & Gustafson, D. H. (1975). *Group Techniques for Program Planning: A Guide to Nominal Group and Delphi Processes.* Glenview: Scott Foresman.

Dorst, K. (2009). *Layers of design: understanding design practice*. In proceedings of IASDR 2009, International Association of Societies of Design Research, Seoul.

Dorst, K. (2011). The core of 'design thinking' and its application. D*esign Studies*, 32(6), 521-532.

Dorst, K. & Cross, N. (2001). Creativity in the design process: Co-evolution of problem-solution. *Design Studies*, 22(5), 425-437.

Eilouti, B. (2018). Concept evolution in architectural design: an octonary framework. *Frontiers of Architectural Research,* 7, 180-196.

Elton, L. (2006). Assessing creativity in an unhelpful climate. *Art, Design & Communication in Higher Education,* 5(2), 119-130.

French, M. (1994). I*nvention and evolution design in nature and engineering (2nd ed).* Cambridge: Cambridge University Press.

French, M. (1998). *Conceptual Design for Engineers (3rd ed.).* London: Springer-Verlag.

Gero, J. S. (2000). Creativity, emergence and evolution in design. *Knowledge Based Systems,* 9(7), 435-448.

Goel, V. & Pirolli, P. (1992). The structure of design problem spaces. *Cognitive Science,* 16(3), 395-429.

Goldschmidt, G. & Smolkov, M. (2006). Variance in the impact of visual stimuli on design problem solving performance. *Design Studies*, 27(5), 549-569.

Green, S., Southee, D. & Boult, J. (2014). Towards a Design Process Ontology. *The Design Journal*, 17(4), 515-537.

Habibi, A., Sarafrazi, A. & Izadyar, S. (2014). Delphi Technique Theoretical Framework in Qualitative Research. *The International Journal of Engineering and Science*, 3(4), 8-13.

Howard, T. J., Culley, S. J. & Dekoninck, E. (2007). *Creativity in the engineering design process.* In proceedings of ICED 2007, 16th International Conference on Engineering Design, Paris.

Howard, T. J., Culley, S. J. & Dekoninck, E. (2008). Describing the creative design process by the integration of engineering design and cognitive psychology literature. *Design Studies,* 29(2), 160-180.

Idi, D. & Khaidzir, K. (2015). Concept of Creativity and Innovation in Architectural Design Process. *International Journal of Innovation, Management and Technology,* 6(1), 16-20.

Irdayanti, M. N., Ramlee, M. & Abdullah, Y. (2015). Delphi technique: enhancing research in technical and vocational education. *Journal of Technical Education and Training,* 7(2), 12-23.

Johnson, P. & Indvik, J. (1992). The Mindful Use of Mental Capital in Career Development. *International Journal of Career Management*, 4(2), 8-14.

Kalin, N. M. & Barney, D. T. (2014). Hunting for Monsters: Visual Arts Cur-

riculum as Agonistic Inquiry. *International Journal of Art & Design Education*, 33(1), 19-31.

Khurana, A., Rosenthal, S. R. (1997). Integrating the fuzzy front end of new product development. *MIT Sloan Management Review,* 38(4), 103-20.

Kowaltowski, D., Bianchi, G. & De Paiva, V. (2010). Methods that may stimulate creativity and their use in architectural design education. *International Journal of Technology and Design Education,* 20(4), 453-76.

Kroes, P. (2002). Design methodology and the nature of technical artefacts. *Design Studies*, 23(3), 287-302.

Lawson, B. (2006). *How Designers Think: The Design Process Demystified (4th ed.)*. London: Routledge.

Lessio, D., Philip, M., Wynn, D. C. & Clarkson, P. J. (2009). *Communication and design process planning: initial insights from literature and industry interviews.* In proceedings of ICED09, The 17th International Conference on Engineering Design, California.

Ludwig, B. (1997). Predicting the future: Have you considered using the Delphi methodology? *Journal of Extension,* 35(5), 1–4.

Maher, M.L. (2001). A model of co-evolutionary design. *Engineering with Computers,* 16:195-208.

Maher, M. L. & Poon, J. (1996). Modelling design exploration as co-evolution. *Microcomputers in Civil Engineering,* 11, 195-209.

Maher, M. L. & Tang, H. H. (2003). Co-evolution as a computational and cognitive model of design. *Research in Engineering Design,* 14(1), 47-64.

Mahmoodi, A. S. (2001). The design process in Architecture: A Pedagogic approach using interactive thinking (Doctoral dissertation). University of Leeds, Leeds.

Mahmoodi, A.S. (2005). Thinking in design, interactive thinking in design education. *Fine Arts,* 20, 27-36.

Nagai, Y., Taura, T. & Mukai, F. (2009). Concept blending and dissimilarity: factors for creative concept generation process. *Design Studies*, 30(6), 648-75.

Othman, A. E. & Abdelwahab, N. M. (2018). Achieving sustainability through integrating risk management into the architectural design process. *Journal of Engineering, Design and Technology,* 16(1), 25-43.

Ozsoy, A. (2007). New approaches to creativity and creative thinking. *ITU Journal of the Faculty of Architecture,* 4(2), 1-5.

Rahmann, H. & Jonas, M. (2010). *Creativity in spatial design processes: establishing a non-routine design approach.* In proceedings of ICDC 2010, the First International Conference on Design Creativity, Kobe.

Roberts, A. S., Pearce, M., Lieberman, O. & Matsika, W. (2006). *The development of values in the studio: a hidden curriculum.* In proceedings of CSAAR 2006, The International Conference of the Center for the Study of Architecture in the Arab Region, Rabat.

Roozenburg, N. F. & Eekels, J. (1995). *Product design: Fundamentals and methods.* Chichester: Wiley.

Rowe, P. (1987). *Design thinking.* Cambridge: MIT Press.

Roy, D. & Brine, J. (2013). Design Thinking in EFL Context: Studying the Potential for Language Teaching and Learning. *The International Journal of Design Education,* 6(2), 1-21.

Seggern, H. V. (2008). Exploration: Creativity, understanding and idea. In Seggern, H. V., Werner, J. & Grosse-Bachle, L. (Eds), *Creating knowledge.* Berlin: Jovis.

Smith, S. M. (1995). Getting into and out of mental ruts: a theory of fixation, incubation, and insight. In Sternberg R. J. & Davidson, J. E. (Eds), *The nature of insight.* Cambridge: MIT Press.

Taura, T. & Nagai, Y. (2013). *Concept generation for design creativity: A systematized theory and methodology.* London: Springer-Verlag.

Van Aken, J. E. (2005). Valid knowledge for the professional design of large and complex design processes. *Design Studies,* 26(4), 379-404.

Williams, A., Ostwald, M. & Askland, H. (2010). *Assessing creativity in the context of architectural design education.* In proceedings of DRS 2010, The International Conference of Design & Complexity, Montreal.

Zainudin, A. (2012). *Research Methodology and Data Analysis.* Kuala Lumpur: Penerbit Uitm Press.

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In Situ dynamic system identification of historic masonry monuments based on non-destructive testing

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Abstract

Istanbul is home to numerous architectural heritage which are in a great variety built by Byzantine and Ottoman period. On the other hand, cultural heritage buildings are faced with serious earthquake risks which require the investigation of the structural behaviour of cultural heritage buildings and the taking of necessary conservation measures to preserve and transfer them to the future in a sustainable way. This article describes an experimental in-situ investigation of an 18th century historic masonry monument, Nur-u Osmaniye Mosque in Istanbul by the non-destructive testing. Dynamic system identification study based on operational modal analysis (OMA) tests which include two different test setups in terms of locations and numbers of accelerometers. The extracted dynamic parameters of structure such as natural frequencies, mode shapes and as well as damping ratios obtained from two different test setups compared. In addition, the results of non-destructive in-situ tests used for the 3D Finite Element (FE) model updating by comparing and calibrating numerical and experimental characteristics. The paper presents an in situ dynamic identification procedure of an historic masonry monument based on operational modal analysis and compares dynamic properties obtained from experimental and numerical studies and gives the results of FE model updating of the structure.

Keywords

Historic masonry, Non-destructive testing, Nur-u Osmaniye Mosque, Operational modal analysis, System identification.

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1. Introduction

Experimental methods provide important information for understanding the behaviour of structures, especially when examining historic buildings whose behaviour is generally difficult to fully understand without using diagnostic techniques (Gentile et al., 2015; Makoond et al., 2020). Structural Health Monitoring (SHM) which is one of the most the popular research area for structural engineering of modern structures, as well as historic buildings is very beneficial for identification of the behaviour of historic buildings (Alvandi and Cremona, 2006; Zhou et al., 2010; Chen et al., 2011; Gunaydın, 2020; Baraccani, 2021; Ghandil et al., 2021). Generally, historic masonry buildings need to be monitored because of having probably several damages in the history, which is crucial to maintaining long-term building safety (Moropoulou et al., 2019). Early warnings on damages and operational safety or preventing the deterioration can be managed by structural health monitoring with a specific system installed and analysed (Binda et al., 2000; Pallarés et al., 2021).

One of the most popular dynamic system identification technique is operational modal analysis (OMA). Ambient vibration measurement can be effectively used to estimate the dynamic parameters of the structure, as well as to calibrate the finite element (FE) models (Feng et. al., 1998; Gunaydın, 2020). For identification of modal parameters of structures such as bridges, towers, historic buildings ambient vibration tests are performed (Xu and Zhan, 2001; Brownjohn, 2007; Ramos et al 2010; García-Macías, and Ubertini, 2020; Borlenghi et al., 2021).

For evaluation of dynamic structural characteristics of historic masonry structures, Operational Modal Analysis is an eminently useful tool, because of its non-destructive character and advantages based on the ambient vibrations of the investigated structure (Diaferio, 2011; Gentile et al., 2015; Pieraccini, 2014). The highlighted advantage of operational modal analysis is as follows:

- Operational modal analysis provides a full-scale testing of the structure. Therefore, it is possible to take into consideration the previous damages, repairs and any changes or problems in the historic structure.
- As a non-destructive test, operational modal analysis has a major advantage in diagnostic studies on historic buildings because of some existing limitations and prohibition about the destruction or taking samples from the historic buildings according to international conservation principles.
- In operational modal analysis test, there is no need for any external excitation force, because depending on ambient vibration case. So, it offers cheap and fast solutions in comparison with experimental modal analysis which requires expensive and invasive excitation force input for shaking the structure.
- Since it is non-destructive test, the application does not require to interrupt the function of the building. Considering the critical and intensive functions of the historic monuments, it may be rather crucial to be able to perform some tests without any disturbance to users and as well as visitors.

Since the successful practices of operational modal analysis in masonry structures, the interest in dynamic identification based on ambient vibration testing increased (Ramos and Aguilar, 2007; Ramos et al., 2010; Diaferio, 2011). For the ambient vibration test, it is rather sufficient to take a record of structural vibrations approximately for 1 hour after the test devices are installed in the building. Thus, the required ambient vibration data can be obtained in one day for the dynamic identification of the structure. In order to increase the reliability of the numeric analysis results of finite element (FE) models, the fundamental dynamic parameters such as free vibration frequencies, mode shapes and damping ratios which can be calculated based on ambient vibration data, should be used for the calibration process (Costa et al., 2015; Salvatore and Eleonora, 2020). Although the vibration source for operational modal analysis survey is ambient noise such as weak ground motions due to both natural and anthropogenic sources, wind, atmospheric perturbations and road traffic,

the technique also provides very beneficial information in case of a seismic sequence in structural health monitoring status (El-Shafie et al., 2012).

There are several research on ambient vibration testing and operational modal analysis of buildings and the effectiveness of ambient vibration measurement at a small number of locations are presented to predict finite element (FE) model parameters (Feng et al., 1998; Gunaydin, 2020; Borlenghi, 2021). Although several computational approaches are available in the literature, the restoration of historic masonry structures remains a challenge to modern engineers (Teza et al., 2015). Because of some irregularities such as empty volumes, imperfections related with initial construction and repair, damages such as cracks and out of plane displacements and rotations, variability in material strength and stiffness, historic masonry structures contain many unknown as well as uncertainties. However, it is claimed that finite element (FE) techniques have been accepted as an effective tool for structural performance investigations of historic masonry buildings if the the models are calibrated based on data obtained by some diagnostics techniques like in situ ambient vibration assessment of the historical structures (Gentile et al. 2015, El-Shafie et al. 2012, Teza et al. 2015, Gunaydın 2020).

The structural assessment of historic masonry buildings has been gaining importance for sustainable conservation and heritage management. To evaluate the effects of building material degradation, damages and corresponding repairs of past earthquakes on structural behaviour and to determine possible damage locations and critical zones are needed to be identified to maintain structural safety and for sustainable protection (Costa et al., 2015; Gentile and Saisi 2007; Borlenghi 2021). The number of cultural heritage buildings in Turkey is large, especially in Istanbul, which was both the Byzantine and Ottoman capital that has several famous historic masonry monuments. Restoration and conservation of historic structures requires diagnostic monitoring to determine dynamic characteristics and detect possible damages in the future. Since natural frequencies, damping and modal shapes are directly related to structural integrity, stiffness and behaviour of the structure, the operational modal analysis is a beneficial technique in terms of evaluating changes of modal parameters as well as possible damages and deteriorations (Teza et al., 2015; De Stefano, 2016). Churches and mosques can be evaluated as finest architectural heritage and each of these assets requires specific structural investigations and diagnostic studies based on field survey and non-destructive tests such as operational modal analysis to have a correct numerical model (Carpinteri, 2005; Lacannaa, 2016).

Istanbul has experienced several devastating earthquakes throughout its long history. Various architectural monuments were damaged due to major earthquakes that occurred approximately for one hundred years period in Historic Peninsula of Istanbul. If a monument is still intact while plenty of buildings are damaged by earthquakes, it should be a pretty attractive research topic for a researcher. The Nur-u Osmaniye Mosque, which was built in the 18th century as a unique monument of Ottoman Architecture, has survived almost undamaged despite it is located in a region with major earthquake risk and experienced some devastating earthquakes in 18th, 19th and 20th centuries. Moreover, despite its exceptional earthquake performance, there was no exhaustive research on the structure of the monument and why it was not damaged. Therefore, the characterization of structural system of the mosque is an extraordinarily intriguing and as well as challenging task. In this context, in order to identify dynamic characteristics, as well as structural behaviour of the mosque, an in-situ experimental research program was conducted. This article discusses the dynamic system identification process and the characterization of structural dynamic system of Nur-u Osmaniye Mosque based on performed in-situ operational modal analysis tests which implemented for ambient vibration cases with different test configurations. The paper also mentions about calibration of finite element model using the results of the experimental study.

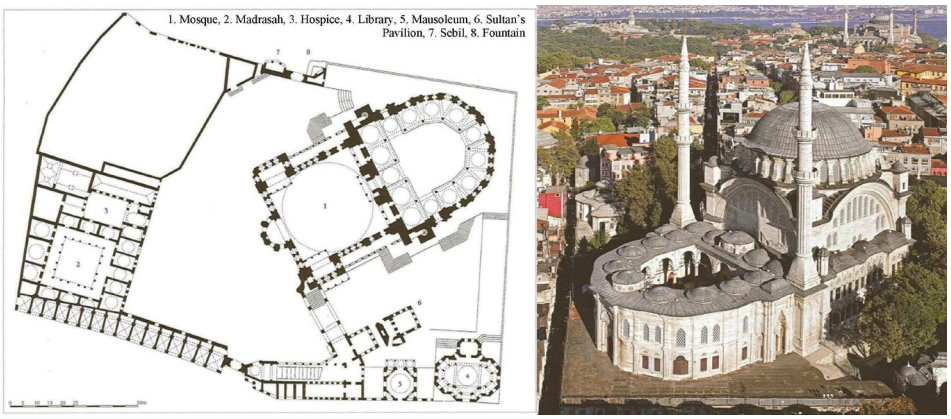


Figure 1. *Plan layout of Nur-u Osmaniye Complex and view of mosque (Kuban, 2007).*

2. Investigated monument: Nur-u Osmaniye Mosque

Nur-u Osmaniye Mosque is one of the most fascinating monuments of Istanbul. It was started to build by Sultan Mahmoud (I) the first and finished by Sultan Osman (III) the third between 1748 and 1755 in Istanbul. The mosque was first introduced Baroque Architecture in a religious complex in the 18th century. As the most significant representative of the new era and so it is also called the Ottoman Baroque, because of its style that synthesized the new art and architecture such as magniloquent details and elliptic courtyard as well as traditional elements of classical Ottoman Architecture. The mosque is located next to the Cemberlitas area of Historic Peninsula, around where there was the famous Constantinus Forum of Byzantine period (Sav, 2012). Among several buildings of the complex such as madrasah, hospice, library, mausoleum, Sultan's pavilion, and fountain, the mosque is the most important monument in the Kulliye (*Islamic Ottoman Social Complex*) as presented in Figure 1.

The mosque stands for the quality of technical approach and level of knowledge of the Ottoman Architects in the period. The unique synthesis of architectural style, design properties of structural system and building techniques are fascinating points of the mosque among the Ottoman monuments (Figure 1). Furthermore, the mosque represents a peak point of structural iron usage in the masonry construction as a result of the increase in line with the production and trade opportunities of the 18th century.

Design principle of the structural system of the mosque is also very simple and clear. The main sanctuary place of the mosque rises on a classic ~27m square baldachin plan covered by a single main brick dome and the famous elliptic courtyard and portico are also covered by petty brick domes. The main dome which is roofing the main sanctuary is supported with four main masonry arches which have highlighted profiles on both inside and outside. Moreover, there are pendants on the corners as transition elements. Under the main arches, the window openings on masonry walls provide transparency and light for interior space.

Regarding the substructure, which is invisible on the courtyard, the structural design of the mosque is very significant. The huge substructure sustains the superstructure of the mosque and forming a platform under the courtyard. However, it is completely hidden in the ground with the only exception of the northwest façade where side shops are located (Figure 2). The load bearing walls of the substructure consist of the roughly cut natural stones such as local limestone and tuffs. The roofing system of the substructure is brick vaults which were built with traditional *Khorasan*, a kind of lime mortar containing brick particles as aggregates. At the bottom of the substructure there are stone masonry foundations which were placed on a masonry platform constructed on wooden grillages and piles almost reaching main rock.

The building techniques are different for the substructure and the superstructure of the mosque. Masonry

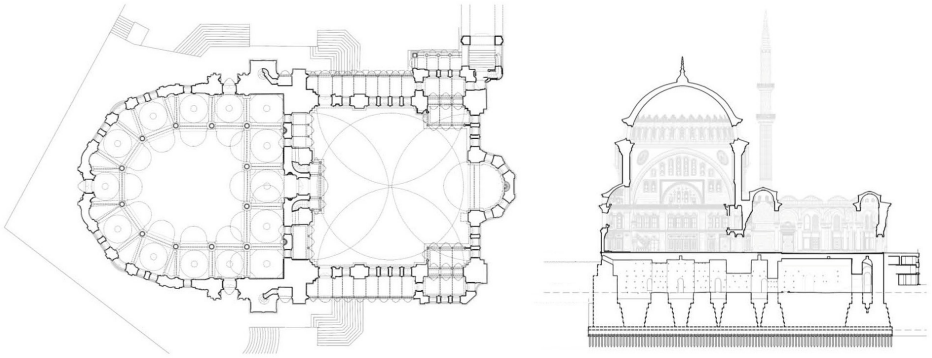


Figure 2. *Ground floor plan and section through courtyard-mihrab direction of the mosque.*

walls, pillars and arches were constructed with cut stone masonry technique using an organic limestone named as küfeki, which is widely used in the Byzantines and Ottoman monuments of Istanbul. Hammer-dressed stone masonry technique was used in the walls and the stones are tied with each other with iron clamps and mortises. Furthermore, during the construction, the structure was strengthened with double iron tie beams on each nine levels from the floor to the main dome. Some of the iron tie beams are observed on the spring level of arches while some are visible within the window openings of masonry walls. The rest of the tie beams are hidden in the wall and as well as dome. Thanks to Ahmed Efendi who was the clerk of the construction process in 18th century. He explained the tie beam usage, levels, and all construction details in his historic manuscript named The History of Nur-u Osmaniye Mosque (Tarih-i Cami-i Şerif-i Nur-u Osmani) (Ahmed Efendi,1918).

Natural stones obtained from local quarries and traditional brick are main building materials of the mosque. Also lime mortar consist of brick and limestone particles and dust as aggregate was used in masonry work of the building. In the sanctuary of the mosque, there are marble and granite columns supporting the gallery floor, however they are not the main elements of load-bearing system because of their location and size. There are bigger granite columns sustaining the brick domes of portico in the courtyard. The drum of the main dome consists of hammer dressed limestone and the rest of the main dome was built with traditional brickwork.

3. Experimental study: Operational Modal Analysis (OMA)

In order to identification of the dynamic structural system, the operational modal analysis performed in terms of two different test setups with different devices and configurations on the structure. The experimental study performed as full scale and non-destructive test considering the ambient vibration of the structure.

3.1. Setup 1 (OMA-1)

The first operational modal analysis test (OMA-1) in Nur-u Osmaniye Mosque was performed with two 24-channel digitizers, using seven triaxial force-balance type accelerometers. Ambient vibration data was recorded with 200 sampling rate using instruments connected with GPS to be able to acquire synchronized data. In order to determine the dynamic parameters of the building in both directions in the plan, the devices are placed on the north and south corners as located opposite to each other.

The best possible locations and cable routes were chosen, in order to keep the cable lengths as short as possible and to avoid the noise caused by the long cables to obtain a clear data. For instrumentation, three levels such as the ground floor level, the spring level of the main arches and the dome base level were selected from bottom to top, respectively. The accelerometers were put at each of the two corners (A and B) of the structure and recording was taken synchronically (Figure 3).

The acceleration – time history graphs obtained from the test and the ambient vibration data showed that the amplitudes decrease from top to bottom levels. Since the fundamental

parameters defining dynamic response of a structure are the natural frequency and damping ratio, they are also the only parameters needed to determine the response of the structure subjected to earthquake loads (Şafak, 2010). For this reason, digital signal processing performed both in time and frequency domain. After applying the required filters, Fourier (FFT) and Power (PSD) spectrums were calculated to pick and compare the identified natural frequencies and corresponding modes. The frequency analysis was applied separately in both directions as perpendicular to Qibla direction (x), for northeast-southwest component and the main axis of the structure Qibla (towards Mecca)

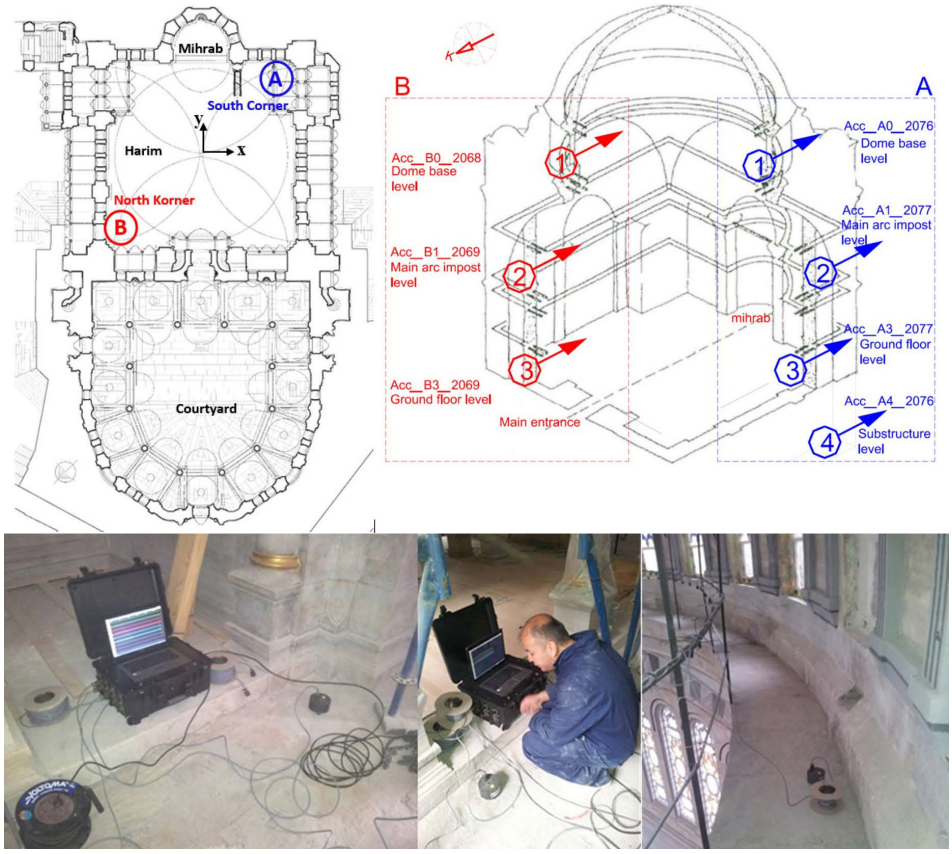


Figure 3. *Setup for OMA-1 on plan and axonometric view, and data recording.*

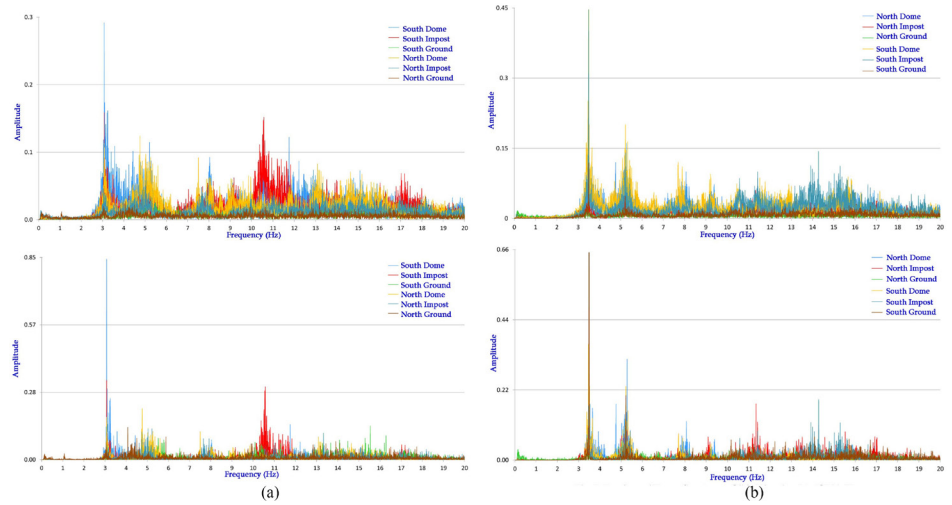


Figure 4. *Fourier (above) and Power (below) Spectrums, a) Perpendicular to Qibla-x b) Qibla-y direction, (OMA-1).*

Table 1. *Identified natural frequencies in OMA-1, periods, and modes in x-y directions.*

Mode	Direction-Number	Frequency [Hz]	Period [s]	Mode Shape and Direction
1	X_1	3.08	0.325	Translational movement – x direction
2	Y_1	3.49	0.287	Translational movement – y direction
3	$T_1 = XY_1$	5.22	0.192	Torsion
4	$T_2 = XY_2$	7.70	0.130	Torsion
5	$T_3 = XY_3$	9.17	0.109	Torsion
6	$T_4 = XY_4$	10.58	0.095	Torsion
7	Y_2	11.41	0.088	Translational movement – y direction
8	X_2	11.76	0.085	Translational movement – x direction

direction (y), for southeast – northwest component and consequently the natural frequencies of the main modes of the structure were identified (Figure 4 and Table 1). In direction perpendicular to Qibla, the first frequency calculated as 3.08 Hz while the second and third natural frequencies are 5.22 Hz, and 8.05 Hz respectively.

In Qibla direction (y), the main modes and corresponding natural frequencies of the structure were presented in Figure 4. The first frequency (3.49 Hz) in this direction shows that the behaviour of the structure is more rigid than the other direction's (3.08 Hz). Furthermore, Fourier and Power spectrums are purer in Qibla direction.

The natural frequencies obtained from the spectrums for the dome base level, the main arches' impost level and ground floor levels were calculated for the (x) component of all the acceleration, perpendicular to the qibla. The first frequency in the direction perpendicular to the qibla is 3.08 Hz. The second frequency obtained as 5.22 Hz while third one is 8.05 Hz. Moreover, the natural frequencies for qibla direction (y) are obtained from calculated spectrums by analysing the y direction of recorded accelerations and first three modes and natural frequencies in the direction are detected as, 3.49Hz, 5.22 Hz and 7.70 Hz, respectively.

Although natural frequencies can be determined from spectra, it is not possible to obtain an idea about mode shapes directly. Therefore, it is useful to compare the spectra of two direction by overlapping them in order to understand the modal shapes of the structure. When the spectra calculated for both directions are compared, it is determined that the peaks of the frequencies seen in the spectrum in only one direction correspond to the translational movement in the relevant direction, and the frequencies that coincide with each other in the spectra in both directions mean torsion motion and torsional mode shape.

Considering the spectra in both main directions, it is seen that, the frequencies belonging to a total of eight modes can be detected (Figure 5 and Table 1). Since four of the free vibration modes of the structure correspond to the torsion mode, it has been determined that there are two translation modes in the direction of the qibla and perpendicular to the qibla. The first three frequencies and modes determined by analysis are striking. It was determined that the first two modes (F1=3.08 Hz and F2=3.49 Hz) are translational movements perpendicular to the qibla and in the direction of the qibla, respectively. On the other hand, the third mode (f3 = 5.22 Hz) is the torsional mode. The obtained results from the OMA show that the dynamic behaviour of the structure is quite pure and smooth.

3.2. Setup 2 (OMA-2)

In the second operational modal analysis test performed on the building, accelerations of the ambient vibration case were recorded to determine the dynamic parameters of the structure such as natural vibration frequencies, mode shapes and damping ratio and compare them with the results of first study. In this second study, the test set consisting of nine triaxial accelerometers (Sensebox, force-balance), two 16-channel data acquisition devices, integrated computer, GPS devices for time synchronization were used (Figure 6). For data acquisition, the crown points and the spring level of the main arches and the ground floor level were selected

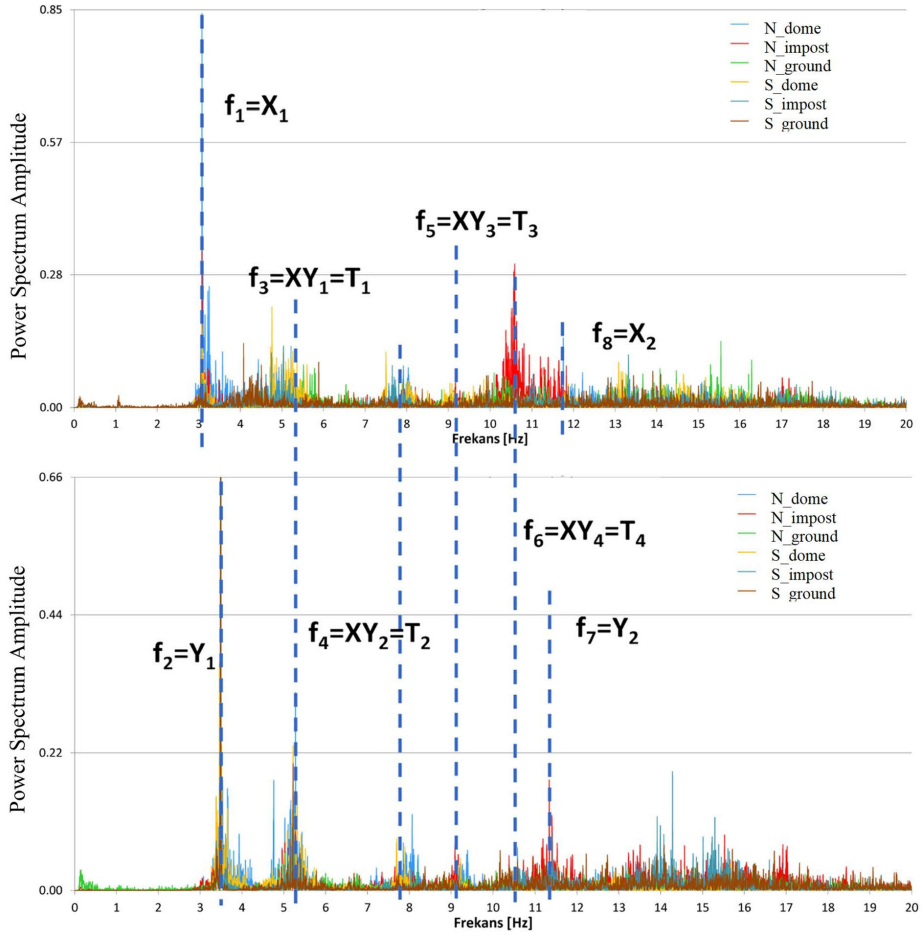


Figure 5. *Comparison and matching of the spectrums for x and y directions (OMA-1).*

from top to bottom respectively (Figure 6). Some locations of accelerometers were changed, and the number of devices increased with respect to the first study to be able to compare the results from the two setups. In the second test, x, y and z denotes the same directions as in the first test. In this case, the data acquired with 200 sampling rate analysed by using ARTeMIS (2016) software for dynamic diagnosis. The acceleration – time history graphs obtained from OMA-2 test are similar to those of the first study OMA-1, as the acceleration amplitudes, decrease from dome to the bottom levels.

In order to obtain mode shapes, accelerations from each device located in the building are defined in the relevant points on the simple representative building model created in the Artemis software. Each accelerometer data was associated with the same representative node on the model, and directions of the devices and model were matched. In this way, it is possible to display the modal vibrations as well as the mode shapes of the building via a representative geometric model simulation.

The natural frequencies, mode shapes and damping ratios were calculated using Frequency Domain Decomposition (FDD), Enhanced Frequency Domain Decomposition (EFDD) and Curve-fit Frequency Domain Decomposition (CFDD) methods of Artemis for both directions x and y. The calculated frequency and damping values by using three different techniques are very close to each other (Table 2). As generally expected, the damping ratios are low due to the ambient vibration data, and the largest ratio is around 2.2%. Also, the damping ratios in the first two modes with high participation is significantly higher than the other modes.

It has been determined that the identified frequencies based on ambient vibration data in OMA-1 and OMA-2 tests performed on the building are very close to each other (Table 2). The results of the first test were calculated

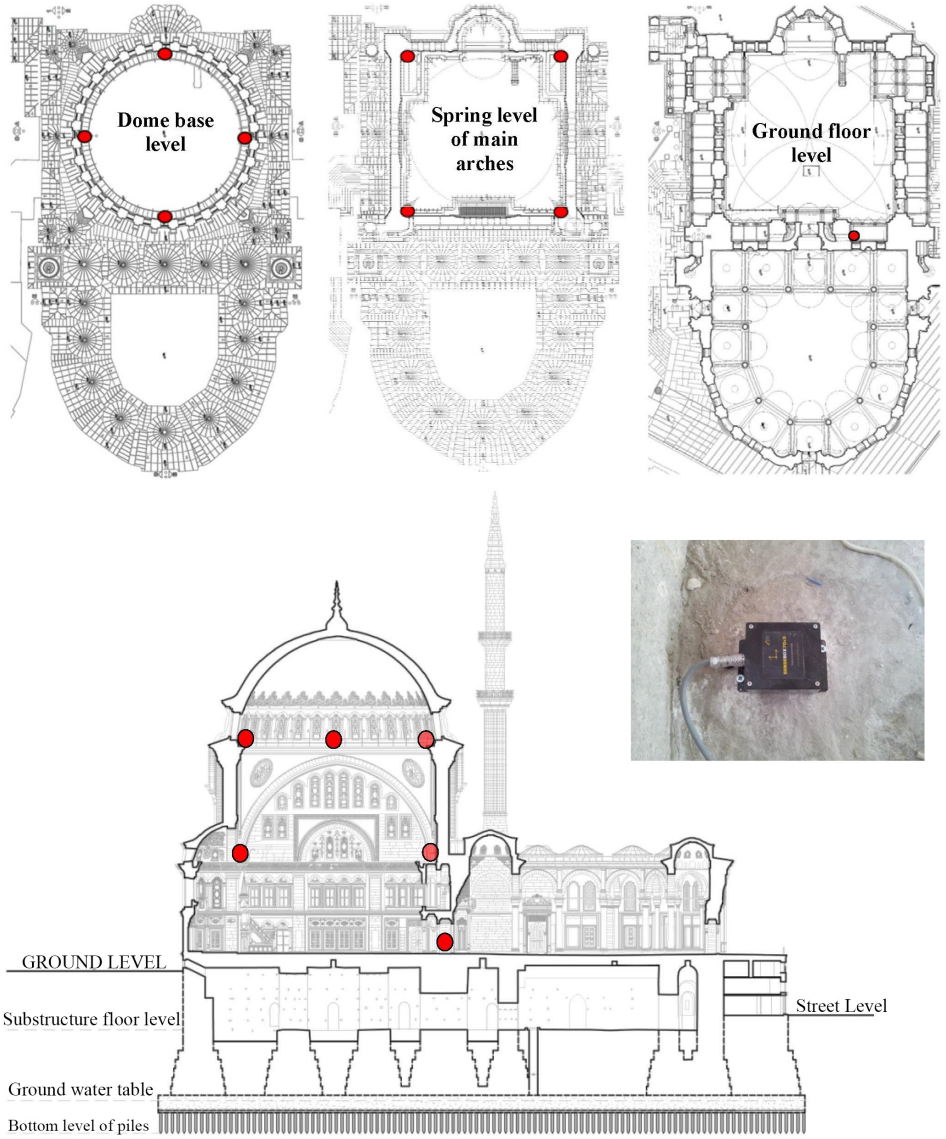


Figure 6. *The locations of accelerometers on the plan and section of the mosque for OMA-2 test setup.*

Table 2. *Calculated frequencies and damping ratios and comparison of OMA-1 and OMA-2.*

Mode	OMA -1	OMA-2					Average	
	FFT	FDD	EFDD		CFDD			
	Frequency [Hz]	Frequency [Hz]	Frequency [Hz]	Damping [%]	Frequency [Hz]	Damping [%]	**Damping [%]**	**Frequency [Hz]**
1	3.080	3.101	3.097	0.685	3.100	1.324	1.005	3.099
2	3.490	3.442	3.454	1.185	3.458	2.217	1.701	3.451
3	5.220	5.176	5.168	0.448	5.175	0.921	0.685	5.173
4	-	7.397	7.384	0.212	7.380	0.561	0.387	7.387
5	7.700	7.861	7.850	0.099	7.861	0.269	0.184	7.857
6	9.140	9.106	9.122	0.254	9.121	0.575	0.415	9.116
7	-	12.231	12.235	0.440	12.235	0.666	0.553	12.234

by FFT and PSD method, while the data acquired by the second test were analysed by the software using FDD, EFDD and CFDD tools. It was determined that the calculated frequencies by the analysis of the data obtained from different device locations, numbers and types have resulted in almost the same values and the two tests confirmed the results of each other.

The mode shapes and modal assurance criteria (MAC) results determined by the analysis are displayed on the model representing the mosque (Figure 7). It is observed that the first mode shape corresponds to the translational movement in the direction perpendicular to the qibla (y), while the second mode shape to the translational movement in the qibla direction (x) and the

third mode to a torsional shape as predicted in the first test (Figure 7). The first three are the dominant modes of the building and greatly mobilize the building mass while the fourth and fifth modes are torsional modes that involve complex motion. The sixth mode shape is the opening of the main dome in the short direction and the seventh mode has a shape that corresponds to the entire expansion movement of the dome. The results of mode shapes obtained by comparing the frequencies determined in the both direction of main axis of the structure in the first test (OMA-1) were confirmed by the numerical and graphical results obtained in the second test (OMA-2). In this sense, it was concluded that the modes and frequencies determined in both tests were nearly the same, as well as the determined mode shapes.

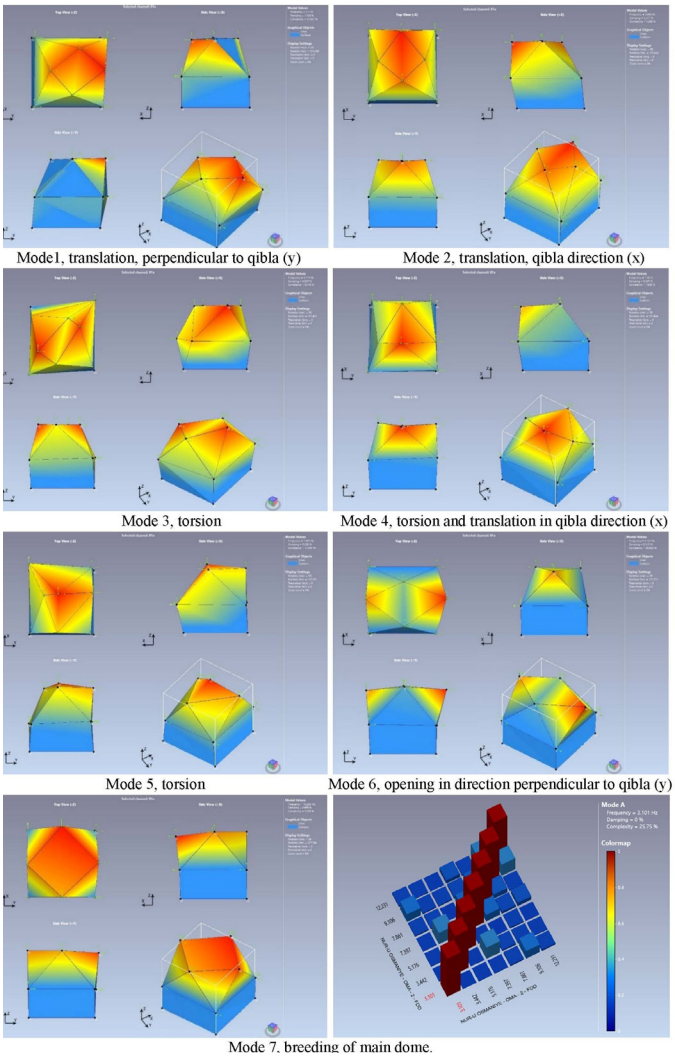
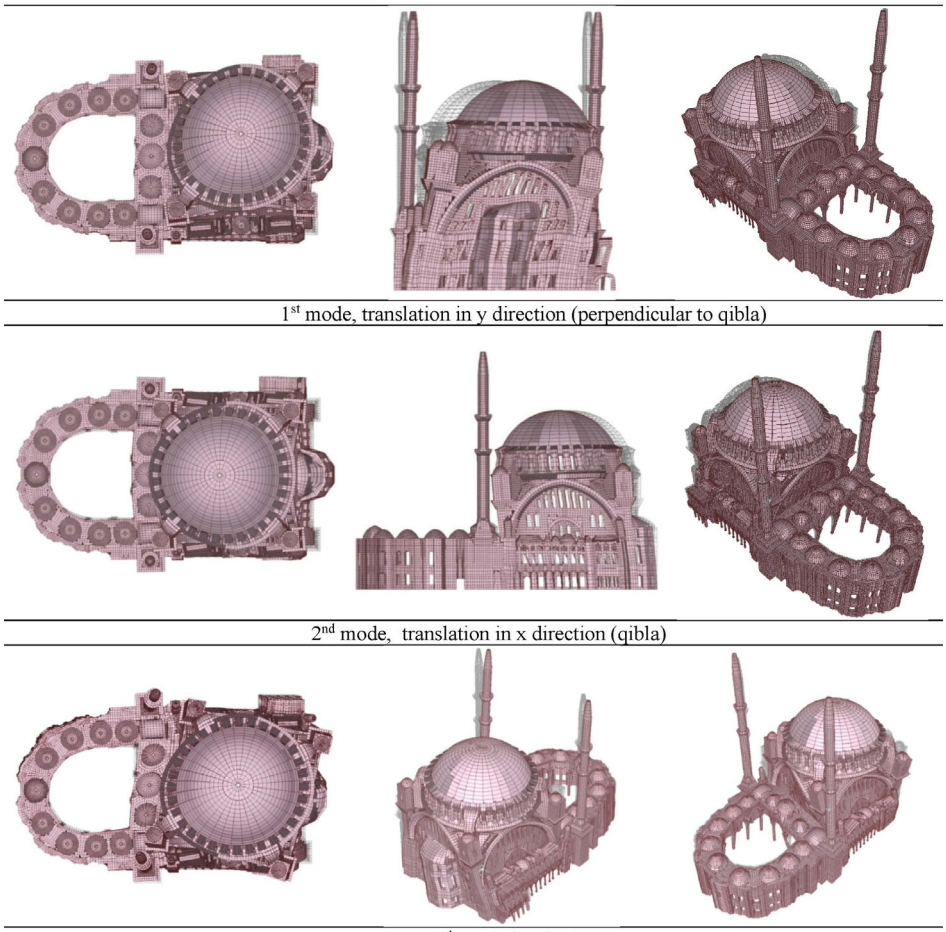


Figure 7. *Identified mode shapes and MAC graphics for OMA-2.*

4. Numerical analysis and calibration

The field survey allowed assessing the main frequencies of Nur-u Osmaniye Mosque. Calculated frequencies from operational modal analysis tests were used to calibrate the 3D numerical model which is generated by using finite element method using the data obtained by a long field survey. In the 3D model, totally 95866 solid element (masonry walls, pillars, arches, domes, and vaults) and 162162 joints are generated by considering natural stone sizes. Iron ties are modeled to be effective only in case of axial loadings. The substructure of the building is excluded from the model because this part of the building is extremely rigid and completely buried in the ground.

As a result of the laboratory experiments carried out on the main building material, the limestone (kufeki) samples, it was determined that the natural unit volume weight is 2.40 g/cm^3, and the ratio of the open pores is approximately 9 %. Also, uniaxial compressive strength of the cylindrical kufeki stone samples were determined as 26 MPa which is corresponding to 29 MPa as equivalent cube strength. The modulus of elasticity of the main building stone, organic limestone kufeki, was found to be around 28000 MPa in the laboratory tests which performed using core samples taken from building. For this organic shell limestone, which is the main building material of the monuments in Ottoman and Byzantine architecture, there are findings very close to the result obtained in the scope of this study in the research of the relevant literature (Arioglu and Arioglu, 1999; 2005). However, the natural stone blocks are assembled in the masonry elements such as walls, arches, and piers by combining them with Khorasan mortar and metal elements such as clamps and mortises. The binder of traditional Khorasan mortar is air lime putty. Brick and limestone particles which have diameter under 10mm and 6mm respectively, are used as aggregates. The binder/aggregate ratio is approximately 1/3. The metal elements fixed with lead into the stone blocks. In this case, it should be expected that only the values of the natural stone material obtained in the laboratory are not valid, and the in-situ



Mode	*FFT Frequency* *[Hz]*	*FE Model Frequency* *[Hz]*	*Difference* *%*
1	3,080	3,165	2,76
2	3,490	3,201	8,28
3	5,220	4,681	10,33

Figure 8. *The first three mode shapes of calibrated FE model and comparison of experimental and numerical results.*

masonry structure exhibits a different behaviour than stone. Since it is not possible to use only the values of the material determined in the laboratory, the actual values must be found by a deductive method by verifying the dynamic characteristics of the structure.

In order to calibrate the dynamic behaviour of the numeric 3D model, iterative solutions were obtained by changing the modulus of elasticity of the masonry material. By monitoring the effects of changes in material properties on the modal analysis results, the modulus of elasticity that provides the frequencies obtained from the operational modal analysis tests was determined. Thus, it was detected that the modulus of elasticity value of 8000 MPa for natural masonry material provided the closest values to the operational modal analysis test results. This value of modulus of elasticity corresponds to approximately 1/3 of the value obtained in the laboratory tests of natural stone and is in accordance with the studies in the literature (Bartoli, 2013).

Operational modal analysis tests results show that the period of the first main vibration mode obtained in y-direction or perpendicular to qibla is 0.316 seconds (3.165 Hz) as shown in Figure 8. In this mode, the cumulative mass participation ratio is calculated as 48% due to the asymmetric structure of the main body and the courtyard with respect to y-axis. If the courtyard mass was not considered, the total mass participation ratio increases to 65%.

The second main vibration mode of mosque is calculated in the x-direction (parallel to qibla) and corresponding period of the mode was calculated as 0.312 seconds (3.205 Hz). The mass contribution of the courtyard was relatively small by comparing it to the main structural body of the mosque. The contribution of the courtyard in the total mass participation ratio was calculated to 52%. If the courtyard is ignored, the ratio is enhanced to 65%.

The third main vibration mode consists of torsional displacements. Figure 8 shows the main torsional effects of mode-3 with 0.214 seconds period (4.67 Hz). In total, 15 mode were calculated to reach a satisfactory total mass participation ratio (~95%) by using the Ritz method. Twelve of the free vibration modes is related with the x and y direction movements with different frequencies. One of three remaining vibration modes is breeding of main dome and the others two are torsional modes of mosque. Especially, as the contribution in mass participation ratio of the first three modes exceeds 50 %, it can imply that a large part of the structural mass moves together.

Figure 8 presents frequency results which are calculated using data obtained by the operational and the numerical modal analysis. The differences between the frequency results of experimental and numerical analysis are below 3%, 8% and 11 % for the first 3 modes, respectively. The highest difference is calculated for the mode 3, however, the highest difference is situated approximately 10%.

5. Conclusion

The study has focused on a multidisciplinary work consisting of a field survey, monitoring, operational modal analysis, signal processing, finite element modelling and numerical analysis to assess main dynamic characteristics of Nur-u Osmaniye Mosque. The results of two operational modal analysis tests were used to a generate calibrated finite element model to be able to determine the dynamic behaviour and to perform earthquake analysis of the structure.

In experimental study, two separate operational modal analysis setups (OMA-1 and OMA-2) carried out on Nur-u Osmaniye Mosque. The device types, numbers and locations on the structure were selected in a different way to examine the effect of the test setups. Dominant natural vibration frequencies, periods and mode shapes, which are the basic dynamic parameters of the structure, were determined as a result of the evaluation and analysis of the acquired vibration data caused by the environmental effects without any excitation in the building.

In the first operational modal analysis test (OMA-1), by using the calculated Fourier and power spectrums from the acceleration records acquired from the building, the modes in the direction of both main axes of the building and the corresponding free vibration frequencies were determined. As a result of the analyses, it has been determined that the first mode (frequency 3.08 Hz) and the second modes (frequency 3.49 Hz) are translational modes in direction perpendicular to the qibla and in the direction of qibla, respectively. Moreover, the third mode (frequency 5.22 Hz) is a torsional mode while other modes are more complex and less dominant than the first three modes.

The results of the second operational modal analysis test (OMA-2) obtained by using Artemis software with three different techniques are nearly the same in comparison with the first test (OMA-1). It has been determined that the identified frequencies based on ambient vibration data are very close to each other in OMA-1 and OMA-2 tests which have different device locations, numbers and types. As two tests have resulted in almost the same values for frequencies and modes, two tests confirmed the results of each other. Furthermore, in terms of the mode shapes obtained by the analysis comparing the frequencies determined in the direction of both main axes of the structure in the first test (OMA-1) were confirmed by the numerical and graphical results obtained in the second test (OMA-2). For this reason, it was concluded that the modes and calculated frequencies in both tests were nearly the same, as well as the determined mode shapes.

Considering the operational modal analysis results, the first two main modes are translational in the direction

of principal axes of the structure and the third dominant mode in the form of torsion shows that the structure has a very smooth structural system and dynamic behaviour. According to the operational modal analysis results, the structure displays a more rigid behaviour in the direction of the qibla than the direction perpendicular to it. The reason for the stiffness difference seems to be the presence of courtyard and minarets in the direction of qibla. Minaret bases and the courtyard are thought to make the structure more rigid in the qibla direction. The structure displays a clearer dynamic behaviour in the qibla direction than the direction perpendicular to the qibla. This situation can be explained by the symmetry that the structure has in the qibla direction. Since it is not completely symmetric in the direction perpendicular to the qibla the structure exhibits a more complex dynamic behaviour with the effect of the sultan's mahfil, courtyard and as well as minarets.

In order to obtain the same frequencies as the experimental results, the finite element model calibrated according to the results of operational modal analysis. For this purpose, the modulus of elasticity values of the *küfeki* named shell limestone which is the main building material, were changed and it was determined that the value giving the closest result was 8.000 MPa. This value corresponds to approximately one third of the modulus of elasticity (28.000 MPa) obtained in the laboratory test of organic limestone. Because the natural stones used in the building are combined with mortar and iron clamps and mortises in masonry, the structural elements which are assembly of the used materials have turned into a stiffness of approximately one third.

Finally, as the natural frequency is the main dynamic characteristic of the structures, it is possible to use the any change in natural frequency as a damage indicator. Therefore, the earthquake analysis can be carried out on the finite model which is calibrated according to the frequencies obtained in this study. In addition, in case of future earthquakes, the damage assessment of the structure can be made by examining whether the frequency values obtained in this study have changed or not. In this regard, the results of the experimental study can be considered as a "documentation of behaviour" of the structure.

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References

Ahmed Efendi (1918). *Tarih-i Cami-i Şerif-i Nur-u Osmani.* Tarih-i Osmani Encümeni Mecmuası İlavesi, 49, İstanbul: Dersaadet.

Alvandi, A., & Cremona, C. (2006). Assessment of vibration-based damage identification techniques. *Journal of Sound and Vibration*, 292(1-2), 179–202. https://doi.org/10.1016/j.jsv.2005.07.036

Arıoğlu, E. & Arıoğlu, N. (1999). *Mimar Sinan'ın yaygın olarak kullandığı küfeki taşının mühendislik gizemi.* Mimar Sinan Dönemi Yapı Teknikleri Semineri, İstanbul.

Arıoglu, N. and Arıoglu, E. (2005). Engineering mystery of master Architect Sinan's "Kufeki" shell limestone. *Architectural Science Review*, 48, 163-172.

ARTeMIS (2016). Ambient Response Testing and Modal Identification Software, Structural Vibration Solution A/S Aalborg, Denmark. www.svibs.com

Baraccani, S., Palermo, M., Gasparini, G., Trombetti, T. (2021). A time domain approach for data interpretation from long-term static monitoring of historical structures. *Structural Control and Health Monitoring,* 28:e2708. https://doi.org/10.1002/stc.2708

Bartoli, G., Betti, M., & Giordano, S. (2013). In situ static and dynamic investigations on the "Torre Grossa" masonry tower. *Engineering Structures*, 52, 718–733. https://doi.org/10.1016/j.engstruct.2013.01.030

Binda, L., A. Saisi, and C. Tiraboschi. (2000). Investigation procedures for the diagnosis of historic masonries. *Construction and Building Materials,* 14(4), 199–233.

Borlenghi, P., Gentile C., and Saisi A. (2021). Detecting and localizing anomalies on masonry towers from low-cost vibration monitoring, *Smart Structures and Systems*, 27(2), 319-333. https://doi.org/10.12989/sss.2021.27.2.319

Brownjohn, J. M. W. (2007). Structural health monitoring of civil infrastructure. Philosophical Transactions of the Royal Society A: *Mathematical, Physical and Engineering Sciences*, 365(1851), 589–622. https://doi.org/10.1098/rsta.2006.1925

Carpinteri, A., Invernizzi, S., & Lacidogna, G. (2005). In situ damage assessment and nonlinear modelling of a historical masonry tower. *Engineering Structures.* https://doi.org/10.1016/j.engstruct.2004.11.001

Chen, W.H., Lu, Z.R., Lin, W., Chen, S.H., Ni, Y.Q., Xia, Y., Liao, W.Y. (2011). Theoretical and experimental modal analysis of the Guangzhou New TV Tower. *Engineering Structures*, 33(12), 3628-3646. https://doi.org/10.1016/j.engstruct.2011.07.028.

Costa, C., Arêde, A., Costa, A., Caetano, E., Cunha, Á., Magalhães, Filipe. (2015). Updating numerical models of masonry arch bridges by operational modal analysis. *International Journal of Architectural Heritage*, 9(7), 760-774, https://doi.org/10.1080/15583058.2013.850557

De Stefano, A., Matta, E., Clemente, P. (2016). Structural health monitoring of historical heritage in Italy: some relevant experiences, *Journal of Civil Structural Health Monitoring*, 6(1), 83-106. https://doi.org/10.1007/s13349-016-0154-y

Diaferio, M., Foti, D., Mongelli, M., Giannoccaro, N. I., & Andersen, P. (2011). *Operational modal analysis of a historic tower in Bari*. Conference Proceedings of the Society for Experimental Mechanics Series 4, 335–342. https://doi.org/10.1007/978-1-4419-9316-8_31

El-Shafie, A., Noureldin, A., McGaughey, D. (2012). Fast orthogonal search (FOS) versus fast Fourier transform (FFT) as spectral model estimations techniques applied for structural health monitoring (SHM). Structural and *Multidisciplinary Optimization*, 45, 503–513. https://doi.org/10.1007/s00158-011-0695-y

Feng, M. Q., Kim, J.-M., & Xue, H. (1998). Identification of a dynamic system using ambient vibration measurements. *Journal of Applied Mechanics,* 65(4), 1010. https://doi.org/10.1115/1.2791895

García-Macías, E., Ubertini, F. (2020). Automated operational modal analysis and ambient noise deconvolution interferometry for the full structural identification of historic towers: a case study of the Sciri Tower in Perugia, Italy. *Eng. Struct.*, 215. https://doi.org/10.1016/j.engstruct.2020.110615 110615

Ghandil, M., Dabanli, Ö., Riahi, H. T. (2021). An enhanced indirect video-based measurement procedure for dynamic structural system identification applications, Measurement, 182, 109759. https://doi.org/10.1016/j.measurement.2021.109759

Gentile, C., & Saisi, A. (2007). Ambient vibration testing of historic masonry towers for structural identification and damage assessment. *Construction and Building Materials.* https://doi.org/10.1016/j.conbuildmat.2006.01.007

Gentile, C., Saisi, A., and Cabboi A. (2015) Structural identification of a masonry tower based on operational modal analysis. *International Journal of Architectural Heritage*, 9(2), 98-110. https://doi.org/10.1080/15583058.2014.951792

Gunaydin, M. (2020). In situ dynamic investigation on the historic "Iskenderpasa" masonry mosque with non-destructive testing, *Smart Structures And Systems*, 26(1), 1-10. https://doi.org/10.12989/sss.2020.26.1.001

Kuban, D. (2007). *Osmanlı Mimarisi.* İstanbul: Yem Yayınları.

Lacanna, G., Ripepe, M., Marchetti, E., Coli, M., & Garzonio, C. A. (2016). Dynamic response of the Baptistery of San Giovanni in Florence, Italy, based on ambient vibration test. *Journal of Cultural Heritag*e, 20, 632–640. http://dx.doi.org/10.1016/j.culher.2016.02.007

Makoond, N., Pelà, L., Molins, C.,

Roca, P., & Alarcón, D. (2020). Automated data analysis for static structural health monitoring of masonry heritage structures. *Structural Control and Health Monitoring*. e2581. https://doi:10.1002/stc.2581

Moropoulou, A., Karoglou, M., Agapakis, I., Mouzakis, C., Asimakopoulos, S., Pantazis, G., & Lambrou, E. (2019). Structural health monitoring of the Holy Aedicule in Jerusalem. *Structural Control and Health Monitoring,* e2387. https://doi:10.1002/stc.2387

Pallarés, F. J., Betti, M., Bartoli, G., Pallarés, L. (2021). Structural health monitoring (SHM) and Nondestructive testing (NDT) of slender masonry structures: A practical review, *Construction and Building Materials,* 297, 123768, https://doi.org/10.1016/j.conbuildmat.2021.123768

Pieraccini, M., Dei, D., Betti, M., Bartoli, G., Tucci, G., & Guardini, N. (2014). Dynamic identification of historic masonry towers through an expeditious and no-contact approach: Application to the "Torre del Mangia" in Siena (Italy). J*ournal of Cultural Heritage,* 15(3), 275–282. https://doi.org/10.1016/j.culher.2013.07.006

Ramos L.F. and Aguilar R. (2007). *Dynamic Identification of St. Torcato's Church: Preliminary Tests*. Guimaraés, Portugal: University of Minho.

Ramos, L.F., Marques, L., Lourenco. P.B., de Roeck, G., Campo-Costa, A., Roque, J. (2010). Monitoring historical masonry structures with operational modal analysis: Two case studies. *Mechanical Systems and Signal Processing;* 24, 1291-1305.

Salvatore, R. and Eleonora, S. (2020). Damage assessment of Nepal heritage through ambient vibration analysis and visual inspection, *Structural Control and Health Monitoring,* e2493. https://doi.org/10.1002/stc.2493

Sav, M. (2012). *Çemberlitaş ve Nuruosmaniye Camii ile Çevresinin Arkeotopografyası.* Restorasyon Yıllığı, 5 (2012), 7-24.

Şafak E., Çaktı E., Kaya Y. (2010). Recent developments on structural health monitoring and data analyses. *Earthquake Engineering in Europe. Geotechnical, Geological, and Earthquake Engineering,* 17, 331-355. https://doi.org/10.1007/978-90-481-9544-2_14

Teza, G., Pesci, A., Trevisani, S. (2015). Multisensor surveys of tall historical buildings in high seismic hazard areas before and during a seismic sequence, J*ournal of Cultural Heritage,* 16(3), 255-266. https://doi.org/10.1016/j.culher.2014.06.008.

Xu, YL., and Zhan, S. (2001). Field measurements of Di Wang Tower during Typhoon York. *Journal of Wind Engineering and Industrial Aerodynamics,* 89(1), 73–93.

Zhou, X., Huang, P., Gu, M., Zhu, L., & Pan, H. (2010). Wind loads and wind-induced responses of Guangzhou New TV Tower. *Advances in Structural Engineering,* 13(4), 707–726. https://doi.org/10.1260/1369-4332.13.4.707

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Integration of the management theories for enhancing green marketing implementation in the construction industry

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Abstract

Environmental sustainability and environmental concerns have become growing issues in the field of marketing management. Furthermore, these concerns have become key factors of marketing activities in recent years. Green marketing has been a motivator drawing attention of researchers and companies to identify ways to implement sustainable strategies. Even if companies in different industries have started to focus on implementing green marketing mix and adopting green marketing strategies, there is a lack of green marketing focus in the construction industry.

This study aims to investigate integration of the management theories (i.e. Industrial Organization Theory, Attractive Quality Attributes Theory, Diffusion of the Innovation Theory, Business Network and Resource Advantage Theories) to the green marketing theory to enhance green marketing implementation in the construction industry. This paper underlines how management theories can be implemented to the product/construction/service supply chain ensuring better implementation of green marketing initiatives to B2B green marketing strategies and/or B2B companies' approaches. This research examines transformation of the green marketing to show conceptual changes in the definition of the green marketing concept and adopted green marketing strategies. This study can guide professionals and further studies, which can pave the way for enhancing implementation of green marketing in construction industry and green marketing research. This paper can contribute to the establishment of the sustainable built environment.

Keywords

Business-to-business green marketing, Construction supply chain, Green marketing mix, Green marketing strategy, Management theories.

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1. Introduction

Marketing has become an important part of the supply chain management that enables organizations to gain competitive advantage in competitive markets and maximize profits. It can enhance strategic management. Marketing can be defined as an organizational culture composed of core values and beliefs that lead to consumer-oriented operations and strategies (Deshpande and Webster, 1989). Marketing has been defined as a "set of market attitudes" that emphasizes a functional dimension and a strategic management tool that widely represents changes between companies and customers (Agueda et al., 2002). The inclusion of sustainability elements into marketing strategies led companies to sustainable marketing approaches and consumers to socially responsible purchasing behaviors in response to companies' green marketing mix tools and strategies (Leonidou et al., 2013). Therefore, this transformation led the AMA (American Marketing Association) to redefine the marketing concept. Marketing orientation has moved from the satisfaction of the organizations and individuals' objectives (definition of AMA in 1985) to the creation of the value-based customer relationships (definition of AMA in 2004). Therefore, there has been a clear shift from the transactional marketing to the relationship marketing (Sombultawee & Boon-itt, 2017; Popp & Woratschek, 2017), referring to the maintenance, development and establishment of relational change-based marketing activities (Popp & Woratschek, 2017). Lazer's social/societal orientation and efforts to define green marketing have affected the current marketing definition of AMA (2013), which focuses on the creation of value for the whole society enabling the repositioning and conceptualization of marketing.

The traditional marketing has been shifted to a more strategic and sustainable one, namely to the green marketing. Green marketing has been applied to different industries through their environmental consciousness and commitment to the sustainable development. Industries which have adopted green marketing strategy implementation to their strategic management processes, have benefitted from the industry specific green marketing activities which play significant roles in transition to the green circular economy in accordance with the definition of the UN Sustainable Development Goals (SDGs) number 12: "Ensure sustainable consumption and production patterns" (United Nations, 2020).

Integration of sustainability into the construction supply chain (CSC) can enable and support establishment of the sustainable built environment. Furthermore, green marketing integrated to the construction supply chain management (CSCM) can support the creation of environment-friendly corporate values (Leonidou et al., 2013) and enable the establishment of green CSCM. There is, however, a lack of green marketing focus in the CSCM in the literature (Tuz & Sertyesilışık, 2020).

Green marketing focuses on sustainable marketing management that can enhance not only the environmental but also the economic and social performance of companies. Focusing on ascertaining the needs and expectations, green marketing can encourage companies to strategize based on consumers' current and future needs, competitors' actions, and environmental regulations (Kumar & Ghodeswar, 2015). Environment-oriented and eco-friendly green marketing strategies can enhance companies' financial performance and competitive advantage in the market (Kumar & Ghodeswar, 2015; Sharma et al., 2010). Green marketing strategies cover all stages including production to post-production with the aim of balancing the profit while protecting the environment (Hasan & Ali, 2015). Therefore, environmentally oriented and environment-friendly green marketing becomes an important management tool in CSCM. Business-to-Business (B2B) green marketing initiatives that create green value during operational phases / processes can improve green marketing practices in the construction industry by providing input for Business to Customer (B2C) green marketing practices.

This study aims to investigate integration of management theories to the green marketing theory to enhance green marketing implementation in the construction industry. This study an-

swers the following research question: How can management theories be integrated to the green marketing theory so that green marketing implementation in the construction industry can be enhanced? This study examines how a construction company can improve its green marketing capabilities. Tertiary review which provides a comprehensive assessment of the state of the knowledge (Martins & Pato, 2019) has been used. The method has been conducted to reveal strategic applications and models / frameworks in researched subjects and provide a classification framework. The results contribute to the green marketing and management theories literature and provide a better understanding of the green marketing with respect to management theories implementation.

This study shows how green marketing has been transformed throughout the years. This study focuses on different managerial theories to describe effective green marketing practice in construction industry. In the first step, this study focuses on the conceptualization of the market structure of construction industry, thereby investigating the Industrial Organization Theory (IOT) and the contingency theory. Since a company can be a stakeholder of a CSC or create its own supply chain in the construction industry, this study focuses on the configuration of a green CSC. In the second step, depending on the position of stakeholders in CSCM, this study discusses the product/construction/service lifecycle, attractive quality attributes theory (AQAT), the diffusion of the innovation theory (DIT) as well as leanness and agility. Moreover, this study focuses on the B2B green marketing practice in terms of the business network and resource advantage theories among companies in the CSC. Furthermore, this study examines the internal green marketing practice of the company operating in the construction industry based on the total quality management principles (TQM).

2. Green marketing

The literature has witnessed the deep roots of green marketing focused on environmental sustainability. The environment was brought to the agenda as a modernist research problem first in business industry in 1962 with the effects of publication of Rachel Carson's book entitled as "The Silent Spring", which pointed out the birth of the modern environmental activism (Kilbourne & Beckmann, 1998; Leonidou & Leonidou, 2011). The environmental footprint of human activities on environment cause adverse consequences on economic activities. From this point of view, the environmental deterioration was defined as a problem, which required an immediate action. The marketing discipline, however, had not paid attention to the environmental deterioration in those years (Kilbourne & Beckmann, 1998; Leonidou & Leonidou, 2011).

The deep roots of green marketing appeared in 1969 with Lazer's initiatives, who introduced green marketing as the social/societal dimension of the marketing. The author highlighted the adverse effects of the traditional marketing on natural resources and pointed out need for taking urgent actions to make traditional marketing greener (Kumar, 2016; Kumar & Ghodeswar, 2015). Green marketing first appeared in the 1970s with the AMA's first workshop organization about marketing and environment, which resulted in one of the first books, entitled as "Ecological Marketing" (Simão & Lisboa 2017; Zhu & Sarkis, 2016). Conceptually, Fisk (1974) introduced the ecological green marketing concept as: "Focusing on the acknowledgement of an impending ecological crisis and the willingness and ability of marketers to assume responsibility for avoiding this doom". Hennion and Kinnear (1976), on the other hand, redefined the green marketing concept as: "*Ecological marketing* is concerned with all marketing activities (a) that have served to help cause environmental problems and (b) that may serve to provide a remedy for environmental problems" (Kumar et al., 2012; Dangelico & Vocalelli, 2017).

Companies' profit-maximization-oriented operations had adverse consequences on the environment before the 1970s, leading to the depletion of natural resources and environmental degradation. In the early 1970s, these adverse consequences gave rise to draw

Table 1. *Green marketing stages.*

	Ecological Green Marketing	Environmental Green Marketing	Sustainable Green Marketing
Timeline	Early 1970s	End of 1980s	Late 1990s
Characterstic(s)	A limited tool on tap of traditional marketing	Socio-environmental performance Global recognition of environmental problems Clean technology usage	Socio-environmental performance Global recognition of environmental problems Clean technology usage Sustainable supply chain management
Main Concern(s)	Manufacturing inputs Technology usage	Innovative production Clean technology usage from the sustainability perspective	Ecological conservation Pursuit of sustainability
Action(s)	End of pipe laws Command and control	Innovative and technological solutions instead of legal and public pressure centered solutions	Customer involvement Costumer orientation
Environmental Concern(s)	Pollution Energy consumption	Pollution Energy consumption Ecosystem destruction Minimization of involuntary harms occurring in the supply chain of production	Natural environment sustainability Social environment sustainability Sustainable customer relationship
Applied to	End of the production	Through supply chain	Through supply chain and customer relations

attention to the environment as well as to the relationship between humans and environment (Leonidou & Leonidou, 2011). Furthermore, they pointed out the impact of marketing on the environment (Kilbourne & Beckmann, 1998). Marketing was reconsidered from the environment perspective, where the environmental concerns and the consumer behavior relations were addressed (Kilbourne & Beckmann, 1998). In the early 1980s, conservation of energy and legislation initiatives were the determinants of the marketing movement whereas development of the link between environmentally responsible behavior and the environmental attitudes at the individual level remained inconclusive (Kilbourne & Beckmann, 1998). In the early 1990s, an increasing focus was placed on environmental studies in marketing as companies began to establish a prestigious and profitable strategy on environmentalism and sustainable development (Kumar, 2016, Leonidou & Leonidou, 2011). Associated with the expansion of marketing focus on environmental beliefs and values in the mid-1990s (Kilbourne & Beckmann, 1998), cooperation environmentalism has become the focal point in terms of the marketing strategy perspective (Kumar, 2016). Environmental problems created potential opportunities in the early 2000s (Leonidou & Leonidou, 2011), which suggested understanding of the green marketing dynamics and achieving effective performance by strategizing environmental priority at the business and functional levels (Kumar, 2016). More effective frameworks and elements of the green marketing mix have become the drivers for investigation from the managerial perspectives in the literature recently (Kumar, 2016). Table 1 summarizes the three staged green marketing concept transformation throughout the years. Green marketing was initially described as a limited tool of the traditional marketing (Peattie, 2001) with the focus on the final product from the B2C green marketing perspective. In the successive stage, however, focusing on environmental issues and reshaping supply chain management (SCM) from the B2B green marketing perspective have become the main goals. Furthermore, establishment of sustainable customer relations and involvement of customers in SCM have enhanced B2B company's integration of green marketing initiatives into the green marketing strategies.

As green marketing has shifted its focus throughout the time, definitions of the green marketing concept have been varied through the timeline starting from 1969. Table 2 provides the definitions of the green marketing concept from the starting point to the most recent one. Starting from the greening traditional marketing, green marketing definitions include environmental issues and environmental protection. The definitions do not only meet the needs of customers through B2C green marketing with environment-friendly products/services, but also include sustainable SCM that requires green B2B marketing.

2.1 Green marketing strategy

Environment-oriented green marketing includes a combination of short-term demands from the social perspective and long-term well-being of consumers (Hemantha, 2012). Green marketing adopts marketing decisions and strategies that focus on the determination of the needs and expectations, meeting the specified needs, profitably and sustainability (Chan, 2013; Kumar & Ghodeswar, 2015). Green marketing strategies cover all stages including production to postproduction with the aim of balancing the profit while protecting the environment (Hasan & Ali, 2015). There have been many attempts to introduce different green marketing strategies as summarized in Table 3.

Table 2. *Green marketing definitions.*

Author(s)	Main Concern/Focus	Defined Name
Lazer (1969)	Social/societal dimension of marketing Greening the viewpoints of traditional marketing	GM
Fisk (1974)	Ecological crisis	Ecological Marketing
Henion and Kinnear (1976)	Environmental problems	Ecological Marketing
Charter (1992)	Human and/or natural environment well-being	GM
Ottmann (1993); Pride and Ferrell (1993); Herbig et al. (1993)	Environmental friendliness of products	GM
Mintu and Lozada (1993)	Physical environment protection and conservation	GM
Polonsky (1994)	Satisfying human needs with minimum deterioration on environment	GM
Lampe and Gazda (1995)	Reduction in environmental effects of products and services	GM
Dom and Apeldoorn (1996)	Environmentally friendly corporate performance	GM
Menon and Menon (1997); Kilbourne (1998)	Implementing entrepreneurial and environmentally beneficial marketing	Envriopreneurial marketing
Menon et al. (1999)	Natural environment concern in beneficial marketing activities	GM
Charter and Polonsky (1999)	Environmental performance promotion of products	GM
Fuller (1999)	Compatibility of marketing activities with eco-systems	Sustainable Marketing
Peattie (1995); Welford (2000)	Sustainable identification, anticipation and satisfaction of customer needs	GM
Xia-Di and Tie-Jun (2000)	Green consumption	GM
Peattie (2001)	Reduction in negative impacts of products and services socially and environmentally	GM
Prakash (2002)	Employment of environmental claims	GM
Jain and Kaur (2004)	Ecological interests of the society	GM
Shamsuddoka (2005)	Modification of traditional marketing activities	GM
Dibb et al. (2005)	Utilization of traditional marketing mix with environmental concern	GM
Prosenak et al. (2008)	Well-being of society	GM
Pride and Ferrell (2008)	Lean production	GM
Kotler and Amstrong (2009)	Sustainable development	GM
Chang and Fong (2010) Sharma et al. (2010) Lecren and Ozanne (2011)	Developing competitive advantage and customer loyalty	GM
Polonsky (2011)	Environmental protection through marketing mix	GM
Kimoti (2011)	Environment friendly products	GM
Domingos and Sakal (2008) Hemantha (2012) Murin et al. (2015)	Environment-oriented marketing	GM
Stainer and Stainer (1997); Lu et al.(2013)	Environment and mission-focused business operations	GM
Chan (2013)	Sustainable identification, anticipation and satisfaction of customer needs	GM
Akenji (2014);Maniatis (2015); Yang et al. (2015)	Sustainable business development	GM
Solamian et al. (2015)	Environmental protection through marketing mix	GM
Kumar and Ghodeswar (2015)	Sustainable development	GM
Yadev and Pathak (2015)	Lean and green production and marketing	GM
AMA	Environmentally safe production, ecologically concerned marketing mix tools	GM
GM : Green Marketing		

Table 3. *Green marketing strategies.*

Authors	Strategies	Model / Framework	
King (1985)	Marketing failures	Categorization	Thrust marketing Accountant's marketing Marketing department marketing Formula marketing
Varadarajan and Menon (1988)	Cause related marketing strategies	Framework	Strategic Quasi-strategic Tactical
McDaniel and Rylander (1993)	Strategic green marketing process	Strategic green planning model	10-point plan
Jose (1996)	Environment-strategy matrix	Matrix (9 cells)	Market attractiveness Environmental attractiveness
Hutchinson (1996)	Green marketing strategy	Framework	Companies' responsibilities such as social, economic, resource usage, and ecology for sustainable society
Menon and Menon (1997)	Envirepreneural marketing strategies	Framework	Strategic envirepreneural marketing Quasi-strategic envirepreneural marketing Tactical envirepreneural marketing
Banerjee (2002)	Corporate environmentalism	Environmental orientation Environmental strategy focus	The corporate strategy The business/functional strategy
Ginsberg and Bloom (2004)	Green marketing strategy	Matrix	The lean green strategy The defensive green strategy The shaded green strategy The extreme green strategy
Papadas et al. (2017)	Green marketing orientation	Dimensions	Strategic green marketing Tactical green marketing Internal green marketing

Table 4. *Green marketing mix.*

Author	Green Marketing Mix	Criteria
Solaiman et al. (2015); Zhu and Sarkis (2016); Dangelico and Vocalelli (2017); Hosseinzadeh and Azizpour (2013); Abrazi et al. (2013); Dawari and Strutton (2014); Kordshouli et al. (2015); Padhy and Vishnoi (2015); Leonidou et al. (2013a); Lampe and Gazda (1995)	4Ps	Product, Price, Promotion, Place,
Kinoti (2011)	5 Marketing Mix Elements	Green Based Product, Green Logistics, Green promotion, Green Pricing, Green Consumption
Kumar and Ghodeswar (2015)	4 Marketing Mix Elements	Green Product, Green Advertising, Green Communication, Green Consumer Engagement
Kumar (2016)	4 Marketing Mix Elements	Green Product, Green Promotion, Green Retailing and Distribution, Other Functions (Branding, Positioning, International Marketing)
Shamsuddoha (2005)	External (7Ps) and Internal (7Ps) Green Ps	Internal Green Ps: Product, Price, Promotion, Place, Process, Providing Information, Policies External Green Ps: Paying Customers, Providers, Politicians, Problems, Pressure Groups, Predictions, Partners
Simão and Lisboa (2017)	8 Marketing Mix Elements	Green Product Development, Green Price Fixing, Green Positioning, Green Logistics, Green Communication, Green Partnership Development, Adequate Residual Marketing Management
Liu et al. (2012)	6Ps	Product, Promotion, Planning, Process, People, Project
Hasan and Ali (2015)	2 Marketing Mix Elements	Green Innovation, Green Promotion
Marthur and Marthur (2000)	4 Marketing Mix Elements	Green Product, Recycling, Green Promotions, Appointments of Environmental Policy Managers
Leonidou et al. (2013)	7 Marketing Mix Elements	Product/Service, Price, Promotion, Distribution, People, Process, Atmosphere
Polonsky and Rosenberger (2001)	8 Marketing Mix Elements	Targeting, Design, Pricing, Positioning, Logistics, Promotion, Marketing Waste, Green Alliances
Violeta and Gherorghe (2009)	5Ps + EE	Product, Process, Planning, People, Promotion, Eco-Efficiency
Pomering (2017)	10Ps	Product, Price, Promotion, Place, Participants, Physical Evidence, Process, Principles, Promise, Partnership

As seen in Table 3, there are many different green marketing strategies that companies can implement to meet the needs and demands of environmentally conscious customers through design and development of green products (Porter, 1991), environment-oriented advertisement (Kangun et al., 1991), minimization of the environmental damage in product transportation (Solaiman et al., 2015), greening the production process that provides resource efficiency and differentiation by offering new products with green benefits (Polonsky & Rosenberg, 2001). Thus, green marketing strategies can contribute to customer loyalty, financial performance, improvement of market position and creation of competitive advantage.

2.2 Green marketing mix

Marketing mix differentiates with respect to meanings and acts upon the companies' operational areas as bringing product and/or services. The traditional marketing mix (4Ps) represents product, place, promotion, and price (Abzari et al., 2013), while the extended marketing mix for service industry (7Ps) adds people, physical evidence, and process to the traditional marketing mix (Dangelico & Vocalelli,2017). Transformation of the marketing mix into the green marketing concept is needed to respond to environmental issues (Eneizan et al., 2016). Due to the fact that green marketing has become crucial in the marketing literature, researchers have attempted to transform the marketing mix into the green marketing mix throughout the years.

Despite the well understood green marketing philosophy, green strategies and implementation, majority of the attempts regarding greening marketing mix rely on the transformation of the traditional marketing mix (4Ps). The extant researches in this field (e.g. Abzari et al., 2013; Dangelico & Vocalelli, 2017; Leonidou et al., 2013; Solaiman et al., 2015; Zhu and Sarkis, 2016) have solely analyzed transformation of traditional elements of the marketing mix into the green marketing mix elements, which can be listed as green product, price, promotion, and green place (distribution).

Table 4 summarizes the characterization of the green marketing mix and presents the elements of the green marketing mix in the literature. Many attempts occurred throughout the years to transform the marketing mix into the green marketing mix. The majority of them (e.g. Solaiman et al. 2015; Zhu and Sarkis, 2016; Dangelico & Vocalelli, 2017) used the traditional marketing mix (4Ps) as the green marketing mix, while the remaining (e.g. Kumar & Ghodeswar, 2015; Simão & Lisboa, 2017) attempted to try to modify and add some new elements. A little attempt (e.g. Leonidou et al. 2013) tried to transform, modify, and/

or enhance the extended marketing mix (7Ps) for service industry from the green marketing perspective. Construction industry is a service industry. SCM in the construction industry is different from other industries especially due to its project-based restructuring, the participation of different stakeholders in the CSCM processes (Li & Wang, 2016), differentiation in managerial practices at every stage due to the differentiation in contract types. Ensuring the integration of sustainability factors [e.g. environmental quality (planet), social justice (people) and economic well-being (profit) (Kumar et al., 2012)] green marketing plays an important role in CPM. In line with the 17th goal definition of the UN SDGs: "Partnership for Goals" (United Nations, 2020), B2B green marketing strategies can improve CSCM processes where the output of each stage becomes the input to the successive stage.

3. Theoretical background

3.1 Green marketing, the IOT and the contingency theory

IOT focuses on the market structure in which industry-based operations are carried out. The theory conceptualizes the market structure and focuses on the industry-related market functions rather than evaluating organizational operations (Tirole, 1988). Therefore, IOT examines industry-specific market conditions and aims to emphasize the impact of the market structure on companies' strategic management process (Porter, 1981). Structure-Conduct-Performance paradigm (SCP) is considered as a pillar of IOT and provides the linkage between the companies' green operations and market structure (Ramsay, 2001). Figure 1 represents the construction industry through Structure-Conduct-Performance paradigm (SCP) based on IOT.

Construction industry, which plays an important role in the countries' economies as the locomotive industry, becomes attractive for companies and intensifies competition within the industry. Therefore, the diverse stakeholder-intensive construction industry provides a structure that expresses market dynamics (e.g. green market environment, green market environment, market intensity) that enable stakeholders in the industry to proactively focus on more advantageous strategies to differentiate in the construction market (Tuz & Sertyesilışık, 2020). The uniqueness and project-oriented features of the construction industry require the participation of different stakeholders in CSCM with its B2B marketing relations. Conduct is concerned with strategic management of construction companies in terms of B2B green marketing strategy and green production process (Ramsay, 2001). In order for construction companies to take part in supply chains that differ according to the changing market dynamics within the industry, construction companies need to differentiate in the market with their performances that explain to what extent their green goals meet customer expectations (Wirth & Bloch, 1995). Basically, IOT focuses on external factors that determine and guide the green marketing direction of construction companies (Aziz et al., 2018). Therefore, a bidirectional green interaction occurs; while external factors put pressure on construction firms' green strategic management (the structure), companies' green strategies (the conducts) become the determinants of the social, economic and environmental performance of the industry (the performance) (Aziz et al., 2018). IOT posits the bidirectional green interactions that the construction industry-specific market drivers enhance green scope of the industry, while encouraging the construction companies to green their

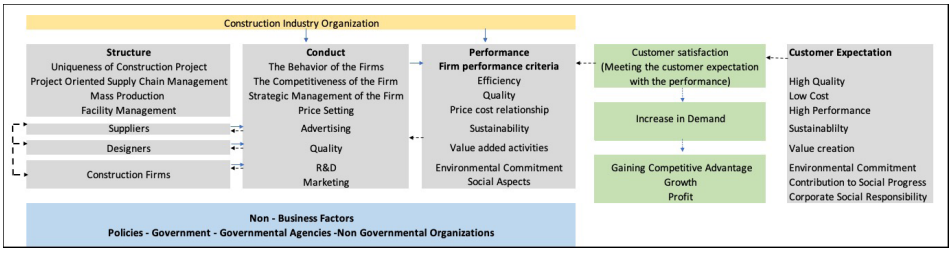

Figure 1. *Structure-Conduct-Performance paradigm (SCP) based on IOT.*

operations and their strategic management decision process. Furthermore, the contingency theory emphasizes that the most suitable structure for effective company management does not exist and that internal and external factors are the determinants of the organization's actions (Aziz et al., 2018). In other words, effective strategic management is situational and depends on changes in the market environment in which the organization operates (Omran & El-Galfy, 2014). Therefore, construction industry-related external factors can be considered as constraints and opportunities affecting the strategic management of the construction companies (Omran & El-Galfy, 2014).

IOT and contingency theory emphasize the importance of identifying construction industry-based external factors that directly affect B2B green marketing implementation. Furthermore, the evaluation of opportunities and constraints provided by construction industry, especially with the differentiation in CSCM, can be an opportunity to identify appropriate B2B green marketing strategies with respect to the green marketing mix and green approaches.

Companies focus on how to gain sustainable competitive advantage in their industries through their operations. Sustainable competitive advantage has external and internal features (Zhang & London, 2013): the first represents internal capabilities, while the second depends on the market environment. The continuously changing characteristics of the market condition necessitates construction companies to analyze the structure of the construction industry to gain the sustainable competitive advantage in the market (Zhang & London, 2013). Sustainability performance of the companies in the construction industry starts to act as one of the main competitive advantage in the changing requirements of the global market. Construction industry can benchmark from the International manufacturing network (IMN) which provides a sustainable strategic decision-making process affected by a range of factors such as the governmental green policy and green regulations, the sustainable market structure, the elasticity and homogeneity of green demand, and the changes in the green expectations of customers (Mishra et al., 2019). IMN provides sequential steps to give a strategic decision-making process for the companies as: identification of the factor(s); PESTLE-SWOT Analysis; and Analytical Hierarchy Process (Mishra et al., 2019). Adaptation of these steps into strategic management process can enhance the green performance of construction companies. Furthermore, it is important to evaluate industry-specific external features to gain sustainable competitive advantage. The International Sustainable Industrial Competitiveness Model (ISIC Model), which extends Porter's diamond model in a sustainable manner, consists of the following eight determinants: green factors; green demand; green strategy; green structure and competition of firms; green relevant and supportive industries; green constraints of government; luck and sustainable development (Zhang and London, 2013). The analysis of the industry-specific market structure with its sustainability-oriented ISIC model can enable construction companies to evaluate green marketing strategies, orientations and mix tools to achieve sustainable competitive advantage (Zhang & London, 2013).

3.2 Green marketing, AQAT, product life cycle, the diffusion of innovation theory as well as lean and agility principles

The supply chain, which differs on industry basis, is structured by the participation/selection of the most appropriate companies to meet the green demand of the customers. The supply chain has a feature that can be differentiated and improved in terms of size and configuration according to the coordination and control mechanism structure of the relevant industry (MacCarthy et al., 2016). The supply chain is assumed to stem from the economic concerns of the activities carried out in the relevant industry and there are several determinants that can affect the conceptualization and structure of the supply chain (e.g. sustainability, technology, foreign market factors (such as political factors and regulators) (MacCarthy et al., 2016). Therefore, adding technological

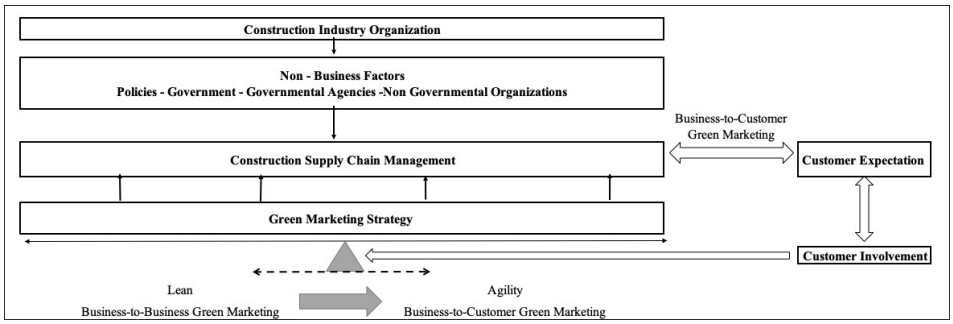

Figure 2. *Green supply chain management based on lean and agility (Adopted from Naim et al., 1999, enhanced by the authors).*

and strategic factors to the three pillars of sustainability (i.e. economic, environmental and social factors), can provide potential selection criteria for eligible companies that can participate in the supply chain.

We argue that the supply chain in the construction industry aims to meet green customer expectations and that from the B2B relationship perspective, construction companies proactively restructure their business networks, operations, and marketing strategies to add value to their operations. Therefore, in this study, the CSC refers to the business networks where a green circular economy is created while minimizing the degradation of nature and meeting the diversified needs of the society through the use of appropriate green technology.

As supply chains are structured to meet customer expectations from the B2C perspective, it is important to define the expectations of the customers from the products/construction/services that have produced/constructed/provided as a result of the supply chain activities. We argue that as the CSC consists of upstream and downstream activities, and as CSC should aim to produce the right product/construction/service in the right place, on time based on the specifications in downstream activities, CSC should give a quick respond to meet the ever-changing customer expectations in upstream activities and that B2B green marketing strategies play an important role in structuring the CSC.

Lean management can support the CSC process to be green based on B2B green marketing networks, while agility can allow the CSC to adapt to changing market conditions from the B2C green marketing perspective. Therefore, focusing on leanness and agility as a strategic green marketing tool in CSCM is important for creating value for customers. Agility refers to the configuration of a dynamic business network integration which can enable the supply chain to respond to rapid changes in expectations of customers (Carvalho et al., 2011). Furthermore, lean management embraces all supply chain processes with respect to product life cycle and focuses on minimization of waste in production to achieve low cost, high quality, the most efficient and value created product/service (Carvalho et al., 2011). In this study, the strategic green marketing orientation is adapted from the work of Chahal et al. (2014). Figure 2 presents a CSC where stakeholders can strategically involve and operate in B2B relationships to meet customer expectations from the B2C perspective. Passive greening focuses on meeting basic needs in environmental issues (e.g. regulations, policies) while mutual greening is about the implementation of green initiatives for the product/service that provides an incremental change (Chahal et al., 2014). Diversification in target segments in construction projects is the main concern of niche marketing, whereas collaborative greening refers to the collaboration of the passive, mutual and niche greening approaches (Chahal et al., 2014).

It is important to determine the target segmentation for the configuration of the supply chain in the construction industry. IOT and the Contingency Theory can provide construction industry-based analysis of the green market environment. In addition to these analyses, the selection of target segmentation can reveal the extent to which the CSC should include green initiatives

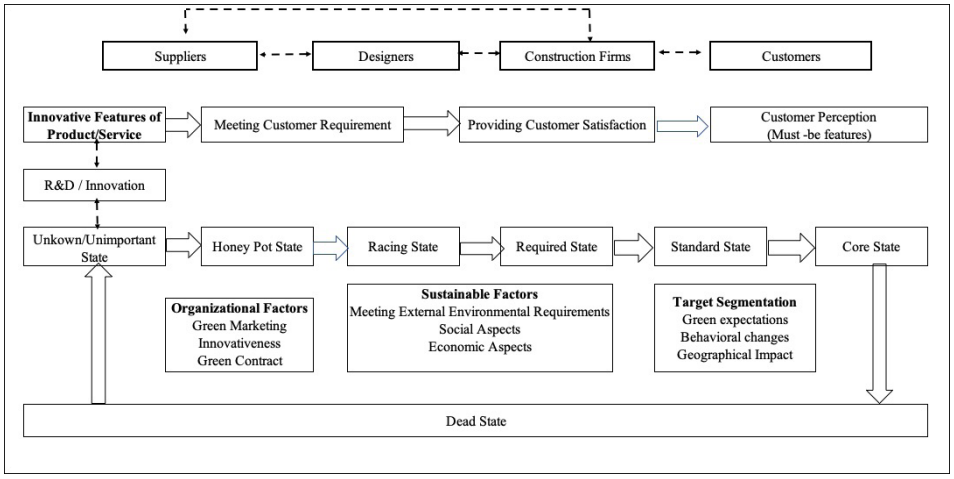

Figure 3. *Product life cycle based on AQAT (Adopted from Batarfi et al., 2017 and enhanced by the authors).*

that can affect overall green performance. CSC stakeholders can adopt different green marketing strategies according to the size of target market of the supply chain. While the lean green strategy can enable stakeholders to gain low-cost competitive advantage based on low-cost production and increase efficiency through environmental performance, stakeholders focusing on long-term green investments in terms of green innovative satisfying products/services can emphasize their green differentiation capabilities with the adoption of the shady green strategy (Ginsberg & Boom, 2004). Furthermore, the stakeholders can adopt extreme green strategy that benefits from greenness and integrates environmental issues into all stages of product life cycle and strategic management process (Ginsberg & Boom, 2004).

The AQAT and the Kano model focus on the assessment of customer needs and suggest the classification of customer requirements in terms of the dynamic characteristics of product/construction/service throughout the life cycle. According to these theories, Batarfi et al. (2017) classified the customer needs into the 5 different subgroups as: attractive, one-dimensional, must-have, indifferent and inverted. Thölke et al. (2001) stated that the competitiveness of the industrial market may cause changes in customer expectations therefore described 4 different situations as: feature innovation, budding features, slowing features, and standard features according to the position of the feature in the life cycle process. In this current study, the Batarfi et al. (2017)'s study that considers the direct and indirect factors on the state of a feature is taken into consideration. As it is seen in the Figure 3, the offered attributes of a product/service/technology provided by different stakeholders (e.g. suppliers, designers, construction firms) in the CSC can vary throughout the product life cycle (e.g. transforming from attractive to a must-be feature) due to the perception shifts of customers and the market (Batarfi et al. 2017). Moreover, the status of the feature of any product/service/technology varies with the prevalence in the construction industry-specific market and can differ over time. Even if the features of the product/construction/service that meet the customer requirements provide customer satisfaction, change in the perception of the customer may lead to the evaluation of the product features in different statuses. Since both B2B and B2C customer expectation is one of the determinants of feature changes of products/services, it is important to respond to these changes from the strategic management perspective in the CSC (Batarfi et al. 2017).

Diffusion of the Innovation Theory (DIT) stresses the adoption of technological innovation by the organizations, which consists of significant characteristics namely relative advantage, observability, compatibility, complexity and trialability. The characteristics also refer to the unknown/

unimportant state of the life cycle in which the adoption of R&D and innovation continues (Vaccaro, 2009). The stakeholders can get relative advantage through adoption of innovation when the existing features of the product/service/technology do not adequately meet the green expectations of customers continues. Observability can provide stakeholders establishing B2B green relations that consist of the provision of communicating the beneficial features, while compatibility, from the B2B and B2C perspectives, can enhance the coherence between the green expectations and the provided features (Vaccaro, 2009). As complexity and trialability depend on the customer satisfaction, DIT, in terms of the green marketing, shows the relationship between the CSC and green innovation to create value for the end customer (Vaccaro, 2009).

Proactive/reactive B2B green marketing strategies can provide a focus on B2B green marketing based on continuity of innovation. Reactive green marketing strategies focus on small changes on the existing product/service, which do not cause any customer's behavioral changes (MacCarthy et al., 2016). The stakeholders can adopt proactive B2B green marketing strategies that relate to high environmental commitment and are based on the radical environmental benefits throughout the CSC where the external factors (e.g. environmental regulatory and policies) are met. While providing differentiation and competitive advantage in the market, proactive B2B green marketing strategies can increase brand value and customer loyalty in the industry (MacCarthy et al., 2016). Therefore, the adoption of proactive B2B green marketing strategies by companies in the construction industry can lead to an increase in brand value and customer loyalty.

3.3 Green marketing, the business network theory and the resource advantage theory

Understanding the external factors associated with the construction industry can provide an assessment of constraints and opportunities as the first step in determining appropriate green marketing strategies. Green marketing encourages companies to develop strategies on the current and future needs of consumers to create higher value (Kumar & Godeshwar,2015), while encouraging companies to continuous learning from competitors and build green networks (Sombultawee & Boon-itt, 2017). Industrial Marketing and Purchasing (IMP) research mainly emphasizes that the industry includes different types of organizations (Lavissière et al., 2019; Bondeli et al., 2018). Furthermore, the IMP centralizes business networks between different organizations in a particular industry to analyze transactions between organizations (Lavissière et al., 2019). The industrial business network has been widely defined as consisting of a wide variety of organizations with direct dynamic business network affected by external market driven factors (Bondeli et al., 2018).

The supply chain enhances B2B green marketing where companies can operate, communicate and collaborate sustainably. It is important for companies to define internal business networks that are effective in establishing B2B networks in the industry (Welch & Wilkinson, 2002). The ARA model basically conceptualizes an industry's business network and frames a triple concept that depicts the industrial business network in three layers, as actors, actions and resources (Lenney & Easton, 2009) where actors represent the stakeholders taking part in the CSCM that interact with others in terms of B2B relationships, while resources refer to the support of tangible and/or intangible resources for stakeholders' B2B relationship orientation (Lavissière et al., 2019), whereas activities refer to the operations/work break down structures performed between the stakeholders through the B2B relationship (Lavissière et al., 2020; Welch & Wilkinson, 2002).

As companies in the construction industry encounter challenges in meeting the expectations of customers, we argue that the effects of environment-concern on customers' expectations can enable construction companies to focus on differentiation in the construction market orientations positioning themselves as green companies and that construction companies are trying to strategically connect with other market players in the construction industry in terms

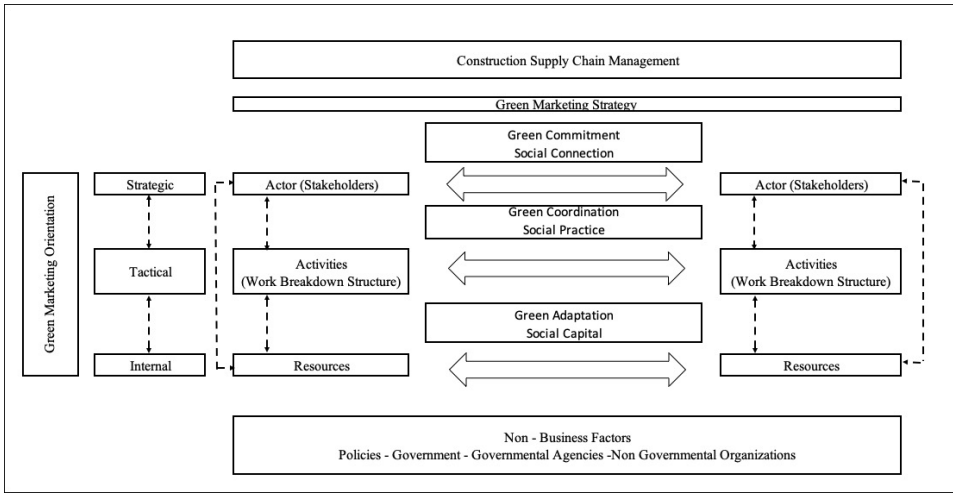

Figure 4. *Green B2B marketing in a supply chain management based on business network theory and Resource Advantage Theory (Adopted from Bondeli et al., 2018, enhanced by the authors).*

of green B2B relationships to create a green CSCM and/or become a stakeholder in a green supply chain.

The Figure 4 conceptualizes green B2B marketing relationships in CSCM. The strategic green marketing orientation focuses on environmental strategies that enable actors (stakeholders) to develop both corporate and proactive green marketing strategies (Papadas et al., 2017). Strategic green marketing orientation can improve the interaction, cooperation and partnership of actors with other organizations (Lavissière et al., 2019). Therefore, green marketing can enable and support existence of a mutual green commitment between the stakeholders who prioritize linking the green activities and green resource allocation while the strategic green corporate strategy can lead stakeholders to expand their position in the construction market (Bondeli et al., 2018). Furthermore, the adoption of strategic green orientation at the actor level can respond to the effects of non-business actors on market orientation, while protecting the environment and social stakeholders (Papadas et al., 2017). Strategic green marketing orientation does not only focus on mutual relationship from the economic perspective, but also improves social connections between actors that determine mutual green recognition (Bondeli et al., 2018). The tactical green orientation focuses on activity-based decisions to respond to the environmental degradation (Papadas et al., 2017). While green marketing spreads from the consumer-centered to the business-centered marketing, determination of the green marketing mix related to the green characterization of the product/service in CSC activities can enable actors to benefit from the environmental protection and convey the environmental benefits to customers (Papadas et al., 2017). Furthermore, the activity can provide green mutual coordination that can enhance interdependence among stakeholders and social connections between stakeholders based on social practices created in the activity layer of the ARA (Bondeli et al., 2018). At the activity level, tactical green orientation can strengthen the social dimensions of mutual green activities where the B2B green marketing mix can improve business networks and implementation of green marketing initiatives (Bondeli et al., 2018). Therefore, the green marketing mix implementation can provide stakeholders to ensure the improvement in the CSCM (Zhu & Sarkis, 2016).

The internal green orientation, which reflects on the sustainable resources of companies, plays an important role in structuring a supply chain suitable for B2B relations, increasing sustainable performance and creating value. The resource advantage theory argues that the value of a resource can be defined in terms of its potential to create value for the customer (Green et al., 2015). Resources including business relations between stakeholders in a CSC can provide effective products/services and

enable stakeholders to differentiate in the construction industry (Green et al., 2015). The internal green marketing orientation focuses on the stakeholders' environmental value-oriented organizational culture and reflects on their corporate vision and contribution of resources to environmental management strategies that should shed light on the supply chain processes (Papadas et al., 2017). The involvement of internal green marketing oriented stakeholders in the CSCM can contribute to improving the environmental management of related construction projects. Since a stakeholder's business network has become a resource itself, internal adaptation of green marketing initiatives and reflection on B2B green marketing can create a social capital that can contribute to stakeholder's economic performance and creation of the circular green economy (Green et al., 2015).

3.4 Green marketing, the natural resource based view and total quality management

Integration of green marketing into a supply chain can increase the environmental sustainability of the relevant product/construction/service. We argue that the green product/construction/service that provides B2C focused green marketing initiatives is improved due to the green value creation of the B2B green relations of stakeholders in operational stages. B2B green marketing implementations have been examined from the Natural Resource Based View, where the organizational resources become a driver for environmental commitment and where B2B green marketing strategies have been classified based on their process and marketing orientation (Fraj et al., 2013). Another study that examined the ways to spread and enhance sustainable initiatives in the operations of B2B companies, have focused on the value creation in the supply chain where the stakeholders can communicate and sustainably perform relevant operations (Blenkhorn & MacKenzie, 2017). The results of the studies (Blenkhorn & MacKenzie, 2017; Fraj et al., 2013) show that the green marketing (through the individual supply chain) of B2B companies' operations needs to implement strategic management tools targeting individual corporate commitment to environmental issues and that the need to externalize these green efforts to communicate with other B2B companies (or stakeholders) in a production supply chain through B2B green marketing tools.

There is an important relationship between TQM and marketing. TQM is a management system having potential to enhance the individual and organizational performance in terms of the traditional marketing (Abbas, 2020). From the relationship marketing perspective, TQM focuses on monitoring the market and demand changes and TQM relies on enhancing customer satisfaction, delivering value to customers and managing customer relations through high qualified product/service (Almahamid & Qasrawi, 2017). Furthermore, from the sustainable development point of view, TQM aims waste minimization through efficient resource usage (Yusr et al., 2017), implements continuous improvement (employee training, progress development) in all stages of CSC processes and develops environment-friendly competitive and technological product/service just-in-time with minimum cost (Shafiq et al., 2017). TQM, which is linked to the environmental management (Siva et al., 2016), can enhance green CSCM while improving the stakeholder's environment-concerned innovative capabilities and performances to innovate and produce green product/service to meet customers' green satisfaction (Abbas, 2020; Almahamid & Qasrawi, 2017). Operating based on the successive customer perspective (Van Donk et al., 2010), TQM's internal customer-oriented approach intersects with product/service CSCM in providing green value to the end customer (Abbas, 2020). Transforming the inputs to green output for the successive internal customer in the CSC represents the B2B interaction among internal companies from the B2C perspective. Thus, implementing internal B2C green marketing in any supply chain of a product/construction/service can provide implementation of green marketing initiatives to the B2B green marketing strategies and/or approaches.

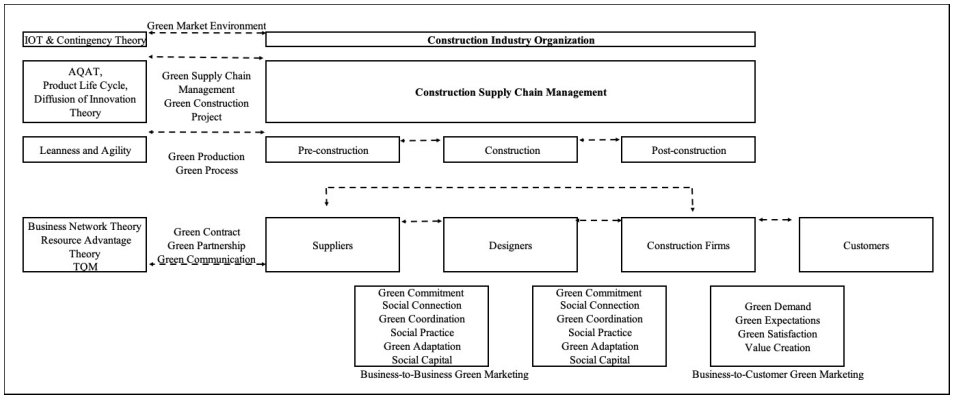

Figure 5. *Integrated management and green marketing theories in the construction industry.*

4. Discussion

Green marketing can be an effective tool for companies in the construction industry to enable continuous learning from their customers and competitors. While B2C green marketing can create value for customers, B2B green marketing can increase the green business performance of companies in a supply chain (Kumar & Godeshwar, 2015). Therefore, it is important to understand how green marketing implications can be enhanced to improve the strategic marketing capabilities of companies operating in the construction industry.

Although the importance of the B2C green marketing has been recognized in different industries, there is limited focus on how construction companies can integrate green marketing from the B2B perspective into their strategic management. This study focused on the steps that can enable a company in the construction industry to apply green marketing to improve its marketing capabilities and marketing performance. In particular, this study focused on integration of the following management theories into the green marketing theory: the green market structure of the industry based on the IOT and contingency theory; green SCM based on the product lifecycle, AQAT, DIT and leanness and agility; the B2B green marketing based on the Business Network Theory and the resource advantage theory; the internal green marketing management based on the Natural Resource Based View and TQM.

Managerial Implications

Environmental problems, which have become the focus, necessitate the requirement that all future operations can be environment-friendly. Thus, B2B companies in the construction industry may find it necessary to adapt their green marketing initiatives to their strategy to operate in the markets. The theoretical approach analyses described in this paper can be used to widespread green marketing implementation as well as to support the managers who are operating or willing to operate in the construction industry and for researchers in the relevant field.

Figure 5 summarizes the integration of management theories to improve green marketing practices in the construction industry. Fundamentally, the conceptualization process of the amalgamated framework for the integration of management theories has been shaped based on the consideration and evaluation of the construction industry (IOT and Contingency Theory). The management theories, therefore, provide the analysis of the green market environment of the construction industry. The framework has been designed to evaluate the supply chain management in the construction industry (AQAT, Product Life Cycle, DIT). These management theories can support professionals that will take part in the construction industry to analyze how and which green initiatives can be implemented in their supply chain management/construction project. The framework focuses on the stages of supply chain/construction project with respect to leanness and agility management theories. These theories enable the professionals to deeply focus on green production/green process to enhance green initiatives in their operations. B2B relations have been the focal points of the conceptualized framework that provides an in-

depth analysis of the relations between the professionals in the supply chain management from the management theories perspective (BNT, RAT and TQM). These theories provide evaluation of how green contract, green partnership and green communication can be established among the professionals through CSCM.

The integration of IOT and contingency theory can enhance the establishment and creation of a green market environment in the construction industry. Furthermore, AQAT, Product Lifecycle and DIT can enable the structuring and management of the green supply chain where B2B green marketing practices support achievement of the green construction project. Leanness and agility can transform construction phases to achieve sustainable product/construction/service that meets the green demand of end customers. Furthermore, Business network theory, resource advantage theory and TQM, which focus on the B2B green marketing and the internal green motivation of stakeholders, can provide a green partnership, green communication and a green contract to ensure the implementation of green initiatives. Therefore, B2B green marketing among stakeholders can increase green commitment and social connection through operations that include green coordination and social practices based on green adaptation in resources and social capital focus.

Construction industry-based market structure analysis is significant for environmental value creation. Since there is a bidirectional green interaction between the organization performance and the industry based external factors, external factor analysis becomes significant. Managers can assess green performance of the construction industry based on the classification of the external factors while evaluating the green performance of the company through SWOT and PESTLE analyses. Moreover, managers can evaluate the green market structure through the combination of evaluation results with SCP implementation. This process can have a direct impact on strategical green decision-making process (the conduct) to decide how to gain sustainable competitive advantage (the performance). Managers, who are aware of the external factors, can use the sustainability-oriented ISIC model through analysis of the construction market structure. This can lead to the evaluation of green marketing strategies, trends and mixed tools to achieve sustainable competitive advantage.

Based on their assessment of the construction industry market environment, managers can determine the importance of green target segmentation and then evaluate their companies' ability to differentiate based on green initiatives. Managers can be recommended to adopt an appropriate green marketing strategy (e.g. lean green, defensive, shaded green, extreme green) based on how they reflect green initiatives into their strategic management processes to gain competitive initiative. As SDG number 12 and target 12.2 point out the efficient use of natural resources and sustainable management to be in compliance with SDG, managers can embrace lean management that focus on waste minimization with respect to materials, time and effort while enhancing speed, quality, and sustainability performance of the supply chain (Tuz & Sertyesilışık, 2020). Furthermore, to be able to give a quick response to continuously changing dynamism of customer expectations, managers can adopt agility in the upstream process of the CSC. Company executives can adopt mutual greening to drive incremental green change in their supply chain. Additionally, companies focused on specific target segmentation may adopt niche greening in their supply chains.

To respond quickly to the green target segmentation, managers can focus on evaluating the status of the product/construction/service offered based on its characteristics in its life cycle. Managers can also adopt proactive/reactive B2B green marketing strategies based on the continuity of their innovation degrees and environment commitment. This can enable managers to focus on green innovative solutions for different situations of product/construction/service features, while improving the strategic decision-making process on whether or not to offer a new

feature to meet customer expectations.

Managers can focus on B2B green relationships throughout the supply chain and adopt the strategic green orientation to have B2B green mutual and social relationships with other companies at the company level. Furthermore, executives can focus on tactical green orientation to improve the green coordination and social dimensions of mutual green activities where B2B green marketing mix can improve business networks and implementation of green marketing initiatives. From the resource-advantage theory perspective, managers can focus on the internal green marketing orientation to project green initiatives into an environmental value-oriented organizational culture that can shed light on green values. Furthermore, managers can focus on the TQM to develop the CSC of a green product/construction/service to develop green B2B relationships among stakeholders while meeting customers' green satisfaction. The internal customer approach of TQM that focuses on production process throughout the supply chain can pave the ways of the B2B company to establish its green production process, while allowing communication among B2B companies via green marketing tools which reflect the green initiatives. Thus, it is recommended that B2B companies, which are in the first stage of green marketing practice in the construction industry, consider the following to adapt green initiatives to their activities: distinguishing between administrative and production-oriented activities; planning the production stages with environmental commitment focus and procuring environment-friendly products; determining TQM as a management philosophy for the B2B companies participating in product/construction/service production process; greening the production process with the internal customer approach and reflecting these initiatives to the marketing strategies in their relations with other B2B companies.

5. Conclusion

This study investigated integration of the management theories to the green marketing theory for enhancing green marketing implementation in the construction industry. This paper can guide professionals and scholars to improve green marketing practices and research in the construction industry. The integration of management theories to green marketing practices can enhance green marketing implementation and can support managers who are operating or willing to operate in the construction industry as well as researchers in the relevant field. This study can support construction companies and scholars to better understand integration of the green marketing to the construction industry. This study can support companies operating in the construction industry to better integrate green marketing practices into their strategic marketing and CSCM. Accordingly, based on the integration of management theories and green marketing (figure 5), this study suggests how companies in the construction industry can adopt green marketing initiatives and strategize for those initiatives. Furthermore, this study suggests how CSCs can be restructured by implementing B2B strategic green marketing. The study also suggests the extent of which internal marketing can be restructured with respect to the green initiatives. This study can contribute to strategic green marketing management theory by integrating management theories to enhance green marketing practices in the construction industry. Additionally, this study can support companies willing to adopt green marketing practices in the construction industry and to establish sustainable built environment. Future research is recommended to be on the relation between the environmental resiliency, resilient design and construction stages and green marketing focus in the construction industry.

References

Abbas, J. (2020). Impact of total quality management on corporate green performance through the mediating role of corporate social responsibility. *Journal of Cleaner Production, 242,* 118458.

Abzari, M., Safari Shad, F., Abedi Sharbiyani, A. A., & Parvareshi Morad, A. (2013). Studying the effect of green marketing mix on market share increase. *European Online Journal of Natural and Social Sciences: Proceedings, 2*(3 (s)), 641-653.

Agueda, E., Angel, M., Arturo, M., & David, M. C. (2002). Market orientation in service. A review and analysis. *European Journal of Marketing, 36*(9-10), 1003-1021.

Almahamid, S. M., & Qasrawi, S. T. (2017). The impact of TQM practices and KM processes on organisational performance. *International Journal of Quality & Reliability Management*,*34*,1034-1055.

Aziz, N. A. A., Foong, S. Y., San Ong, T., Senik, R., Attan, H., & Arshad, Y. (2018). Intensity of market competition, strategic orientation and adoption of green initiatives in Malaysian public listed companies. *International Journal of Productivity and Performance Management, 67*(8), 1334-1351.

Batarfi, R., Guergachi, A., & Wahab, M. I. M. (2017). The life cycle of a feature: modelling the transitions between feature states. *International Journal of Quality & Reliability Management, 34*(8), 1229-1251.

Blenkhorn, D. L., & MacKenzie, H. H. (2017). Categorizing corporate social responsibility (CSR) initiatives in B2B markets: the why, when and how. *Journal of Business & Industrial Marketing, 32*(8),1172-1181.

Bondeli, J. V., Havenvid, M. I., & Solli-Sæther, H. (2018). Placing social capital in business networks: conceptualisation and research agenda. *Journal of Business & Industrial Marketing,33*(8),1100-1113.

Carvalho, H., Duarte, S., & Machado, V. C. (2011). Lean, agile, resilient and green: divergencies and synergies. International *Journal of Lean Six Sigma,2*(2),151-179.

Chahal, H., Dangwal, R., & Raina, S. (2014). Antecedents and consequences of strategic green marketing orientation. J*ournal of Global Responsibility,5*(2),338-362.

Chan, E. S. (2013). Managing green marketing: Hong Kong hotel managers' perspective. *International Journal of Hospitality Management, 34*, 442-461.

Dangelico, R. M., & Vocalelli, D. (2017). "Green Marketing": an analysis of definitions, strategy steps, and tools through a systematic review of the literature. *Journal of Cleaner Production, 165*, 1263-1279.

Deshpande, R., & Webster Jr, F. E. (1989). Organizational culture and marketing: defining the research agenda. *Journal of marketing, 53*(1), 3-15.

Eneizan, B. M., & Obaid, T. F. (2016). Prior research on green marketing and green marketing strategy: critical analysis. *Singaporean Journal of Business, Economics and Management Studies, 51*(3965), 1-19.

Fraj, E., Martínez, E., & Matute, J. (2013). Green marketing in B2B organisations: An empirical analysis from the natural-resource-based view of the firm. *Journal of Business & Industrial Marketing, 28*(5),396-410.

Ginsberg, J. M., & Bloom, P. N. (2004). Choosing the right green marketing strategy. *MIT Sloan management review, 46*(1), 79-84.

Green, K. W., Toms, L. C., & Clark, J. (2015). Impact of market orientation on environmental sustainability strategy. *Management Research Review, 38*(2), 217-238.

Hasan, Z., & Ali, N. A. (2015). The impact of green marketing strategy on the firm's performance in Malaysia. *Procedia-Social and Behavioral Sciences, 172*(27), 463-470.

Hemantha, Y. (2012). Green Marketing: An Exploratory Research on Consumers in Bangalore City. *Abhinav Journal of Research in Commerce & Management, 1*(9), 84-96.

Kangun, N., Carlson, L., & Grove, S. J. (1991). Environmental advertising claims: A preliminary investigation. *Journal of public policy & marketing, 10*(2), 47-58.

Kilbourne, W. E., & Beckmann, S. C. (1998). Review and critical assessment of research on marketing and the environment. *Journal of marketing management, 14*(6), 513-532.

Kumar, P. (2016). State of green marketing research over 25 years (1990-2014). *Marketing Intelligence & Planning, 34*(1), 137-158.

Kumar, P., & Ghodeswar, B. (2015). Green Marketing Mix: A Review of Literature and Direction for Future Research. *International Journal of Asian Business and Information Management (IJABIM), 6*(3), 42-59.

Kumar, V., Rahman, Z., Kazmi, A. A., & Goyal, P. (2012). Evolution of sustainability as marketing strategy:

Beginning of new era. *Procedia-Social and Behavioral Sciences, 37*, 482-489.

Lavissière, A., Mandják, T., Hofmann, J., & Fedi, L. (2019). Port marketing as manifestation of sustainable marketing in a B2B context. *Journal of Business & Industrial Marketing, 35*(3), 524-536.

Lenney, P., & Easton, G. (2009). Actors, resources, activities and commitments. *Industrial Marketing Management, 38*(5), 553-561.

Leonidou, C.N., Katsikeas, C.S., &Morgan, N.A. (2013). "Greening" the marketing mix: do firms do it and does it pay off?", *Journal of the Academy of Marketing Science,41*(2), 151-170.

Leonidou, C. N., & Leonidou, C.L. (2011). Research into environmental marketing/management: a bibliographic analysis", *European Journal of Marketing, 45*(1/2), 68-103.

Liu, S., Kasturiratne, D., & Moizer, J. (2012). A hub-and-spoke model for multi-dimensional integration of green marketing and sustainable supply chain management. *Industrial Marketing Management, 41*, 581-588.

MacCarthy, B. L., Blome, C., Olhager, J., Srai, J.S., & Zhao, X. (2016). Supply chain evolution – theory, concepts and science. *International Journal of Operations & Production Management, 36*(12),1696-1718.

Martins, C.L., & Pato, M.V. (2019). Supply chain sustainability: A tertiary literature review", J*ournal of Cleaner Production, 225*, 995-1016.

Mishra, S., Singh, S. P., Johansen, J., Cheng Y., & Farooq, S. (2019). Evaluating indicators for international manufacturing network under circular economy. *Management Decision, 57*(4), 811-839.

Omran, M.A., & El-Gafhy, A. M. (2014). Theoretical perspectives on corporate disclosure: a critical evaluation and literature survey. A*sian Review of Accounting, 22*(3), 257-286.

Papadas, K., Avlonitis, G.J., Carrigan, M. (2017). Green marketing orientation: conceptualization, scale development and validation. *Journal of Business Research, 80*, 236-246.

Peattie, K. (2001). Towards sustainability: the third age of green marketing. *The Marketing Review, 2*, 129-146.

Polonsky, M.J., & Rosenberger, P.J. (2001). Reevaluating green marketing: a strategic approach", *Business Horizons, 44*(5), 21-30.

Popp, B., & Woratschek, H. (2017). Consumers' relationships with brands and brand communities–The multifaceted roles of identification and satisfaction. *Journal of Retailing and Consumer Services, 35*, 46-56.

Porter, M. E. (1981). The contributions of industrial organization to strategic management", A*cademy of management review, 6*(4), 609-620.

Porter, M.E. (1991). America's green strategy. *Reader in Business and the Environment, 33*.

Ramsay, J. (2001). The resource based perspective, rents, and purchasing's contribution to sustainable competitive advantage. *Journal of Supply Chain Management, 37*(2), 38-47.

Shafiq, M., Lasrado, F., & Hafeez, K. (2019). The effect of TQM on organisational performance: empirical evidence from the textile sector of a developing country using SEM. *Total Quality Management & Business Excellence, 30*(1-2), 31-52.

Sharma, A., Iyer, G.R., Mehrotra, A., & Kridhnan, R. (2010). Sustainability and business-to-business marketing: a framework and implications. *Industrial Marketing Management, 39*(2), 330-341.

Simão, L., & Lisboa, A. (2017). Green marketing and green brand – the toyota case. *Procedia Manufacturing,12*,183-194.

Siva, V., Gremyr, I., Bergquist, B., Garvare, R., Zobel, T. &Isaksson, R. (2016), "The support of quality management to sustainable development: a literature review", *Journal of Cleaner Production, 138*, 148-157.

Solaiman, M., Osman, A. & Halim, M.S.B.A. (2015). Green marketing: a marketing mix point of view. *International Journal of Business and Technopreneurship, 5*(1), 87-98.

Sombultawee, K. & Boon-itt, S. (2017). Marketing operations alignment: a systematic literature and citation network analysis review. Kasetsart *Journal of Social Sciences*,1-10. https://doi.org/10.1016/j.kjss.2017.09.009

Thölke, J.M., Hultinka, E.J. & Robbenb, H.S. (2001). Launching new product features: a multiple case exam-

ination. *Journal of Product Innovation Management,18*(1), 3-14.

Tirole, J. (1988). *The Theory of Industrial Organization*, The MIT Press.

Tuz, A., & Sertyeşilışık, B. (2020). Finding and minding gaps in the state-of-the-art of the lean and green marketing in the construction industry. *Market-Trziste*, 32(2),187-203.

United Nations (2020). "Sustainable development goals knowledge platform sustainable development goal 12", available at: https://sustainabledevelopment.un.org/sdg12 (accessed 30 June 2020).

Vaccaro, V.L. (2009). B2B green marketing and innovation theory for competitive advantage. *Journal of Systems and Information Technology, 11*(4), 315-330.

Van Donk, D. P., van der Vaart, T., Brandon-Jones, A., & Silvestro, R. (2010). Measuring internal service quality: comparing the gap-based and perceptions-only approaches. *International Journal of Operations & Production Management,30*(12),1291-1318.

Welch, C. &Wilkinson, I. (2009). Idea logics and network theory in business marketing. *Journal of Business-to-Business Marketing, 9*(3), 27-48.

Writh, M.O. & Bloch, H. (1995). Industrial organization theory and media analysis. *Journal of Media Economics, 8*(2),15-26.

Yadav, R. & Pathak, G.S. (2013). Green marketing: initiatives in the Indian context", *Indian Journal of Marketing, 43*(10), 25-32.

Yusr, M.M., Mokhtar, S.S.M., Othman, A.R. & Sulaiman, Y. (2017). Does interaction between TQM practices and knowledge management processes enhance the innovation performance?. *International Journal of Quality & Reliability Management,34*, 955-975.

Zhang, P. & London, K. (2013). Towards an internationalized sustainable industrial competitiveness model. *Competitiveness Review: An International Business Journal, 23*(2), 95-113.

Zhu, Q. & Sarkis, J. (2016). Green marketing and consumerism as social change in China: Analyzing the literature. *International Journal of Production Economics, 181*, 289-302.

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Critical success factors(CSFs) for e-Business technologies adoption in architectural practice in Nigeria

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Abstract

Although digital technology has rapidly changed the way professionals in the construction sector render services to their clients, the factors architectural firms must consider to ensure a successful e-Business technologies adoption in their professional practice are not very clear. This research investigated the critical success factors (CSFs) for e-Business technologies adoption in architectural practice in Nigeria. A questionnaire survey involving 243 architectural firms was conducted and the data from196 firms that have adopted e-Business technologies were analysed using descriptive statistics, Spearman's ranked correlation tests, relative importance index and principal components analysis. Significant relationships were found between the duration of use of e-Business technologies and the firms' age, staff strength, number and location of offices, while the top three CSFs for e-Business technologies adoption were availability and access to reliable, affordable and fast Internet services; availability of skilled manpower and knowledge of the benefits of e-Business technologies adoption. In addition, the underlying dimensions of the CSFs were found to be human, technology, management and environment-related. The study is instructive in highlighting the factors architectural practices should give priority attention to for a successful e-Business technologies adoption in improving professional service delivery efficiency and gain competitive advantage.

Keywords

Architectural firms, Critical success factors, e-Business, Technologies adoption, Professional practice.

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1. Introduction

As construction organisations continue to embrace information and communication technologies (ICTs) with the overall aim of improving their productivity and competitiveness in the global market, the architecture profession is not left out in this move. Evidence in the literature (Ibem, Akinola, Erebor, Tolani & Nwa-uwa, 2018; Ogunmakinde et al., 2014; Tepavcevic et al., 2012; NBS Research, 2018) shows that digital technology has changed the way professionals in the construction industry practice their professions. Architecture as a service-oriented and creative profession renders unique services in the construction sector (Oluwatayo et al., 2014). Hence, there is a growing need for the profession to adopt transformational technologies such as 3D computer-aided design, Building Information Modelling (BIM) and the Internet that will enable its practitioners deliver better services towards creating a better and sustainable built environment.

Notably, architectural practice involves collaboration with other professionals and stakeholders in the course of professional service delivery (McDonald & Madhavaram, 2007; Penttilä, 2009).This makes intra-and inter-firm communication, collaboration and coordination inevitable for a successful architectural practice (Ibem, Aduwo & Ayo-Vaughan, 2017; Oyedele & Tham, 2007; Shen et al., 2010). Some authors (Hussin et al., 2013; Cherian & Kumaran, 2016) have alluded that construction entities that rely on the traditional manual methods and processes in their business operations usually experience poor communication and difficulties in information sharing and teamwork management leading to time and cost overruns and low productivity. In a bid to address these challenges, Eadie and Perera (2016) have noted that ICTs play key roles in all aspects of construction project delivery from design, tendering, project programming to project completion. Ashworth and Perera (2015) argued that one aspect of ICTs adoption that comes with lots of benefits to professionals in the construction sector, including architects is e-Business. In construction, e-Business has been defined as doing business using the Internet (Ruikar & Anumba, 2008; Schneider, 2003). The existing studies have also shown that e-Business technologies adoption offers huge benefits as it engenders efficient work flow and faster communication (Ashworth & Perera, 2015), reduces time and cost of project delivery (Cherian & Kumaran, 2016), improves quality of projects (Dossick & Neff, 2010; Fadeyi, 2017) and promotes effective integration of people, tasks and processes involved in construction project delivery (LaValle et al., 2011). In view of these benefits, research has shown that e-Business technologies and practices were increasingly becoming indispensable in successful professional practice in the construction industry (Eadie & Perera, 2016; Oladapo, 2006).

From the review of published literature, it was observed that certain factors and conditions can facilitate or inhibit a successful adoption of e-Business technologies by firms and organisations (Dubelaar et al., 2005; Eadie, Perera, & Heaney, 2010). However, the specific activities, factors and situations that are considered crucial for a successful adoption and implementation of e-Business technologies and practices by firms or organisations have been described as critical success factors (CSFs) (Mathenge & Wausi, 2018; Perera et al., 2012; Rockart, 1982). Previous studies (Afolabi, Ibem, Aduwo, Tunji-Olayeni, & Oluwunmi, 2019; Butler, 2000; Dubelaar et al., 2005, Kolakota & Robinson, 1999) made attempt to identify the success factors for e-Business model adoption by organisations, but none of them specifically examined this in the context of architectural practice. In addition, although the existing studies provide insight into the adoption of ICTs in professional practice (Arif & Karam, 2001; Oladapo, 2006), impact of ICTs in architectural practice (Abdulkadir & Kamara, 2013; Ogunmakinde et al., 2014), the use of e-Procurement technologies in building project delivery (Ibem, Aduwo & Ayo-Vaughan, 2017), digital technologies (Ibem, Uwakonye, Akpoiroro, Somtochukwu, 2018; NBS Research 2018) and Building Information Modelling (BIM) (Ibem, Uwakonye, Akpoiroro,

Somtochukwu, 2018) adoption in architectural practice, they failed to identify the critical success factors (CSFs) for the adoption of e-Business technologies in architectural practice, especially in developing countries in sub-Saharan Africa, including Nigeria. As a result, there is a gap in knowledge on the specific situations that can enhance a successful adoption of e-Business technologies by architecture firms, especially, in Nigeria- the largest economy in Africa.

It was in an attempt to bridge this gap that the current study sought to investigate the critical success factors (CSFs) for e-Business technologies adoption in architectural practice in Nigeria. The four basic research objectives pursued in the study were to:

- identify the categories of architectural firms that have adopted e-Business technologies in Nigeria,
- examine the relationship between the characteristics of architectural firms and their duration of use of e-Business technologies in the study area,
- identify the factors with the highest influence on successful adoption of e-Business technologies by architectural firms, and
- investigate the underlying dimensions of the CSFs for e-Business technologies adoption in professional practice by the architectural firms in Nigeria.

In view of the risk associated with the transition from the traditional methods to digital business model by firms/organisations, the current research makes contribution to knowledge by revealing the specific factors and situations architectural firms must give priority attention in the acquisition and use of e-Business technologies and processes. The study also provides a guide for categorising architectural firms with respect to their capacity to adopt e-Business technologies and possibly the Internet of Things (IoT) in the nearest future. It is therefore envisaged that the findings of this study will inform architectural practice, especially on the strategies for leveraging e-Business technologies to improve their professional service delivery efficiency and gain competitive advantage locally and globally.

2.Review of literature

2.1 Concept of electronic (e-) Business

Historical facts show that the term 'e-Business' originated from the International Business Machine (IBM, 2001). Since then, the term has been defined in various ways in the literature. For examples, e-Business has been defined as the use of digital or electronic tools and computer networks to carry out business activities and financial transactions (Schneider, 2003; Zwass 2003). It has also been described as the practice or process of remodelling traditional business process using electronic tools (Cherian & Kumaran, 2016). In construction, Ruikar and Anumba (2008) described e-Business as doing construction business using Internet technology. Based on the foregoing, e-Business as used in this research, refers to the use of Internet or web-based technologies, tools and processes in architectural practice.

Emerging from the definitions of e-Business presented here is the understanding that e-Business involves the use of digital/electronic tools and computer networks collectively known as e-Business technologies in business operations as explained by previous authors (Devaraj & Wei, 2007; Issa et al., 2003). IBM (2001) specifically described e-Business as leveraging the Web/Internet services such as electronic data interchange (EDI), e-Mail, software packages, communication networks and other electronic tools in business operations. For construction entities, authors (Issa et al., 2003; Perera et al., 2012; Bowmaster et al., 2017) have identified cloud computing, BIM and Internet-supported project management software packages and communication networks as some of the key e-Business technologies found useful to the industry.

Several authors (Bowmaster et al., 2017; Costa & Tavares, 2014; Ruikar & Anumba, 2008) have noted that the adoption of e-Business technologies goes beyond the replacement of paper-based or manual practices with digital technologies and tools but involves a transition from manual to digital processes and practices in business operations as well as intelligent use of

digital media and electronic (e-)Tools to create a virtual environment that facilitates intra-and inter-organisational/ firm interactions, communication and exchange of information. This means that for construction entities, e-Business technologies use encompass the adoption of various digital media and electronic tools, applications and processes in facilitating information and data generation and exchange, which is referred to as electronic (e-)Procurement) and the deployment of electronic means and processes in financial transactions associated with construction project delivery, otherwise known as electronic (e-) Commerce).

2.2. Intersection of e-Business technologies and architectural practice

Architectural practice involves the use of tools, information and creative knowledge to provide a wide range of professional services related to building and construction projects. According to the International Standard Organisation (ISO) 10845(2010), there are six main areas of professional service delivery in building and engineering projects. These are 1) establishment of what is to be procured 2) selection of procurement strategies to be used 3) call for tender offers 4) tender evaluation 5) award of contract and 6) contract administration. As it relates to architecture, professional practice involves the provision of services starting from the brief taking, designing, planning, construction, maintenance, operation to demolition stages of building projects (Grilo & Jardim-Goncalves, 2011; McDonald & Madhavaram, 2007). Following from these, the Architects Registration Council of Nigeria (ARCON, 2011) has delineated the scope of core architectural services delivery stages in building and related projects in Nigeria to include design stages (I and II), tendering and award, construction and post construction stages as shown in columns 1 and 2 of Table 1.

Relating these services delivery stages to the six areas of construction procurement service delivery identified by ISO 10845(2010), it is evident that the five services delivery stages identified by the ARCON cover the six key construction procurement activities shown in Table I. This means that architectural practice involves the provision of a wide range of services in the formation, management and fulfilment of building and engineering contracts.

Table 1. *Architectural Services Delivery Stages (ASDS) in Nigeria (Source: ARCON (2011) & ISO 10845(2010)).*

Table 1

Stage	Scope of services	Construction procurement activities
Design Stage 1	Commences from the date of receipt of instructions to the submission of the final concept design and include the preliminary estimated total cost for client's approval.	Establishment of what is to be procured
Design Stage 2	Begins from the date of client's approval of final concept design and ends with the submission of the tender documents for client's approval.	Deciding on procurement strategies to be used
Tendering and Award Stage	Starts from call for tender offers and ends with the awarding of the contract.	Soliciting for tender offers evaluating tender offers and awarding contracts
Construction Stage	Commences from handing-over site to the contractor, issuing of Architects Payment Certificates, completion and acceptance of the works by the client, Defects Liability Period, issuing of the Practical Completion Certificate and ends with the issuing of Final Payment Certificate.	Contract administration to ensure compliant with project requirements.
Post Construction Stage	Project hand over to client through the defects liability period up to final account.	Contract administration to ensure compliant with project requirements.

Source: ARCON (2011) & ISO 10845(2010)

Further evidence in the literature (McDonald & Madhavaram, 2007; Penttilä, 2009; Rivard, 2000) also indicates that architectural practice involves the gathering, processing, displaying and exchanging of various kinds of data related to building and construction projects. As a result, architectural practices are confronted with challenges of ineffective and inefficient communication process (Ibem, Aduwo & Ayo-Vaughan, 2017; Oluwatayo & Amole, 2014; Oyedele & Tham, 2007), poor data management and exchange (Johnson & Clayton, 1998; Penttilä, 2009; Ogunmakinde et al., 2014; Shen et al., 2010). To address these challenges, Gajendran and Perera (2017) explained that e-Business technologies have become an integral part of professional practice in architecture. This is because they help to achieve effective communication and information exchange among the design, engineering and construction teams, prompt access to key information and reduction in cost and turnaround time of projects (Worst, 2009). In addition, they facilitate automation of information flow via the Internet and optimises business processes (Issa et al., 2003) resulting in overall improvement in the

quality of service and firms' productivity (Abdulkadir & Kamara, 2013; Ibem, Akinola, Erebor, Tolani & Nwa-uwa, 2018).

In the light of the foregoing, several studies have highlighted the levels of penetration of ICTs in architectural practice. For examples, the extant study by Arif and Karam (2001) revealed that architectural practices in Western Cape Province, South Africa, had deployed information technology (IT) to support their work processes, while the review by Abdulkadir and Kamara (2013) reported that in architectural practice, ICTs have been extensively used in the design process resulting in enhanced productivity, performance and the competitiveness of firms and improved transparency in business processes and the quality products. The findings by authors (Arif & Karam, 2001; Abdulkadir & Kamara, 2013) were also corroborated by Oladapo (2006) who reported that in architectural practices in southwest Nigeria, core architectural functions such as preparation of drawings have been largely digitised, but the use of the Internet was limited to e-Mails and its potentials in other vital areas such as e-Business and electronic data exchange were yet to be explored. Ogunmakinde et al. (2014) also revealed that ICTs were impacting architectural practice in Nigeria as the core architectural business activities such as communication, architectural design, word processing and presentations have largely been computerized with the use of different architectural design software and word processing packages. They identified changing trends, level of competition, and industry demands as the determinants of ICTs use in architectural practice in this country. In contrast to the findings by Oladapo (2006) on the limited use of Internet services, other studies (Ibem, Aduwo & Ayo-Vaughan, 2017; Ibem, Akinola, Erebor, Tolani & Nwa-uwa, 2018) provide copious evidence indicating that architectural firms in Nigeria were using different digital media and electronic tools to support their core business operations. However, these studies are silent on the success factors for e-Business technologies adoption by architectural firms in Nigeria.

2.3. Critical success factors (CSFs) for e-Business technologies adoption

Evidence in the published literature (Li et al., 2005; Rockart, 1982) has shown that Rockart and the Sloan School of Management were the first to introduce critical success factors (CSFs) as a business concept. In fact, Rockart (1982) first defined CSFs as 'those key areas of activity where favourable results are very necessary for the achievement of goals by managers. This definition suggests that CSFs can be described as factors, features, situations or changes required to achieve a substantial success in any business endeavour (Mathenge & Wausi, 2018). Therefore, as used in this research, CSFs are those factors, situation and elements that are significantly important in ensuring that firms or organizations achieve success in the adoption of e-Business technologies and process. This is consistent with the submission by Boynton and Zmud (1984) as cited in Li et al. (2005) indicating that CSFs are key areas that influence business and management success.

As it relates to e-Business technologies, the literature highlights a variety of factors that can lead to a successful adoption of these technologies by firms/organisations. For instance, Kalakota and Robinson (1999) identified the existence of effective change management, appropriate technology and skilled personnel, while Butler (2000) insisted that a sound knowledge of the capabilities and value of e-Business technologies by executives are top among the success factors for e-Business technologies and processes adoption. Further, the study by Dubelaar et al. (2005) classified the success factors of e-Business technologies adoption into three main categories: strategic, structural, and management factors. The authors explained that the strategic factors are related to the following: 1) Internet and related technologies 2) understanding the competitive advantages of e-Business technologies over traditional system 3) availability of new competitors and large markets 4) adoption of web-based marketing approach 5) organisation's/firm's strategic position in the market 6) buyer and customer behaviour 7) first-mover advantage and quick time to market 8) quality of products and services offered by the

firm 9) readiness of firm to innovate, and 10) expectations of customers and business partners. The structural factors include 1) availability of the appropriate digital infrastructure 2) good e-Business education and training to employees, management, and customers 3) extension of e-Business model to cover entire supply chain, and 4) effective and efficient cost control measures, while the management factors are 1) existence of e-Business leadership in the firm 2) top management support for e-Business 3) knowledge of the capabilities of e-Business technologies by to executives, and 4) ability and willingness of top management to communicate the values of e-Business model in the organization (Dubelaar et al., 2005).

For construction entities, the study by Perera et al (2012) identified enabling technologies as the perquisite for successful e-Business activities in this sector, while Afolabi, Ibem, Aduwo, Tunji-Olayeni, & Oluwunmi (2019) reported that the CSFs for e-Procurement adoption in the Nigerian construction business environment were mainly management, human and technology in nature, and that access to reliable and fast Internet services at affordable cost was top on the list of CSFs for the adoption of this aspect of e-Business in this industry. From the studies reviewed here, it can be inferred that the CSFs for e-Business technologies adoption in organisations differ but can be generally described as social, technical and economic factors. In spite of this understanding, very little is known about the CSFs for e-Business technologies adoption among architectural organisations, especially in a developing nation like Nigeria. This forms part of the knowledge gap the current study attempted to fill.

3. Research methods

This research is part of a bigger study that investigated Internet/web-based technologies, tools and applications adoption by firms and organisations in the Nigerian construction sector. The data used in this paper were derived from a cross-sectional survey of architectural firms accredited by the Architects Registration Council of Nigeria (ARCON) to provide professional services in Nigeria. From the register of architectural firms published by ARCON in April 2017, a total of 1,079 architectural firms were identified with contacts details of their principals in Nigeria. In order to have a sample size that is representative of the total population of firms identified, the formula for estimating sample size for a finite population first developed by Yamane (1967) and presented in equation 1 was adopted.

$$n = \frac{N}{1+N(e)^2} \quad \ldots\ldots \text{Equation 1}$$

Where n is the estimated sample size, N = is the research population, e is allowable error in statistical estimation, which for this research is ±5% margin of error at 95% confidence level. Substituting these parameters as shown in Equation 2, a minimum of 292 firms were obtained.

$$n = \frac{1079}{1+1079(0.05)^2} \quad \ldots\ldots \text{Equation 2}$$

$$n = 291.8 \text{ firms}$$

To accommodate possible low response rate, 10% of 292 was added to the calculated sample size. This translated to a total of 321 architectural firms.

A structured questionnaire designed by the authors was used to generate the primary data. The review of literature helped in the identification of the variables investigated and these were framed into questions in the questionnaire. Although the questionnaire for the larger research project was structured into five distinct sections, the data for this papers were drawn from sections A, B and C of the questionnaire. These sections dwelt on the basic information related to the respondents and their respective firms, e-Business technologies adoption, the length of use of these technologies to facilitate professional practice and the CSFs for e-Business technologies adoption, respectively. In order to identify those who have adopted e-Business technologies, participants in the research were requested to indicate if their firms have used e-Business technologies in professional practice using two options- *'No'* and *'Yes'*. In addition, they were also asked to indicate how long their firms have been using e-Business technologies by choosing any of these

options: 1 for *Not Sure*, 2 for *less than 1 year*, 3 for *1-5years*, 4 for *6-10years*, and 5 for *Over 10years*. Section C of the questionnaire had questions on the factors they considered to be of high influence in the successful adoption of e-Business technologies in architectural practice. A total of 21 factors identified from the review of previous works (e.g. Dubelaar et al., 2005, Perera et al., 2012; Afolabi, Ibem, Aduwo, Tunji-Olayeni, & Oluwunmi, 2019) were included in the questionnaire and the participants were asked to rate each of them according to their influence in the successful adoption of e-Business technologies in their respective firms using 1 for *"No Influence"*; 2 for *"Very Low Influence"*; 3 for *"Not Sure"* 4 for *"High Influence"* and 5 for *"Very High Influence"*. On the one hand the validity of the questionnaire was examined by subjecting it to review by experts and also pre-testing it among architectural firms in Lagos metropolis, southwest Nigeria. The reliability of the questionnaire was on the other hand examined by subjecting the 21 CSFs to Cronbach's Alpha test and the result produced 0.945, which is more than 0.6 minimum value recommended in the research literature (see Pallant, 2011)

The surveys were carried out by the researchers and trained research assistants between the second week of November 2017 and last week of August 2018.The surveys involved the distribution by hand and e-Mail attachment a total of 321 copies of the questionnaires to randomly selected principals of architectural firms or their representatives across major cities and urban areas in Nigeria. The choice of administration of questionnaire as the data collection method was based on the nature of the research objectives and the geographic coverage of the survey. Moreover, previous studies on critical success factors cited in this paper had adopted similar method (see for examples Li, Akintoye, Edwards & Hardcastle, 2005; Mathenge & Wausi, 2018; Ibem, Akinola, Erebor, Tolani & Nwa-uwa, 2018). Similarly, random sampling technique was used in the selection of participants because of the need to give every firm equal chances of being included in the surveys, and thus eliminating bias associated with non-probability sampling technique in the survey. Of the 321 copies of questionnaires administered, 243 representing about 76% of the number administered to architectural firms were retrieved. Preliminary analysis of the data however revealed that 196 copies of the questionnaire representing around 81% of the retrieved questionnaire were found to have been filled by participants who indicated that their firms have deployed e-Business technologies and processes in professional practice. In view of the fact that the main interest of this study was on firms that have been using e-Business technologies, only data from the 196 participants who indicated that their firms have been using e-Business technologies to facilitate professional practice were further subjected to statistical analyses.

In line with the stated four research objectives, the data were subjected to four types of analyses with the help of Statistical Package for the Social Sciences (SPSS) software package. For the first research objective, simple descriptive statistics, namely, frequency distributions and percentages were used, while Spearman's ranked correlation (Rho) tests were used to address the second research objective. The choice of Spearman's ranked correlation (Rho) tests was based on the fact that the variables involved in this specific analysis are ordinal/interval data and non-parametric in nature. In addressing the third research objective, descriptive statistics, including mean and standard deviation; and relative importance index (RII) and ranking were used. Ranking of the CSFs was based on the relative important index calculated for each of the 21 factors using the formula given in equation 3.

$$RII = \frac{\sum W}{A \times N}; \quad (0 \leq RII \leq 1) \qquad \text{Equation 3}$$

Where W is the score given to each of the 21 factors by all the participants in the survey, ∑W is the sum of scores (W1 + W2 + W3 + ...+ W21), A is the highest possible score on the 5-point Likert type scale, which in this research is 5.0 and N represents the total number of respondents who rated each of the 21 factors investigated. In interpreting the results, the closer the calculated RII for each factor is to 1.00, the more influential the factor is assumed to be in

contributing to a successful e-Business technologies adoption in the firms. The relative importance index was useful in prioritising the factors rated on Likert-type scale by the respondents in the survey. The last research objective was addressed using the Principal Component Analysis (PCA) Varimax with Kaiser Normalization Rotation Method. This analysis was used to extract the key dimensions of the 21 CSFs for e-Business technologies adoption by architectural firms in the survey and it was adopted because the dataset is ordinal and non-parametric in nature.

4.Results

4.1. Users of e-Business technologies

Table 2 is a display of the results on the characteristics of registered architectural firms who have adopted e-Business technologies in professional practice in Nigeria. The results show that the highest proportion of the firms that have adopted e-Business technologies were those that are over 10 years old and had more than one offices located within the southern part of Nigeria (Table 2). The results also revealed that more than one-half of the firms had staff strength of less than 21 persons and their main area of professional practice experience was in residential buildings. It was also observed that the highest percentage of the firms have been using e-Business technologies for less than 6 years as at 2017/2018.

The results in Table 2 generally indicate that architectural firms who used e-Business technologies and processes encountered in the survey

Table 2. *Characteristics of firms who use e-Business technologies.*

Characteristics of firms	Categories	Frequency n=196	Percent
Age of firm	Below 6years	42	21.4
	6-10years	43	21.9
	11years+	103	52.6
	No Response	8	4.1
	1	103	52.6
	2	42	21.4
Number of offices in	More than 2	39	19.9
Nigeria	No Response	12	6.1
	Less than 10 persons	71	36.2
	10-20 persons	54	27.6
Staff Strength	21-30 persons	18	9.2
	31-40persons	3	1.5
	41-50 persons	41	20.9
	No Response	9	4.6
Areas of firm's main	Residential buildings only	127	64.8
professional practice	Non-residential buildings	37	18.9
experience	only		
	Residential and non-residential buildings	25	12.8
	Infrastructure (e.g. energy, transport, telecommunication and water supply)	7	3.5
	South East	18	9.2
Location of office(s)	South-South	53	27.0
(Geo-political zone in	South-West	55	28.1
Nigeria)	North-Central	33	16.8
	North-West	5	2.3
	North-East	2	1.0
	No Response	30	15.3
	Less than 1 year	52	26.0
Duration of use of e-	1 year - 5 years	62	32.0
Business technologies	6 years-10 years	22	11.0
and practices	Over 10 years	11	6.0
	Not Sure	49	25.0

Table 3. *Ranking of CSFs for e-Business technologies adoption in the firms.*

	No. of Responses	Sum	Mean	Std. Deviation	RII	Ranking
Access to reliable, affordable and fast Internet services	183	746.00	4.08	1.05	0.81	1st
Availability of skilled manpower to handle e-Business technologies and processes	180	722.00	4.01	1.05	0.80	2nd
Having adequate knowledge of the benefits of e-Business	175	690.00	3.94	0.97	0.79	3rd
Access to reliable ICT Infrastructure	184	721.00	3.92	1.07	0.78	
Top management commitment and support to adoption of e-Business tools and practices	179	699.00	3.91	1.04	0.78	
Having an efficient change management plan and training of all the stakeholders	175	681.00	3.89	0.97	0.78	4th
High level of computer literacy in the industry	174	676.00	3.89	1.01	0.78	
Access to affordable e-Business technologies and applications	184	712.00	3.87	1.10	0.77	
Security and authenticity of e-Business processes	173	669.00	3.87	1.08	0.77	5th
Availability of regular power supply	184	711.00	3.86	1.37	0.77	
Confidentially in e-Business processes	177	677.00	3.83	1.16	0.76	6th
High level of awareness of e-Business model in the architecture industry	176	659.00	3.74	1.11	0.75	
High level of trust on e-Business technologies amongst people in the industry	176	657.00	3.73	1.17	0.75	7th
Interoperability of e-Business software packages, applications and systems	175	652.00	3.73	0.97	0.75	
User-friendliness of e-Business technologies, practices and processes	177	654.00	3.70	1.13	0.74	8th
Compatibility of e-Business model with the existing work processes in the firm	168	616.00	3.67	1.08	0.73	9th
Acceptability of the legality of electronic contracts	173	623.00	3.60	1.18	0.72	
Employees' commitment to successful adoption of e-Business operations	172	618.00	3.59	1.01	0.72	10th
Existence of pro e-Business policies and legislation	171	609.00	3.56	1.19	0.71	
Existence of a uniform standard for describing, displaying and specifying construction materials, works and services	175	621.00	3.55	1.11	0.71	11th
Government support for the adoption of e-Business technologies in the industry	174	608.00	3.49	1.22	0.70	12th

are more than 10 years old with professional practice experience in residential developments and had their offices in southern part of Nigeria. These results suggest that a majority the architectural firms included in the survey started using e-Business technologies around 2011 and 2012.

4.2. Relationship between firms' characteristics and duration of use of e-Business technologies

Results of the Spearman's ranked correlation (Rho) tests revealed that whereas positive significant relationship existed between the firms' duration of use of e-Business technologies and their age (ρ =0.309, p=0.000), staff strength (ρ =0.205, p=0.015), number of offices in Nigeria (ρ = 0.286, p = 0.001), a negative significant relationship was found between the duration of use of e-Business technologies and location of the firms' office(s) (ρ = -0.221, p=0.007). However, no significant relationship was found between the duration of e-Business technologies use and the main area of firms' professional practice experience (ρ = 0.097, p=0.270). These results mean that the older a firm is, the larger its staff strength and the more the number of offices, the longer the time it has been using e-Business technologies in professional practice. In addition, the result also means that the duration of use of e-Business technologies is not a function of the main area of professional service delivery experience of the firms sampled.

4.3. CSFs for e-Business technologies adoption

Table 3 shows the results of CSFs for e-Business technologies adoption in the architectural firms sampled. The results reveal that all the 21 factors investigated have mean values of between 3.49 and 4.08 (see Table 3), suggesting that they all have potentials in ensuring a successful e-Business technologies adoption in architectural practice in Nigeria. Based on the relative importance index of each of the factors investigated, it is obvious that the top three CSFs with the highest influence on successful adoption of e-Business technologies in professional practice identified in the survey are 1) access to reliable, affordable and fast Internet services (RII = 0.81), 2) availability of skilled manpower to handle e-Business technologies and processes (RII= 0.80), and 3) having adequate knowledge of the benefits of e-Business (0.79), while the least factor is government support for the adoption of e-Business technologies in the industry (RII=0.70). The closeness of the RII of the three top factors is a measure of their relative contribution to a successful e-Business technology and processes adoption in architectural practices. It is also an indication that these three factors require the same level of attention for a successful adoption of e-Business technologies and process by in the firms.

4.4. Underlying dimensions of CSFs for e-Business technologies adoption

Before subjecting the dataset to principal component analysis (PCA), its suitability for this analysis was investigated using Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The test results produced KMO value of 0.897, which is greater than 0.70 and the Bartlett's Test of Sphericity ($\chi 2$ = 1673.709; df = 210) was significant at p=0.000; meaning that the dataset is suitable for the analysis. The PCA yielded four underlying dimensions (i.e. components 1-4) each with Eigenvalue greater than 1.0 and all accounting for around 62.1% of the variance in the 21 factors investigated as shown in Table 4. The suggested name and the factors loading on each of the components identified in Table 4 are shown in Table 5.

From the results in Tables (4 and 5), it can be seen that the first dimension, which is *'availability of skill manpower, electricity, affordable and reliable e-Business infrastructure*' has six factors loaded on it and counts for around 17.31% of the variance in all the 21 factors investigated. The second is *'existence of favourable operational environment for e-Business adoption*' which also has six factors loaded on it but accounts for about 16.91% of the variance in the 21 factors, while the third dimension, which is 'characteristics of e-Business technologies and processes' has five items loaded on it and accounts for around 13.99% of the variance in all the items include in the PCA. The last dimension is 'e-Business readiness of top management and employees' with four items loaded on it and accounts for around 13.86% of the variance in the 21 factors investigated.

5. Discussion

As stated earlier, this study investigated the critical success factors (CSFs) for e-Business technologies adoption in architectural practice in Nigeria. Arising from the findings are four key issues considered important for further discussion. First, the results revealed that a majority of the adopters of e-Business technologies among the architectural firms were those that had existed for over 10 years, had at most two offices located in southern part of Nigeria and residential developments as their main area of professional practice experience.

Table 4. *Model summary of the PCA.*

Table 4

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total(Eigenvalue)	% of Variance	Cumulative %
1	8.378	39.894	39.894	3.636	17.313	17.313
2	2.082	9.916	49.810	3.550	16.907	34.220
3	1.429	6.803	56.613	2.939	13.994	48.214
4	1.147	5.460	62.074	2.911	13.860	62.074

Extraction Method: Principal Component Analysis.

Table 5. *Underlying dimensions of CSFs for e-Business technologies adoption.*

Dimension names	Critical Success Factors (CSFs)	Factor loadings
1. Availability of skill manpower, electricity and affordable and reliable e-Business infrastructure	Access to affordable e-Business technologies and applications	0.718
	Access to reliable, affordable and fast Internet services	0.785
	Access to reliable ICT Infrastructure	0.836
	Availability of regular power supply	0.760
	High level of computer literacy in the industry	0.703
	Availability of skilled manpower to handle e-Business technologies and processes	0.575
	High level of awareness of e-Business model in the architecture industry	0.682
2. Existence of favourable operational environment for e-Business adoption	High level of trust on e-Business technologies amongst people in the industry	0.542
	Acceptability of the legality of electronic contracts	0.737
	Government support for the adoption of e-Business technologies in the industry	0.849
	Existence of pro e-Business policies and legislation	0.854
	Existence of a uniform standard for describing, displaying and specifying construction materials, works and services	0.610
3. Characteristics of e-Business technologies and processes	Interoperability of e-Business software packages, applications and systems	0.633
	Security and authenticity of e-Business processes	0.503
	Compatibility of e-Business model with the existing work processes	0.607
	User-friendliness of e-Business technologies, practices and processes in the firms	0.771
	Confidentially in e-Business processes	0. 458
	Employees' commitment to successful adoption of e-Business operations	0.674
4. e-Business readiness of top management and employees	Top management commitment and support to adoption of e-Business tools and practices	0.459
	Having adequate knowledge of the benefits of e-Business	0.755
	Having an efficient change management plan and training of all the stakeholders	0.676

The results also indicated that the highest proportion of the firms had been using e-Business technologies for less than six years. Notably, the characteristics of firms encountered in this survey seem to be consistent with the findings of previous studies (Ogunmakinde et al., 2014; Oluwatayo et al., 2014) indicating that most architectural practices in Nigeria are small and medium size firms operating in major town and cities in Nigeria. The results also suggest that the use of e-Business technologies in professional practice by the architectural firms in Nigeria is a recent development as most of the firms encountered in the survey started using these technologies and processes between 2011 and 2012, while around 17.0% of them began using them before this time. Based on the evidence from this research, it can be inferred that whereas architectural practices in the developed economies had embraced e-Business technologies and processes in the mid-1990s as indicated by Tepavcevic et al. (2012), most of their counterparts in Nigeria started using these technologies about 25 years later. This may imply that many of the registered architectural practices in Nigeria sampled are late adopters e-Business technologies, which suggests a slow rate of diffusion of e-Business technologies and indeed digital technology as well as Internet penetration in architectural practice in Nigeria.

Second, the study also found significant positive relationships between the duration of use of e-Business technologies and the age, staff strength, number of offices and a negative relationship with location of the office(s) in Nigeria. This means that the differences in the duration of use of e-Business technologies among architectural practices in Nigeria is a function of their age and staff strength as well as the location and number of offices operated. This specific finding appears to be consistent with those of a recent study by Aduwo, Ibem, Ayo-Vaughan, Afolabi, Uwakonye & Oluwunmi (2020) revealing that the

adoption of e-Procurement by construction entities in Nigeria, which is one aspect of e-Business, varied according to their characteristics. Further analysis of the results revealed that the adoption of e-Business by architectural firms seems to increase with their age, staff strength, and number of offices. This is understandable because the older firms with large staff strength and multiple offices are confronted with the greater challenge of management, integration and exchange of information than the younger firms with fewer staff and less number of offices. Similarly, the result showing that there was a strong relationship between the duration of use of e-Business technologies and location of the firms' offices might be explained based on the observation that most of the firms have their offices in big cities in the southern part of Nigeria such as Lagos and Port Harcourt where there appears to be more demand for architectural services and availability of ICT infrastructure. This might suggest that architectural firms in large cities are most likely to adopt e-Business technologies than those in smaller cities where the demand for architectural services are less and the supply of ICT infrastructure is marginal. However, the result showing that there was no significant relationship between the duration of e-Business technologies use and the firms' main area of professional service delivery experience was expected. This is because a majority of the firms have their professional practice experience in residential buildings, which of course is in line with the submissions by several authors (Arif & Karam, 2001; Authors et al., 2018; Ogunmakinde et al., 2014; McDonald & Madhavaram, 2007) indicating that across the world, the core professional area of architectural practices is the provision of building design and construction services to different categories of clients.

Furthermore, in line with the existing studies (Afolabi, Ibem, Aduwo, Tunji-Olayeni, & Oluwunmi, 2019; Dubelaar et al., 2005; Kolakota & Robinson, 1999), all the 21 factors investigated emerged as CSFs for e-Business technologies adoption in professional practice in the firms sampled. However, in order of their contributions to facilitating a successful adoption of e-Business technologies and processes, the top three factors are access to reliable, affordable and fast Internet services; availability of skilled manpower to handle e-Business technologies and processes; and having adequate knowledge of the benefits of e-Business technologies. These results are well expected because evidence in the literature (IBM, 2001; Issa et al., 2003; Ruikar & Anumba, 2008) shows that the e-Business model relies mainly on the use of the Internet or web-based technologies to support the execution of procurement and transaction activities by firms or organisations. Therefore, the emergence of access to reliable, affordable and fast Internet services as the most important CSF for e-Business technologies adoption in professional practice by architectural firms is considered to be order. In fact, this finding agrees with that of a recent study by Afolabi, Ibem, Aduwo, Tunji-Olayeni, & Oluwunmi (2019) which also reported that access to reliable and fast Internet services at affordable cost was the most important CSFs for the adoption of e-Procurement in construction business in Nigeria.

Similarly, the emergence of availability of skilled manpower to handle e-Business technologies and processes as the second most important CSFs for e-Business technologies adoption by architecture firms is also in tandem with the finding by Afolabi, Ibem, Aduwo, Tunji-Olayeni, & Oluwunmi (2019) as previously highlighted. Since the previous authors have shown that the adoption of e-Business technologies involves a transition from the adoption of manual tools and processes to the use of digital media and e-Tools (Bowmaster et al., 2017; Costa & Tavares, 2014) and remodelling traditional work process (Cherian & Kumaran 2016), the need for skilled personnel to oversee the implementation of e-Business technologies and processes for effectiveness and efficiency in professionals service delivery by architectural firms may not be considered to be out of place. In fact, previous studies had reported that the lack of technical expertise was a key impediment to the uptake use of e-Procurement, which is incidentally an aspect

of e-Business by construction organisations in Nigeria (Aduwo, Ibem,Tunji-Olayeni, Uwakonye & Ayo-Vaughan, 2016), the UK (Eadie et al., 2010), and Turkey (Isikdag, 2019). This suggests that the skill set needed to function effectively in e-Business environment is different from those required in the traditional and papered-based business settings; and hence architectural firms need to have adequate number, well-trained and experienced ICT savvy staff to ensure that they can successfully carry out their business operations using e-Business technologies and processes.

Last, it was also found that four underlying dimensions of CSFs for e-Business technologies in architectural practice were identified in this research. These dimensions are related to technology, organisational and environmental factors. For example, the first dimension- availability of skill manpower, electricity, affordable and reliable e-Business infrastructure comprises human, technology and economic factors required for the adoption and use of the e-Business model, while the second deals with the operational environment that favours the adoption of e-Business technologies and processes by the firms. Furthermore, the third dimension deals with the characteristics of e-Business technologies and processes (i.e. technology), while the last dimension is e-Business readiness of top management of the firms. Although, the current study identified 'existence of favourable operational environment for e-Business adoption' as one of the dimensions, the other three dimensions identified in this research seem to be in line with the strategic, structural, and management factors identified by Dubelaar et al. (2005) as well as the human, technology and management factors reported by Afolabi, Ibem, Aduwo, Tunji-Olayeni, and Oluwunmi (2019). Notably, the identification of the characteristics of e-Business technologies and processes as one of the dimensions of the CSFs in this study appears to be in line with the tenets of diffusion innovation theory, which identified the characteristics of innovation (technology) as one of the factors that determines the extent of its adoption by individuals and organisations (Rogers, 2003). These are also in line with the technology, organisation and environment factors identified by Tornatzky and Fleischer (1990) as capable of determining the extent of the adoption of innovation by organizations or firms. In all, these findings are pointing to the fact that these four dimensions are the main factors and situations that can influence the uptake and sustain use of e-Business technologies and process among architectural firms in Nigeria.

6. Conclusions, study implications and recommendations

In this study, the critical success factors(CSFs) for e-Business technologies adoption in professional practice by architectural firms in Nigeria were investigated. From the findings, the following conclusions were made. First, it can be concluded that the categories of architectural firms that use e-Business technologies in Nigeria are those that are over 10 years old, have at most two offices in areas where there are huge markets and involved in residential developments. The implication of this findings is that for clients who desire to engage the services of e-Business-compliant architectural firms, they should beam their searchlight on those that have existed for over a decade and have offices in large cities. The study also implies that architectural practices in Nigeria involved in residential developments have access ICT infrastructure and skilled manpower; hence they are able to adopt e-Business technologies and processes in their operations in line with the current trend in the global architecture markets.

Second, there are relationships between the duration of e-Business technologies use and architectural firms' age, staff strength, number and location of offices. From these findings, it can be inferred that differences in the duration of e-Business technologies adoption in professional practice by architectural firms in Nigeria, can be explained based on variations in their age, staff strength, number and location of offices. This implies that organizational characteristics can be used as parameters for identifying architectural practices that are most likely to adopt e-Business technologies and processes, and may most likely em-

brace emerging digital concepts and practices such as the Internet of Things (IoT) in Nigeria and other countries in sub-Saharan Africa and beyond.

Third, it can also be concluded that the top three CSFs for e-Business technologies adoption in professional practice by architectural firms in Nigeria that require priority attention by their principals are the availability and access to reliable, affordable and fast Internet services; availability of IT skilled manpower; and having adequate knowledge of the benefits of e-Business. The implication of this is that for architectural firms in Nigeria, other countries in sub-Saharan Africa and beyond who are yet to embrace e-Business technologies and process in their operations, they must invest in the acquisition of Internet technology and information technology savvy human resource base to ensure that their adoption of e-Business model will be successful. In addition, the principals and top management staff of architectural firms must have adequate understanding of the capabilities and full benefits of e-Business technologies and processes in professional practice. This is to ensure that firms acquire the right set of ICT infrastructure capability suitable for their e-Business operational requirements and derive optimal benefits from their adoption in the delivery of quality services to their clients. This will no doubt require financial investments in knowledge acquisition by top management staff of the firms and their employees.

Further, the fourth conclusion is that the key dimensions of the CSFs for e-Business technologies adoption in architectural practice are availability of skill manpower, electricity, affordable and reliable e-Business infrastructure; existence of favourable operational environment for e-Business adoption; characteristics of e-Business technologies and processes; and e-Business readiness of top management and employees. This means that these are the four key aspects principals of firms or stakeholders understand and interpret the 21 CSFs for e-Business technologies and processes adoption in the architecture industry investigated in this research. The implication of this is that for architectural practices in Nigeria and possibly other countries in sub-Saharan Africa and beyond to successful adopt and use e-Business technologies and processes and other emerging digital technologies and practices, they must adequately evaluate and give priority attention to these four groups of factors and conditions before embracing the e-Business model in their operations.

Last, although this research has achieved its goal by identifying the specific factors and conditions that must be given priority attention for a successful adoption of e-Business technologies and processes by architectural firms in Nigeria, it is not without some limitations. First, since the data used were derived mainly from the administration of structured questionnaire to participants, the findings are limited to the biases of the respondents. In view of this, future study is suggested and such study should consider combining the administration of questionnaires and interviews in the data collection process. Second, the research sampled only registered architectural firms in Nigeria; and thus the findings are limited to this category of firms and cannot be extended to unregistered architectural and other professional firms in the Nigerian construction industry. Based on this, it is recommended that other study should be conducted to explore the situation among other professional groups in the construction sector, including engineers, quantity surveyors, facilities and project managers and builders among others. Last, the current study is on Nigeria, and thus its findings may have limited implication for other countries, except those in the developing countries in sub-Saharan Africa and other parts of the world that share similar experience with Nigeria when it comes to architectural practice and ICT infrastructure development and adoption.

References

Abdulkadir, G. & Kamara, J. (2013). A Qualitative Method for Assessing the Impact of ICT on the Architectural Design Process. *International Journal of Tropical Design Research and Practice,* 6 (1), 25-35.

Aduwo, E. B., Ibem, E.O, Tunji-Olayeni, P., Uwakonye, O. U., & Ayo-Vaughan, E.K. (2016). Barriers to the

Uptake of e-Procurement in the Nigerian Building Industry Journal of Theoretical and Applied Information Technology, 89(1), 133-147

Aduwo, E.B., Ibem, E.O., Ayo-Vaughan, E.A., Afolabi, A.O., Uwakonye, U.O., & Oluwunmi, A. A. (2020). Determinants of e-Procurement Implementation in Construction in Nigeria. *International Journal on Emerging Technologies, 11(2),746-755.*

Afolabi, A., Ibem, E.O; Aduwo, E.B.; Tunji-Olayeni, P.F. & Oluwunmi, A. A. (2019). Critical Success Factors (CSFs) for e-Procurement Adoption in the Nigerian Construction Industry. Buildings, 47(9)2-18.

Architects Registration Council of Nigeria (ARCON) and the Nigerian Institute of Architects (NIA). (2011). *Conditions of Engagement and Remuneration for Professional Architect's Services.* Abuja: Architects Registration Council of Nigeria.

Architects Registration Council of Nigeria. (2017). *Register of Architectural Firms in Nigeria.* Abuja: Architects Registration Council of Nigeria

Arif, A. A., & Karam, A.H. (2001). Architectural practices and their use of IT in the Western Cape Province, South Africa. *Journal of Information Technology in Construction*, 6,17-34.

Ashworth, A., & Perera, S. (2015). *Cost Studies of Buildings.* London: Routledge.

Boynton, A.C., & Zmud, R.W. (1984). An assessment of critical success factors. *Sloan Management Review*, Summer,17-27.

Bowmaster, J., Rankin, J., & Perera, S. (2017). *E-business in the Atlantic Canadian Architecture, Engineering and Construction (AEC) Industry.* TG83: e-Business in Construction. Retrieved from http://site.cibworld.nl/dl/publications/E-business%20Survey%20Report.pdf.

Butler. A. S. (200). Developing your company's new e-Business. *The Journal of Business Strategy.* 21(6),38-42.

Cherian, T.M., & Kumaran, L.A. (2016). E-Business in Construction Industry: Opportunities and Challenges', *Indian Journal of Science and Technology,* 9 (32),1-6.

Costa, A. A., &Tavares, L. V. (2014). Social e-Business as support for construction e-Procurement: e-Procurement network dynamics. *Automation in Construction*, 43,180-186.

Devaraj, S., & Wei, J.C. (2007). Impact of e-Business Technologies on Operational Performance: The Role of Production Information Integration in the Supply Chain. *Journal of Operations Management,* 25(6),1199-1216.

Dossick C. S., & Neff, G. (2010). Organizational Divisions in BIM-enabled Commercial Construction. *Journal of Construction Engineering & Management,*136(4),459-467.

Dubelaar, C., Sohal, A., & Savic, V. (2005). Benefits, impediments and Critical Success Factors in B2C E-Business Adoption. *Tecnovation,* 25,1251-1262.

Eadie, R., Perera, S., & Heaney, G. (2010). Identification of E-procurement Drivers and Barriers for UK Construction Organizations and Ranking of these from the Perspective of Quantity Surveyors. *Journal of Information Technology in Construction,*15,23-43.

Eadie, R., & Perera, S. (2016). *The State of Construction e-Business in the UK.* CIB TG83: e-Business in Construction. Retrieved from https://www.irbnet.de/daten/iconda/CIB_DC29670.pdf.

Fadeyi, M.O. (2017). The Role of Building Information Modelling in Delivering the Sustainable Building value. *International Journal of Sustainable Built Environment,* 6, 711-722.

Gajendran, T., & Perera, S. (2017). *The Australian Construction e-Business Review. Report for CIB TG83: e-Business in Construction.* Australia: University of Newcastle, Australia, Western Sydney University and the Australian Institute of Building (AIB). Retrieved from https://www.academia.edu/32363427/The_Australian_Construction_e_Business_Review_Report_for_CIB_TG83.

Hussin, J.D., Rahman, I.A., & Memon, A. H. (2013). The Way Forward in Sustainable Construction: Issues and Challenges. *International Journal of Advances in Applied Sciences*, 8,15-24.

Ibem, E.O, Aduwo, E.B. & Ayo-Vaughan, E. K. (2017). e-Procurement Adoption in the Nigerian Building

Industry: Architects' Perspective. *Pollack Periodica*, 12(3),167-180

Ibem, E. O., Akinola, A. O. Erebor, E. M., Tolani, M. O. Nwa-uwa, A. E. (2018). Survey Data on Digitalization of Building Procurement Process by Architectural Firms in Abuja, Nigeria. *Data in Brief*, 20,1063-1067

Ibem, E. O., Uwakonye, O.U., Akpoiroro, G.O., Somtochukwu, M. & Oke, C.A. (2018). Building Information Modeling (BIM) Adoption in Architectural Firms in Lagos, Nigeria. *International Journal of Civil Engineering and Technology*, 9 (9), 902-915.

IBM (2001). *IBM E-Server I-Series E-business Handbook.* A V5R1 Technology and Product. Retrieved from http://www.redbooks.ibm.com/redbooks/pdfs/sg246711.pdf.

International Standard Organization ISO 10845. (2010). *Construction Procurement-Part 1: Process, Methods and Procedures.* Geneva: International Standard Organisation.

Issa, R. R. A., Flood, I., & Caglasin, G. (2003). A Survey of E-business Implementation in the US Construction Industry. *Electronic Journal of Information Technology in Construction,* 8,15-28.

Isikdag, U. (2019). An Evaluation of Barriers to e-Procurement in Turkish Construction Industry. International *Journal of Innovative Technology and Exploring Engineering*, 8 (4), 252-259.

Johnson, R.E., & Clayton, M.J. (1998). The Impact of Information Technology in Design and Construction: The Owner's Perspective. *Automation in Construction,* 8, 3-14.

Klinc R., Turk Ž., & Dolenc, M. (2014). ICT enabled communication in construction 2.0. *Pollack Periodica,* 9(3),109-120.

Kolakota, R., & Robinson, M. (999). *E-Business Road to Success*. Reading: Addison-Wesley.

LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big data, Analytics and the Path from insights to value. *MIT Sloan Management Review,*52(2), 21-31.

Li, B., Akintoye, A., Edwards, P.J., & Hardcastle, C. (2005). Critical success factors for PPP/PFI projects in the UK construction industry. *Construction Management and Economics*, 23 (5),459-471.

McDonald, R. E., & Madhavaram, S. (2007). Marketing of Professional Project Services: An Exploratory Study of the Role of Operant Resources in the Context of Architectural Firms. Marketing *Management Journal*,17(1),95-111

NBS Research (2018). *Digital Transformation in Architecture.* Microsoft and RIBA. Retrieved from https://enterprise.microsoft.com/en-gb/.

Ogunmakinde, O.E., Siyanbola A.B., & Oginni, O. E. (2013). A survey of the impacts of Information Communication Technology (ICT) on Architectural Practice in Nigeria. *Journal of Environmental Sciences and Resources Management,* 6(2),137-156.

Oladapo, A. A. (2006). The impact of ICT on Professional Practice in the Nigerian construction industry. *The Electronic Journal on Information Systems in Developing Countries,* 24(2),1-19.

Oluwatayo, A., & Amole, D. (2014). Organizational Structure of Architectural Firms and Their Performances. *International Journal of Construction Engineering and Management*, 3(1),1-12.

Oluwatayo, A., Amole, D., & Adeboye, A. (2014). Architectural Firms in Nigeria: A Study of Organizational Culture and Determinants. *Global Journal of Researches in Civil and Structural Engineering,* 14(1),13-26.

Oyedele, L. O., & Tham, K. W. (2007). Clients' assessment of architects' performance in building delivery process: Evidence from Nigeria. *Building and Environment,* 42(5),2090-2099.

Penttilä, H.(2009).Services in Digital Design: New Visions for AEC-Field Collaboration. *International Journal of Architectural Computing,* 7(3),459-478.

Rivard, H. (2000). A Survey on the Impact of Information Technology in the Canadian Architecture, Engineering and Construction Industry. *Electronic Journal of Information Technology in Construction,* 5,37-56.

Rockart, J. F. (1982). The changing role of the information systems executive: A critical success factors perspective. *Sloan Management Review,* 24(1),3-13.

Rogers, E.M. (2003). *Diffusion of Innovations.* New York: Free Press.

Ruikar, K., & Anumba, C. J. (2008). *Fundamentals of e-Business in Construction*'. In: Anumba, C. J., & Ruikar, K (Eds). Oxford: Blackwell,1-22.

Schneider, G. P. (2003). *Electronic Commerce* (4th ed.). Boston: Course Technology.

Shen, W., Hao, Q., Mak H., Neelamkavil, J. Xie, H., Dickson, J., Thomas, R., Paradasani, A., & Xue, H. (2010). Systems integration and collaboration in Architecture, Engineering, Construction and Facilities Management: A Review. *Advanced Engineering Informatics,* 24,196-207.

Tepavcevic, B., Šijakov, M., & Štulic, R. (2012). Animation tools in Architectural Design and Education', *Pollack Periodica*, 7 (Supplement 1),157-162.

Tornatzky, L., & Fleischer, M. (1990). *The Process of Technology Innovation.* Lexington: Lexington Books.

Worst, J., (2009). Virtual enterprises: the impact of e-Business on the European construction industry. *Business Leadership Review.* Retrieved from http://www.mbaworld.com/blr-archive/issues64/3/index.pdf.

Yamane, T. (1967). *Elementary sampling theory.* New Jersey: Prentice-Hall.

Zwass, V. (2003). Electronic Commerce and Organizational Innovation: Aspects and Opportunities. *International Journal of Electronic Commerce,* 7(3),7-37.

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Reading 19th century architectural and interior space reflections of modernization through the literary space: Émile Zola's Nana

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Abstract

The interdisciplinary study of architecture across many fields adds meaning to architecture. Literature, which is one of the areas that works together with architecture, conveys information to the reader on many topics, such as periods, daily life practices, social problems, and human-space relations. Analysis of a literary work combines literature and architecture while expanding the boundaries of architecture, thereby contributing to both disciplines. This study reads the spatial components drawn from social problems through one literary text. Specifically, it reveals the social and spatial results of modernism experienced in 19th-century Paris in Nana (1880), the ninth book of Emile Zola's (1840-1902) 20-book Rougon-Macquart series. A qualitative methodology was used for the literature review and analysis of the novel. This case study revealed two main conflicts at the birth of modernism: the issue of class discrimination and the issue of gender. It is displayed that such an interdisciplinary spatial reading can directly relate literary texts and architecture.

Keywords

Émile Zola, Interdisciplinarity, Literary texts, Modernism, Socio-spatial reading.

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1. Introduction

Architecture intertwines with a wide range of disciplines, such as sociology, philosophy, engineering, and literature, which expands the meanings created by architecture itself. As one of the realms that architecture benefits from, literature provides information about space through reading literary texts. These allow us to read about human-space relations, daily life, social themes, and social problems. According to Psarra (2009, p. 67), "[w]hile architects are fascinated by narrative, writers are fascinated by architecture". As suggested by Tümer (1981), reading a literary work from an architectural perspective that was not written with a full architectural awareness provides opportunities to derive impressions and information about the architectural features of space. Havik suggests that "writers are uniquely qualified to read the spaces in which they move – places, buildings, landscapes – on several levels" (Havik, 2006, p. 40).

This study argues that reading literary texts is an effective method to understand the spatial components drawing on contemporary social issues. The study also shows how social issues experienced in daily life are reflected in social themes in literature. More specifically, it uses Nana (1880) as a case study. This is the ninth book of Emile Zola's (1840-1902) 20-book Rougon-Macquart series, in which "Zola exposes the sterility of bourgeois life and lays bare the materialist foundations of bourgeois ideology, of which the Second Empire was for him the epitomized political expression". He depicts the breakdown of a society doomed to dissolution because of its reckless individualism and its uncoordinated use of human energy (Nelson, 1986, p. 164). Referring to different issues and social problems in this series, Zola anticipated what the future would be like by observing the socio-spatial problems of his period, particularly in Paris. Bridge & Watson (2002, p. 7) claim that "[c]ities are not simply material or lived spaces – they are also spaces of the imagination and space of representation". The rapid evolution of Paris in the 19th century "rendered city life difficult to decipher, decode, and represent" (Harvey, 2006, p. 25). Zola was one of those novelists who could successfully "decode the city and render it legible, thereby providing ways to grasp, represent, and shape seemingly inchoate and often disruptive processes of urban change" (Harvey, 2006, p. 25). Following Haussman's interventions in the city, Paris became the focal point of its age. Knapp (1980, p. 46) notes Zola's frequent use of the city and its changes: "Zola captured the transformation as it was taking place; he ritualized it in his novels, injected it with his own dynamism, 'temperament,' likes and dislikes, and in doing imposed mythic and epic qualities onto the city of Paris".

Among many important topics, Zola addressed critical contemporary problems, such as misery and unemployment, luxury, war, education, religion and art. The novel explains the social realities of Paris in the Second Empire Period along with 19th century modernist innovations and developments. For example, Zola conveys the problem of prostitution and growing street life in France through the experience of the book's main character, Nana, who is a prostitute. His purpose is to reflect life as realistically as possible (Onaran, 2019). Nana, who grows up in the Paris slums, has a short career as a talentless actress before she finds victory as a courtesan. Despite being coarse and ignorant, she has a devastating sexuality that magnetizes wealthy and powerful men. Nana, who mercilessly despises the feelings of her lovers, squanders their wealth, leading many to ruin. Through the main character, Zola considers the dominant and destructive effects of social problems, even the collapse of society. According to Arıcan and Oda (2018), Nana is an environmental personality that reflects the appearance of society. Although she is the dominant character and events revolve around her, there are many other characters that support Nana at different points of the narration. Count Muffat is a devout noble, whose passion for Nana drives him to ruin his family life, waste his wealth, and humiliate himself. His wife, Countess Sabine, has a respectable reputation before her husband's affair but her character changes due to corruption within the family. Fontan is the only man Nana

loves although he behaves cruelly and makes her life far worse than before. Satin is an old friend who Nana later becomes passionate about while Nana's maid, Zoe, uses her to gain money from her lovers. Finally, Bordenave, the owner of the Variety Theater, gives Nana her first stage role.

This paper presents the 19th century architectural and interior space reflections of modernization by making an architectural reading of a literary text. To provide background and support the novel's content, the literature review considers modernization, class discrimination, and gender issues. Zola himself is also studied to provide a comprehensive perspective on his novelism. The novel "Nana" is analyzed within the framework of "modernism and class discrimination" and "modernism and the issue of gender". While analyzing class discrimination, three main spatial environments brought about by modernism are examined: boulevards, theatres, and passages. This spatial analysis involves dealing with social issues from different perspectives, such as urban life and interior life. The study demonstrates the corruption and moral deterioration of the bourgeoisie and other classes in Paris's consumer areas: streets, boulevards, cafes, and theaters. It also explains the destruction and changes in human relations affecting all segments of society, which reveal the effects of 19th century modernism in terms of the relationship between people and space.

2. Modernism and class discrimination

In the modern world, social classes also result from social isolation. This statement can also be reversed in that, according to Sayer (1991), the concept of class itself is a modern category. In the modern world, it describes a different body of social relations than its pre-capitalist counterparts (Sayer, 1991) because this distinction is emphasized by the arrangement of the physical environment, which the modern world tries to dominate by emphasizing it. During the 19th century, a dynamic ground was being built through modernism. Technological developments in every field provoked mass social movements resisting this modernization, increased waste, and a large global market (Berman, 1983). The primary distinctive feature of 19th century modernity was the highly developed dynamic new ground where modern experience emerged. Many authors and artists have explored topics and issues within this new ground.

Emile Zola's book, Nana, belongs to a period when Paris was being systematically demolished and rebuilt on the orders of Napoleon III and under the direction of Haussmann. Haussman designed a network of wide boulevards to replace the medieval city's streets. Existing suburbs would be cleaned and a "breathing space" opened for the dark, suffocating masses. However, Haussmann also opened up the entire city to all its inhabitants for the first time in its history. All this renewal provided the impetus for large-scale modernization, which brought together many people from different classes (Berman, 1983). Benjamin (1999, p. 11) notes that "the institutions of the bourgeoisie's worldly and spiritual dominance were to find their apotheosis within the framework of boulevards". He argues further that Haussman's urban ideal was to provide a perspective-oriented view down a succession of long streets (Benjamin, 2014). In line with this, he glorified the bourgeoisie within the framework provided by these institutions and streets, which were symbols of the world and spiritual sovereignty. As Paris's urbanization progressed in parallel with the reading of the spatial reflections of the capitalist economic order, these changes also affected people to create modern man (as cited in Özer, 2016). As also noted by Berman (1983), in this new life of Nana, Zola provides a clear impression of the poor suburbs revealed by Haussman's modernization:

"In the morning, when the man picked up overnight had been newly dismissed, all the courtesans of the quarter were wont to come marketing here, their eyes heavy with sleep, their feet in old down-at-heel shoes and themselves full of the weariness and ill humor entailed by a night of boredom [...] The latter did not the least mind being seen thus outside working hours, and not one of them deigned to smile when the passers-by on the sidewalk

turned round to look at them. Indeed, they were all very full of business and wore a disdainful expression, as became good housewives for whom men had ceased to exist" (Nana, 1880, pp. 162-163).

By the end of modernization efforts, "Paris appears to be victorious; a city in ruins but hastily rebuilt, a world of chaos, the intertwining of deprivation and prosperity, history and modernity" (Knapp, 1980, pp. 53-64). Throughout this whole process, Zola's problem was to reveal the sterility of bourgeois life, and the collapse of a society dissolved by its reckless individualism, and unorganized human energy (Nelson, 1986, pp.164).

Class differences emerging with modernism were noticeable throughout the city. The world of the upper class was intertwined with spaces thought to hide the corruption, although it actually forced them, unwillingly, to see themselves (Zola, 2019). Meanwhile, a new class with a significantly changed lifestyle emerged in 19th century France due to the industrial revolution. The new favorites of the bourgeoisie showed themselves in consumption, especially pleasure and entertainment. This included a new sector in which women slept with men for money to live a luxurious life of pleasure. During that period, Paris's streets, especially in Montmarte, had become the center of prostitution in modern life. In 1867, Jules Valles' La Rue magazine wrote: "Montmartre is the great factory of Parisian corruption, halfway between the Ile-Saint-Ouen and the Breda Quarter" (Hewitt, 2017, p.22). Zola describes this in a similar manner:

"Beneath the trees in the darkening and fast-emptying boulevards fierce bargainings took place. Respectable family parties – fathers, mothers and daughters – […] were used to such scenes [...] There up till two o'clock in the morning restaurants, bars and ham-and-beef shops were brightly lit up, while a noisy mob of women hung obstinately round the doors of the cafes. This suburb was the only corner of night Paris, which was still alight and still alive, the only market still open to nocturnal bargains between group and group and from one end of the street to the other, just as in the wide and open corridor of a disorderly house" (Zola, 1880, p. 175).

Rapidly developing street and boulevard traffic transformed the entire modern environment into a dynamic chaos. To negotiate this, the person of the modern street had to comply with its movements and learn to be one step ahead of catching the dynamic chaos (Berman, 1983). This chaos, which Berman also mentions, is very clearly observed in the urban spaces of Paris depicted by Zola: "From one end of the social ladder to the other everybody was on the loose! Good gracious! Some nice things ought to be going on in Paris between nine o'clock in the evening and three in the morning! And with that she began making very merry and declaring that if one could only have looked into every room one would have seen some funny sights—the little people going it head over ears and a good lot of swells, too, playing the swine rather harder than the rest" (Nana, 1880, p. 176). Commenting on the growth of Paris, Vienna, and London in the nineteenth century, Donald Olsen emphasized the "speed of the bourgeoisie leaving Palais Royal and the transition from the passages to the new streets and boulevards of the Haussmann era". Thus, great possibilities were created for previously limited outdoor pleasures (Olsen as cited in Peterson, 2007, p. 33).

Zola's Nana revealed the intermingling between classes, class differences, and degeneration experienced in boulevards, streets, cafes, and theaters, which offered new opportunities for outdoor pleasures. In the 19th century, theaters were one of the main spaces where the corruption between modern people and the other classes was represented (Zola, 2019). Théâtre des Variétés, which plays an important role in Zola's novel, opened in Paris on June 24, 1807 (L'histoire, 2020). During this period of the industrial revolution, as Paris modernized, theaters were important providers of pleasure and entertainment for the bourgeoisie. Located on Montmarte Boulevard, Théâtre des Variétés was one of the most popular in Paris (Güneş, 2018). From this, we can understand the social life of modern Parisians, as the theater was open from ten o'clock till midnight, when five to ten thousand carriages were waiting

while the boulevards were crowded with pedestrians (Güneş, 2018). In describing this crowd and the theater's interior design, Zola noted that people from all classes came there. It is a space for social mixing: "All Paris was there, the Paris of literature, of finance and of pleasure. There were many journalists, several authors, a number of stock-exchange people and more courtesans than honest women. It was a singularly mixed world, composed, as it was, of all the talents and tarnished by all the vices, a world where the same fatigue and the same fever played over every face" (Zola, 1880, p. 10).

Having one of the 19th century's aesthetically appealing interiors, the Théâtre des Variétés was decorated with green wallpaper and seats covered with pomegranate-colored velvet. As described in Nana, the boxes in front of the stage were positioned between high columns and adorned with long drooping fringes. The auditorium, illuminated in a soft green and painted in white and golden yellow, seems covered by the light of the great chandelier, "which was softened in the fine cloud of dust" (Zola, 1880, p. 19). Theaters also had a particular function during this period. In the novel, the theater owner, Bordevana, turns it into a place for women to exhibit their nudity – a brothel. Bordeneva's insistent and angry statements about the theater being a brothel therefore attract our attention. Some of the audience and the general public conceptualized this theater, where Nana felt at home, as a glass cave and a brothel:

"She drove her public wild by simply showing herself. You wouldn't find another body like hers! Such shoulders as she had, and such legs and such a figure! Strange that she should be dead! You know, above her tights she had nothing on but a golden girdle which hardly concealed her behind and in front. All round her the grotto, which was entirely of glass, shone like day […] Paris would always picture her thus – would see her shining high up among crystal glass like the good God Himself" (Zola, 1880, p. 301).

The Varietes Theater was located within a network of boulevards and modern public passages, which can be regarded as the architectural breakthroughs of the 19th century. In this urban context, it displayed all the scenes of modern life: immoral-evasive relationships, bourgeois immorality, entertainment understandings, the activities of prostitutes for fun, and money: "Bordenave, in order to save His Highness going about by the Passage des Panoramas, had made them open the corridor which led from the porter's lodge to the entrance hall of the theater. Along this narrow alley little women were racing pell-mell, for they were delighted to escape from the men who were waiting for them in the other passage" (Zola, 1880, p. 107).

The rearrangement of Paris's streets due to Haussmann's modernization brought together people from different classes in modernized urban spaces (Berman, 1983). The effect can be read very clearly, especially in the passages mentioned by Zola. Although these spaces served as urban spaces to bring together people from different lives, class differences continued to affect them:

"The Passage des Panoramas was a long, […] a kind of contracted by-lane which had been covered with a sloping glass roof (Nana, 2015 p, 108) […] He knew all the shops, [...] But he did not dare linger under the gaze of the pale shop women, who looked placidly at him as though they knew him by sight. For one instant he seemed to be studying the line of little round windows above the shops, as though he had never noticed them before among the medley of signs" (Nana, 1880, p. 135).

The Passage des Panoramas symbolizes the demi monde and its confusion. In Zola's novel, the passage takes on a sociological meaning (Stierle, 2009). Despite the crowds and chaos of the passage, Count Muffat is uncomfortable being there: "Though he did not like this passage end, where he was afraid of being recognized. [...] There was never anyone in this corner save well-dressed, patient gentlemen, who prowled about the wreckage peculiar to a stage door, where drunken sceneshifters and ragged chorus girls congregate" (Nana, 1880, p. 135-136).

The emergence of "class divisions in the modern city" creates "new divisions within the modern self" (Ber-

man, 1983, p. 153). Nana is significantly connected with the architecture of the passage and the objects it contains. Although these urban spaces are the center of class differences for Muffat, they remind Nana of her past:

"She adored the Passage des Panoramas. The tinsel of the ARTICLE DE PARIS, the false jewelry, the gilded zinc, the cardboard made to look like leather […] had been the passion of her early youth. It remained, and when she passed the shop-windows she could not tear herself away from them. It was the same with her today as when she was a ragged, slouching child who fell into reveries in front of the chocolate maker's sweet-stuff shows or stood listening to a musical box in a neighboring shop" (Nana, 1880, p. 138).

The reflections of modern life provided by Haussmann can be seen very clearly in the urban spaces of Paris in Zola's Nana. As modernization changes the city and the citizens, the effects of class difference on the people is not lost although people from different classes come together in the urban spaces provided in the city.

3. Modernism and the issue of gender

Regarding the roles of women in modern society in the 19th century, according to the bourgeois ideology of the period, men and women were entirely different, with divergent life trajectories requiring functioning in diverse ways. Men had to conquer the world and protect their own; women had to create a home where men could find peace and tranquility (Heynen, 2011). The setting of these duties arose from women's constant social and economic discrimination in the patriarchal society of the 1800s. The options of upper and middle-class women were limited to marriage or motherhood, which both led to domestic dependency (Cruea, 2005). While men were judged by their actions, women throughout the 19th century were judged by their sense of their setting and place. Women who were powerless in the public world wanted to be more effective in private spheres. Additionally, they wanted to feel belonging and a sense of "place" because they lacked a certain sense of identity (Russell, 1993). Thus, the concept of "domestic space" inevitably affected women's social status and identity.

Male dominance in public spaces was also supported by their control of women's experiences in the private sphere. Although women dominated cleaning, household order, and decoration in the domestic space during the day, they had to hand over control to men when present (Russell, 1993). Consequently, men are often positioned in places where they attempt to conquer the unknown whereas women have the role of objectifying modernity's "other" for tradition, continuousness, and home. This is largely the scenario of modernism. However, it becomes more complex if one tries to understand how women are associated with the experience of modernity in the 19th century. In "The Invisible Flâneuse", for example, Janet Wolff discusses how women mostly remain invisible in the approved literature on modernity by Benjamin, Sennett, or Simmel, which invokes Baudelaire's flâneur – the man in the crowd – as the most paradigmatic symbol of modernity. According to Wolff, women in the 19th century could not wander around the city inconspicuously, observing mobility, or appreciating incidental encounters. According to the customs of the time, respectable women – that is, middle-class or bourgeois women – were not allowed in the streets without a suitable companion while any woman seen alone in public spaces risked being labeled a prostitute – a public woman (Heynen, 2005, p.10). Women's desire to remain in private spaces (domestic spaces) protected them from the dangers of the public world of men. At that time, public spaces such as the "street" posed both physical and moral dangers (Russell, 1993). The most opprobrious examples of how sexuality penetrated space were women's restricted access to specific supposedly inappropriate areas of the city and the discomfort of non-heterosexuals in the public sphere (Baydar, 2012). In short, women were seen as the "weaker sex" as both victims and the most disturbing examples of these situations (Zimring, 1993).

Countering these attitudes towards women in the 19th century, Zola addresses thheir predicament by revealing the overbearing conditions under which they live. With his concern for women and their communities, Zola shows that women's lives are just as compelling and significant as men's (Romanczuk, 2002). Zola asserts that all women, regardless of their inherited characteristics or social status, are victims of gender segregation in society (Slott, 1985). Although men dominated 19th-century society, this novel emphasizes women's sovereignty over men. It is thus important that the main character is a woman to show that gender roles have changed. In the novel, role changes are emphasized to examine gender roles. Throughout the story, contrary to traditional male domination, society is affected and corrupted by Nana's influence over men. As a female character, Nana also affects the city of Paris: "With her, the rottenness that is allowed to ferment among the populace is carried upward and rots the aristocracy. She becomes a blind power of nature, a leaven of destruction, and unwittingly she corrupts and disorganizes all Paris" (Zola, 1880, p. 142).

Changes in the characters through Nana's influence are reflected in the spaces. In particular, spaces that were almost completely closed to the outside world with defined borders are transformed, with the private-public distinction disappearing everywhere, including the family base. Thus, Zola represents the collapse and corruption of society through domestic spaces and urban life. Domestic spaces are created as a barrier between the exterior and interior to separate oneself from the external environment and its negative influence. However, Nana's house is both a living space and workplace, which contradicts the traditional understanding of home. The aparment's interior architecture is perfectly suited to Nana's profession: every room opens onto the hallway, which makes it easier for Zoe the maid to prevent Nana's customers from seeing each other as they come and go. Nana's visitors treat her house as a public space, thereby destroying domestic space borders: "Zoe had stowed them all over the place, and she called attention to the great capabilities of the flat, every room in which opened on the corridor. That wasn't the case at Mme Blanche's, where people had all to go through the drawing room" (Nana, 1880, p. 38). Nana's influence on people is also clearly understood by the influx of visitors. Looking at this house, it is possible to see the reflection of the character's inner world on the space. In the novel, the house consists of half-furnished rooms with empty spaces waiting to be filled, which symbolizes the gap that Nana is trying to fill in her life: "She occupied the second floor of a large new house in the Boulevard Haussmann [...] The rooms were too big for her and had never been completely furnished. The vulgar sumptuosity of gilded consoles and gilded chairs formed a crude contrast therein to the bric-a-brac of a secondhand furniture shop – to mahogany round tables, that is to say, and zinc candelabras" (Nana, 1880, p. 25).

In general, Nana herself is comfortable breaking with the idea of home. Instead, she forces her interior to comply with her situation to create social status awareness. She reinforces this by holding a party to which everyone is invited Since there are too many guests, all areas of the house require adaptation. However, the mismatch between the intended activity and the space is evident: "She had decided to make the restaurant come to her. She wanted to celebrate her great success as an actress with a supper which should set people talking. As her dining room was too small, the manager had arranged the table in the drawing room, a table with twenty-five covers, placed somewhat close together" (Nana, 1880, p. 60). Nana's agreement with the restaurant for the invitation causes the outdoor space to move into the interior. However, the resulting atmosphere means the guests gradually forget they are in a home and act as if they are in a public area: "Since the beginning of supper, she had seemed no longer in her own house. All this company had overwhelmed and bewildered her with their shouts to the waiters, the loudness of their voices and the way in which they put themselves at their ease, just as though they were in a

restaurant […] Nana had disappeared, but nobody fretted about her absence" (Nana, 1880, pp. 74-75).

An opposite perception to this permeability occurs when Nana is invited to Count Muffat's house. Here the interior is strictly separated from the exterior. One feels very clearly at home, which reflects Muffat's traditional family life. The house symbolizes the glory and power of the family as a whole: "It was a great square building, and the Muffats had lived in it for a hundred years or more. On the side of the street its frontage seemed to slumber, so lofty was it and dark, so sad and convent like, with its great outer shutters, which were nearly always closed" (Nana, 1880, p. 43).

Social status and power are reflected in both the interior and the guests. Both guests and family members are limited in when they can use the spaces. The domination of Count Muffat and his family heritage on the interior is vividly evident. Countess Sabine has not changed anything at home and preserved the legacy of the man:

"When she was only expecting intimate friends, the countess opened neither the little drawing room nor the dining room […] The drawing room was very large and very lofty; […] at night, when the lamps and the chandelier were burning, it looked merely a serious old chamber with its massive mahogany First Empire furniture, its hangings and chair coverings of yellow velvet, stamped with a large design. Entering it, one was in an atmosphere of cold dignity, of ancient manners, of a vanished age, the air of which seemed devotional" (Nana, 1880, p. 43).

Countess Sabine strikingly demonstrates her presence in the interior through the one noticeable object that she has changed: "the big chair with the red silk upholsteries in which the countess sat had attracted his attention. Its style struck him as crude, not to say fantastically suggestive, in that dim old drawing room. Certainly, it was not the count who had inveigled thither that nest of voluptuous idleness. One might have described it as an experiment, marking the birth of an appetite and of an enjoyment" (Nana, 1880, p. 50).

Another important interior space mentioned in the novel is the country house bought by one of her lovers. This house, which Nana had always dreamed of, away from the corruption in the city, exemplifies how spaces can affect their users: "Yesterday's existence was far, far away, and she was full of sensations of which she had no previous experience […] Great God, she could have cried, so good and charming did it all seem to her! Beyond a doubt she had been born to live honestly!" (Nana, 1880, p. 118). This house makes Nana fully feel that she has the right to a decent life and a family. The most important reason for this is that it gives a sense of belonging lacking in her house in Paris or in her previous life: "Never yet had she felt anything comparable to this. The country filled her with tender thoughts. As a little girl she had long wished to dwell in a meadow […] Now this estate, this stretch of land belonging to her, simply swelled her heart to bursting, so utterly had her old ambition been surpassed" (Nana, 1880, p. 122).

The effect that Nana's country house has on her as a result of her spatial experience continues after she returns to Paris. Choosing to settle in a small neighborhood like Fontan with the idea of having the family that she had not had before reflects how the idea of the home influences her: "We are in a little set of lodgings on the fourth floor in the Rue Veron at Montmartre […] And so, she preferred giving up everything. Besides, the flat in the Boulevard Haussmann was plaguing her to death. It was so stupid with its great gilded rooms! In her access of tenderness for Fontan she began dreaming of a pretty little bright chamber" (Nana, 1880, p. 156). Generally, although Nana is willful and determined, she becomes passive because of Fontan's vulgar attitude towards her. To avoid losing what she has, she cannot escape from this ongoing cycle, gradually lost her self-esteem and returning to where she started. This situation gives information about some of Paris's undesirable streets, but revealed through changes in the urban fabric (Berman, 1983):

"Then began a series of wild descents upon the Parisian pavement whose votaries prowl in muddy bystreets under

the restless flicker of gas lamps. Nana went back to the public-house balls in the suburbs [...] She revisited the dark corners on the outer boulevards, where when she was fifteen years old men used to hug Satin, […] used to take Nana to Bullier's and the public houses in the Boulevard Saint-Michel […] Eventually they always returned to the principal boulevards; for it was there they ran the best chance of getting what they wanted. From the heights of Montmartre to the observatory plateau they scoured the whole town […] There were long periods of waiting and endless periods of walking; there were jostlings and disputes and the nameless, brutal caresses of the stray passer-by who was taken by them to some miserable furnished room and came swearing down the greasy stairs afterward" (Nana, 1880, p. 174).

While sheltering in Satin's home, Nana went to the café of Laure, where she is served a cheap dinner. This space provides information about the image of public places at that time. Although women were generally accompanied outside by men, men could be at risk if they were seen in public with a known courtesan (Liggins, 2006). These women transformed this cafe into a comfortable space for themselves through their shared experience:

"This was a table d'hote in the Rue des Martyrs […] The majority were nearing the age of forty [...] These still wore a modest expression despite their impudent gestures, for they were only beginners in their art, who had started life in the ballrooms of the slums and had been brought to Laure's by some customer or other […] [an] extremely motley throng, where faded dresses and lamentable hats contrasted strangely with handsome costumes, the wearers of which fraternized in vice with their shabbier neighbors" (Nana, 1880, pp. 165-166).

Even though they are all women, there is still a sense of class difference and hierarchy among them: "It was composed of smart, fashionably dressed women who were wearing their diamonds […] to eat the three-franc dinner while flashing their jewels of great price in the jealous and astonished eyes of poor, bedraggled prostitutes. The moment they entered, talking and laughing in their shrill, clear tones and seeming to bring sunshine with them from the outside world, Nana turned her head rapidly away" (Nana, 1880, p. 167).

After developments in Nana's life prevent her from finding the family life she wants, she decides to follow society's prevailing corrupt order. With this sudden recognition of the power she has, she identifies herself with the space and wants to feel her power in it. She adopts a completely different attitude and the effect is observed in her new place. She uses her sexuality as a weapon to get everything she wants. The power of her gender brings her a lot of wealth as men cannot even control their simple impulses:

"Nana's house was situated at the luxurious quarter at Plaine Monceau. Count Muffat had bought the house ready furnished and full of hosts of beautiful objects—lovely Eastern hangings, old credences, huge chairs of the Louis XIII epoch […] But since the studio, which occupied the central portion of the house, could not be of any use to her, she had upset existing arrangements, establishing a small drawing-room on the first floor, next to her bedroom and dressing room, and leaving a conservatory, a large drawing room and a dining room to look after themselves underneath. She astonished the architect with her ideas, for, as became a Parisian work girl […] she had suddenly developed a very pretty taste for every species of luxurious refinement" (Nana, 1880, p. 202).

The boudoir is an important symbol in the history of eroticism and modern architecture. As a clearly sexualized female space, it was a particularly female-inhabited and female-directed domestic space (Troutman, 2005, p. 296). The boudoir demonstrates how the feminine principles of emotion and instinct that form its voluptuous decoration, intimate use, and internalized character are coded spatially and architecturally. It also emphasizes the changing roles of women and suggests the impact of feminine values on space. In Zola's novel, the boudoir is a spatial analogue of sexualized space and projected desire (Troutman, 2005).

In Zola's book, every space that Nana has or influences has gradually moved away from its original function (the concept of home). As literally the only interior space where women have the right to impact, the boudoir expanded as the symbol of the sovereignty that Nana's sexuality established over society. It transcended her house to spread to, and took over all spaces. Thus, Zola opposes traditional gender ideas by depicting new gender roles and sexuality. Nana's character reflects the patriarchal limitations of 19th century Paris. To overcome these limitations, Nana uses her sexual powers to control people and ruin society (Olson, 1994):

"Meanwhile, Nana had cherished her latest caprice. Once more exercised by the notion that her room needed redoing [...]. The room should be done in the velvet of the colour of tea roses, with silver buttons and golden cords, tassels and fringes, and the hangings should be caught up to the ceiling after the manner of a tent. This arrangement ought to be both rich and tender [...]. Nana meditated a bed such as had never before existed; it was to be a throne, an altar, whither Paris was to come in order to adore her sovereign nudity [...]. On the headboard, a band of Loves should peep forth laughing from amid the flowers, as though they were watching the voluptuous dalliance within the shadow of the bed curtains [...]. The bed would cost fifty thousand francs, and Muffat was to give it to her as a New Year's present" (Zola, 1880, p. 270).

Zola clearly depicts Nana's influence over Count Muffat and the corruption she brings to the interior of Muffat's house. The house, which previously reflected Muffat's traditional family life, has become a symbol of the loss of Muffat's power and the breaking of ties within the family: "'And just to think that he was once master,' continued Mme Chantereau,' and that not a single rout seat would have come in without his permission! Ah well, she's changed all that; it's her house now. Do you remember when she did not want to do her drawing room up again. She's done up the entire house'" (Nana, 1880, p. 259). Countess Sabine, whose presence was previously limited to a single piece of furniture, emphasized its presence that became prominent due to the change it made at home. This rupture in family ties also destroyed the domestic place in Muffat's house. Having been separated from the public by certain lines and previously preserved its privacy, this place became completely public and exposed private life after its redesign:

"When the first guests arrived […], they were positively dazzled. One had only to recall to mind the drawing room of the past, through which flitted the icy, ghostly presence of the Countess Muffat […] Then, too, the drawing room looked splendid; it was hung with Genoa velvet, and a huge decorative design by Boucher covered the ceiling, a design for which the architect had paid a hundred thousand francs at the sale of the Chateau de Dampierre […] It seemed as though Sabine's long chair, that solitary red silk chair, whose soft contours were so marked in the old days, had grown and spread till it filled the whole great house with voluptuous idleness and a sense of tense enjoyment not less fierce" (Nana, 1880, pp. 258-259).

Nana's effect on the family and its domestic space is underlined by playing Blonde Venus in the house decorated by Countess Sabine: "The waltz [...] in the Blonde Venus [...] It was as though some fleshly wind had come up out of the common street and were sweeping the relics of a vanished epoch out of the proud old dwelling, bearing away the Muffats' past, the age of honor and religious faith which had long slumbered beneath the lofty ceilings" (Nana, 1880, p. 259). Through these extreme transformations of interior spaces, Zola reveals the corruption that begins in the family before spreading through society. These alterations of the domestic space indicate that the home cannot preserve the integrity of its physical limits. Thus, domestic space borders are destroyed.

4. Conclusion

Lefebvre defined space as both a social product and a form of ideology. According to him, space is a social competition area used by different people in line with this ideology. Different social classes have tried to establish dominance in this area (Moore, 2014). Through the novel, Nana, Zola demonstrates that the intermingling of classes

is more than an attempt to dominate one another; rather, it becomes degenerative through events taking place in the streets, theaters, and avenue cafes. Additionally, in place of male dominance in 19th-century life, Zola tried to change these gender roles through Nana, the main character in his novel. In both interior and public spaces, Nana shows the gender effects of her character on society. Zola deals with these two different issues –class discrimination and gender– through the spatial reflections of modernism.

Nana's movement between social environments and classes enabled Zola to analyze different class structures and address social themes (Olson, 1994). The present study provided a realistic determination of the conflicts at the birth and foundations of modernism through the case study of Nana. In his criticism of 19th-century modernism, Zola chooses spaces to shed light on the period and people's lifestyles. He conveys the problem of social relations that prioritize imperialism while dominated by industrial capitalism in 1870-1900. While Zola chose the Second Imperial Period as his medium, the documents he created reflect a future period. Through analyzing the novel Nana from a spatial viewpoint, this study explained the conditions, problems, class changes, social collapse, and corruption created in a modern state through the breakpoints of the period. These breakpoints, which represent modernism, are consumption and entertainment areas like boulevards, cafes, and theaters. Although the novel was criticized at the time as immoral by the press and conservative intellectuals (Onaran, 2019), it recorded the socially dramatic consequences of modernism and the modern state.

Historically, the meanings and functions of cities have changed continuously for various reasons. During the 19th century, modernism caused radical changes. While the political, economic, and cultural structure influenced the transformation of cities, it also affected all segments of society. Experiences in these areas in Paris's urban and domestic contexts demonstrate the use of spaces and the relationships of the people who experienced them. Thus, early modernism can be criticized at the intersection of people and space through the interdisciplinary correspondence of literature and architecture. The analysis of spatial components can be carried out through literary works that convey spatial comments to the reader. Therefore, literature and architecture influence and support each other, and become stronger and more meaningful by feeding from each other. The collaboration between these two disciplines enabled this study to reveal social issues in different spatial contexts of 19th-century Paris through a socio-spatial reading.

References

Arıcan, O., & Oda, A. (2018). Emile Zola'nın Nana karakterinde çevre ve unsurları. *Turkish Studies, 13*(20), 63–76.

Baydar, G. (2012). Sexualised productions of space. *Gender, Place & Culture, 19*(6), 699-706. https://doi.org/10.1080/0966369X.2012.675472

Benjamin, W. (1999). *The arcades project* (H. Eiland & K. McLaughlin, Trans.). Harvard University Press.

Berman, M. (1983). *All that is solid melts into air: the experience of modernity.* Verso.

Bridge, G. & Watson, S. (2002). City imaginaries. In G. Bridge & S. Watson (Eds.), *A companion to the city* (pp. 7–17). Wiley & Blackwell.

Cruea, S. M. (2005). Changing ideals of womanhood during the nineteenth-century woman movement. *General Studies Writing Faculty Publications.* https://scholarworks.bgsu.edu/gsw_pub/1

Güneş, M. (2018). Avrupa'da bir Cevelan'da tiyatroya ve operaya bakış [A view of theater and opera in wandering in Europe]. In S. Somuncu (Ed.), Avrupa macerasının erken dönem örneği Avrupa'da bir Cevelan (pp 97–117). Manas Press. https://www.academia.edu/37992529

Harvey, D. (2006). *Paris, capital of modernity.* Routledge.

Havik, K. (2006). Lived experience, places read: Toward an urban literacy. In C. Grafe, K. Havik & M. Maaskant (Eds.), *Architecture and literature. Reflections and imaginations* (pp. 37–49). Nai Publishers.

Hewitt, N. (2017). *Montmartre: A cultural history.* Oxford University Press.

Heynen, H. (2005). Modernity and domesticity: tensions and contradictions. In H. Heynen, & G. Baydar (Eds.), *Negotiating domesticity: spatial productions of gender in modern architecture.* Routledge.

Heynen, H. (2011). Gender and architecture. A review of the literature. *Journal of the School of Architecture at the University of Cyprus*, *2*, 158-177.

Knapp, B. L. (1980). *Emilé Zola.* Frederick Unger Publishing Co.

L'histoire. (n.d.). Retrieved from https://www.theatre-des-varietes.fr/theatre/histoire/

Liggins, E. (2006). *George Gissing, the working woman, and urban culture.* Ashgate Publishing, Ltd.

Moore, B. (2014). *Invisible architecture: Ideologies of space in the nineteenth-century city* [Doctoral dissertation, The University of Manchester]. The University of Manchester. https://www.research.manchester.ac.uk/portal/en/theses/invisible-architecture-ideologies-of-space-in-the-nineteenthcentury-city(10ec0828-2272-4cb0-bc41-3880cf58cdc3).html

Nelson, B. (1986). Zola's ideology: The road to utopia. In D. Baguley (Ed.), *Critical Essays on Emile Zola* (pp 161-172). K. Hall & Co.

Olson, S. M. (1994). Zola's Nana| *Power in a prostitute's body* [Master's thesis, The University of Montana]. Scholar Works University of Montana. https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=5144&context=etd

Onaran, B. (Ed.). (2019). *Sunuş: Nana.* Türkiye İş Bankası Kültür Yayınları.

Özer, G. (2016). Modern kentte yabancılaşma: 19. yüzyıl Paris'i ve 21. yüzyıl İstanbul'undan deneysel kesitler [Alienation in the modern city: experimental sections from 19th century Paris and 21st century Istanbul] [Doctoral dissertation, İstanbul Technical University]. DSpace Repository. https://polen.itu.edu.tr/xmlui/handle/11527/15958?locale-attribute=en

Peterson, S. A. (2007). *Flanerie in Zola's Paris* [Master's thesis, University of North Carolina]. NC Docks. https://libres.uncg.edu/ir/uncg/f/umi-uncg-1380.pdf

Psarra, S. (2009). *Architecture and narrative: The formation of space and cultural meaning.* Routledge.

Romanczuk, B. L. (2002). *Screening Zola's women* [Doctoral dissertation, The Ohio State University]. Ohio Link. https://etd.ohiolink.edu/apexprod/rws_olink/r/1501/10?clear=10&p10_accession_num=osu1283186545

Russell, P. (1993). In search of woman's place: An historical survey of gender and space in nineteenth-century Australia. *Australasian Historical Archaeology,* 28-32.

Slott, K. (1985). Narrative tension in the representation of women in Zola's "L'Assommoir" and "Nana". *L'Esprit Créateur*, 25(4), 93-104.

Stierle, K. (2009). The Paris of Zola: Real presences and mythic horizons. *Caliban. French Journal of English Studies*, (25), 259–274.

Troutman, A. (2005). The modernist boudoir and the erotics of space. In H. Heynen, & G. Baydar (Eds.), *Negotiating domesticity: spatial productions of gender in modern architecture.* Routledge.

Tümer, G. (1981). *Mimarlıkta edebiyattan neden ve nasıl yararlanmalı?: Aragon'un "Paris Köylüsü" üzerine bir örnekleme)* [Why and when to make use of literature in architecture?: An sampling on Aragon's Paris Peasant] Ege University Faculty of Fine Arts Department of Architecture.

Zimring, R. E. (1993). *Genealogies of the modern metropolis: Gender and urban space in Zola, Gissing, James, and Conrad* [Doctoral dissertation, Yale University]. eLibrary Ru. https://www.elibrary.ru/item.asp?id=5662133

Zola, É. (1880). *Nana.* (J. Stirling: Peterson & Brothers, Trans.). https://onemorelibrary.com/index.php/en/books/literature/book/french-literature-135/nana-%20emile-zola-2016

Zola, É. (2019). *Nana.* Türkiye İş Bankası Kültür Yayınları.

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Outside the house but not in the city: Promenades in Istanbul as negotiated public spaces for women in 19th-century Ottoman novels

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Abstract

Drawing on from feminist literary theory, this article analyses the first Ottoman novels working within and consolidating the patriarchal discourse published in the rampant modernization period in the second half of 19th century, which is also named the Tanzimat (Reorganization) era of the Ottoman Empire. Having Istanbul as their settings, the discourse of the novels tackle with delineating the limits to the social and cultural transformations, which the novels' writers perceive to be the direct result of Western influence. The novels have a didactic style aimed for guiding their readers to shield certain values, which they think hold the core of Ottoman identity, from the changes. We argue that the discourse of the novels manifest ambivalence regarding the inevitable presence of women outside the house and negotiate with their readers on the place and practices of publicness. No matter how popular and crowded they had then become, the promenades, were where the male writers aimed to confine women in their outings. At one level, their emphasis on the promenades is related with the conceptualization of nature as a safe space in the context of a modernizing city. And, on the other level, they want to keep Muslim women away from Pera, the Westernized and cosmopolitan district, in Istanbul.

Keywords
Public space, Gender, Promenades, Istanbul, Tanzimat novels.

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1. Introduction

Readers of the early Ottoman-Turkish novels, which are usually referred to as Tanzimat novels, must have discerned the promenades (1): urban parks, public gardens, and meadows, as a repeating category of spaces used as an 'acceptable' setting where women and men could intermingle. From the mid- to late-19th century, starting with the first Ottoman novel written in 1851, Vartan Paşa's *Akabi Hikyayesi* (The Story of Akabi), to later novels of better renown, including Namık Kemal's *İntibah* (Awakening) (1876), Recaizade Mahmut Ekrem's *Araba Sevdası* (The Carriage Affair) (1896), and in numerous novels by Ahmet Mithat Efendi, male and female protagonists see, meet, interact with, open up to, or seduce each other in the promenades of Istanbul.

In *Akabi Hikyayesi*, although Agop notices Akabi looking out a window, their first encounter takes place in Alemdağ's Taşdelen meadows where they promise to meet again. Their affair becomes an impossible love story akin to that of Shakespeare's Romeo and Juliet. Because Akabi is an Orthodox and Agop is a Catholic Christian, their families do everything in their power to separate them. They communicate through letters and can only meet one more time at the Beykoz Meadow. In Ahmet Mithat Efendi's novel, *Vah!* (Alas) (1882), Necati sees Ferdane at the Çamlıca promenade, outside the theatre where he saves her from being harassed by a group of men. After this incident, they are only able to meet in the city's public gardens where they eventually confess their love for each other. In another novel by Ahmet Mithat Efendi, *Çingene* (The Gypsy) (1887), the male protagonist falls in love with a young gypsy woman whom he sees at the Kağıthane gardens. He goes there repeatedly until he finally decides to take her under his protection in order to raise her as a respectable woman for marriage.

If these examples insinuate that urban parks and public gardens were neutral grounds for socialising but sometimes became sites of innocent love, be assured that they were also grounds for dangerous liaisons. Çamlıca is a common site of seduction. Ali Bey, the male protagonist of Namık Kemal's novel *İntibah*, falls in a love trap during his first visit to Çamlıca. Mahpeyker, a notorious courtesan in Istanbul, sets in motion a course of events that eventually lead to his demise. In a narrative set twelve years later, Ulviye Hanım seduces Mergup, a well-known dandy among the elite in order to avenge her young neighbour, Dürdane. She is the title character of Ahmet Mithat's novel *Dürdane Hanım* (Miss Dürdane) (1888) who suffers from Mergup's misconduct and reluctance to marry. For Ulviye the only way to teach her neighbor's lover a lesson is to make him fall in love with her. Hence, she goes to Çamlıca to initiate her calculated affair.

These public spaces were also stages of display where class identities are expressed. In *Araba Sevdası*, Recaizade Mahmut Ekrem depicts parks as urban spaces that allowed for social mixing and ostentatious self-presentation among members of the middle class. The novel is a satire about individuals obsessed with class distinction and the struggle to keep their status or move upwards in society with fake or borrowed assets. The dandy protagonist Bihruz Bey thinks he is infatuated with the love of his life only because her glamorous carriage mesmerizes him when the two encounter at Millet Park. All the way through until the very end, the park is the only space where these "lovers" can meet.

How, should we, then, interpret the frequent presence of urban parks, public gardens, and meadows, that enabled men and women, particularly Muslim women, to meet, flirt, seduce, and show off in the Tanzimat novels, especially when it is impossible to come across one simple instance of co-presence in other public spaces of the city such as the doorstep, the street or inner city squares? It remains striking to note that the same does not hold for encounters between Muslim men and non-Muslim women. Furthermore, within the seventeen novels dating from 1851 to 1898 that we have analysed for this article, the promenades' meaning shifts from being sites

of social degradation to sites of pure leisure and joyful encounters both manifest in the events and dialogues in the narratives. Thus, why, among many other places in the city, the writers were concentrating on and yet so ambivalent about the promenades?

Drawing on gender theory and sociological analyses of parks as emergent public spaces of modernity, we explore answers to these questions in the context of the Ottoman Empire's modernization and the reflection of this process on its capital city, Istanbul. In accordance with feminist literary criticism, from which we draw our analytical lens, we focus on literary works as discursive practice and analyse them as texts related to their socio-political and cultural climate. There is a long tradition of analysing novels, not only for understanding the experience of their milieu, but also as part of a discursive formation. Sandra Gilbert and Susan Gubar's *The Mad Woman in the Attic* (1979) and Janet Wolff's *Feminine Sentences* (1990) are important models of seeing the world created in narrative fiction against the social mentality of its era. The methodological perspective adopted in these interpretive works focused on the sub-text, i.e. not only on what the novels say, but on what the novel does not say, and how it does not say it, as literary critic Terry Eagleton stated (1991, p.178). Similarly, our close reading of where women are portrayed and are absent in the settings of the Tanzimat novels form the primary basis of the arguments laid out in this article. Furthermore, we analysed how the spaces, where women protagonists were present are coded in the narratives in relation to: the presence of others, the events occurring in those spaces, and how all of these are evaluated within the novels (either in the form of a value-laden statement or, more subtly, through their consequences in the narratives). Additionally, the novels are put in dialogue with other texts in a contemporary framework such as travellers' accounts, journalists' opinion pieces, and legal documents.

The novels mentioned above were written by male authors. Only four of the seventeen that are analysed for this article were written by Muslim women: *Muhadarat* (Teachings) (1892) and *Refet* (1897) by Fatma Aliye; *Pakize* (1895) by Behiye Ziya Kollar; and *Dilharap* (Devastated) (1896) by Fatma Fahrünissa. Their novels show how the patriarchal mentality prevalent and dominant in the novels of male authors can also be seen in those by female authors, even for those, who took part in the struggle for women's subjectivity. Two of the other novels were written by Ahmet Mithat Efendi, which are: Felatun Bey ile Rakım Efendi (1875), and *Henüz Onyedi Yaşında* (Just Seventeen) (1881). The remaining novels are: Şemsettin Sami's *Taaaşuk-ı Talat ve Fitnat* (The Love of Talat and Fitnat) (1872), Samipaşazade Sezai's *Sergüzeşt* (The Adventure) (1889), Mehmet Celal's *Bir Kadının Hayatı* (The Life of a Woman) (1890), Mizancı Mehmet Murat's *Turfanda mı yoksa Turfa mı?* (Precocious or Weird?) (1891), and Nabizade Nazım's *Zehra* (1896). We selected these novels due to their setting in Istanbul and because they were contemporary novels written in the realistic genre.

There are seminal studies on the Tanzimat novels' discursive formation through allegory and layers of meaning such as Jale Parla's B*abalar ve Oğullar* (Fathers and Sons) (1990) and Şeyda Başlı's *Osmanlı Romanının İmkanları Üzerine* (On the Potentials of the Ottoman Novel) (2010), but these works do not focus on the relationship between public space and gender. And although there are many studies in the context of Ottoman-Turkish novels that focus on the spatial settings in literary narratives, they are mostly descriptive. Moreover, the limited number of studies that explore the relationship between the public realm and literature focus on publicity but do not concentrate on gender (Günaydın, 2007; Akkach, 2010). Works, that problematize women's presence in public spaces, on the other hand, focus on the social realm in much earlier periods and in different literary genres (Ölçer, 2003; Hamadeh, 2008; and Ambros, 2016). Thus, we think that this article through its critical analysis at a discursive level

fills a gap by concentrating on the intertwined relationship between public realm, spatial practice and gender in the Tanzimat novels.

As Felski argues, among many potential examinations, novels are good sources for understanding the inherent mentality of an era, either through writers' contribution or resistance to it (2008, p.77-104). Significantly, Tanzimat novels help us understand how writers, as the intellectuals of their society, made sense of modernization as well as help us understand the inner conflicts, tensions, and anxieties inherent to modernity that is usually absent in other straightforward texts, such as newspaper accounts, memoirs, etc. (Parla, 1990, p.9; Gürbilek, 2004, p.13). As we elaborate in the following section, Tanzimat novels are critical sources because they were more influential than other later printed fictions; firstly, because they were new and the only entertaining mass media that could also be individually consumed in a time when there was no television (Tanpınar 2012, p.451). And secondly, Tanzimat novels were intentionally forming a discourse. As literary historians have also stated, they were written with an agenda and they should be seen as expressive of their writers resistance to modernity in many aspects and their will to guide the public in what to resist and how (Parla, 1990; Moran, 1983).

Furthermore, in the context of late 19th-century Istanbul, we argue that rereading Tanzimat novels testifies to the problematic nature of women's appearance in the public realm and how this was negotiated with readers. In her book *Feminine Sentences*, cultural theorist Janet Wolff (1990, p.4) argues that although women's problems related to equality and freedom cannot be resolved at the level of representation, rereading novels and other texts with a feminist perspective in a particular historical context and with a socially analytical lens can expose the discourse through how women's lives were framed. Thus, we contend that the discursive ambivalence prevalent in the *Tanzimat* novels is the starting point for understanding the collisions, conflicts, and negotiations related to the perpetuating spatial segregation of women.

2. The socio-political climate of the tanzimat era and the first Ottoman novels as discursive instruments

Tanzimat novels have their categorical name not only because they were written after the announcement of the *Tanzimat Fermanı* (Reformation Edict) in 1839, but also from their writers' common anxiety related to the circumstances and consequences of the reforms declared in the edict. The large scope of the reforms was due to the shrinkage of the Empire both in terms of territory and economy as well as the economic advantages given to European states as the result of the treasury debts that were owed to them. The fundamental aim of the reforms was to regain the empire's political and economic power by integrating its trade activities with the international capitalist economy and recentralizing the state apparatus via the creation of new institutions (Quataert, 1994, p.761-765). The reform program set the ground for a secular and democratic country. It extended more rights to non-Muslims living within the Empire and issued a 'call for equality for women' (Quataert 1994, 765). The accompanying trade agreements signed with European Governments induced many European companies to open branches in Istanbul and subsequently witnessed the influx of European officials and workers into the city. Such transformations were followed by the introduction of new institutions and spaces for the expansion of finance, education, military, and public health policies as well as new venues that changed the socio-cultural sphere (Çelik, 1986; Gül, 2009). Furthermore, developments in technology were already altering the urban landscapes, particularly in the case of access via bridges and new modes of public transportation. The ferry line and the train put an end to arduous journeys by rowboats or pack animals and provided effortless trips to the city. The city centre became easily accessible to all, particularly to women even from urban niches that lined the distant shores of the city.

During this period, Istanbul developed a second city centre. Almost all of the new buildings for new institutions with new typologies were located in the district of Pera (2). The prioritization of

Pera was an administrative choice and a response to accommodate the European capital in the city. Embassy complexes, new secular schools, as well as hotels, shops selling imported goods, European-style cafes and restaurants, theaters, bookshops, entertainment halls, and brothels all opened up one after another, making the district a European capital of its own — a city within the city (Akın, 1998). Consequently, the social and cultural life of Pera was in strong contrast with the rest of Istanbul. There were also important differences with respect to urban modernization projects. For instance, the first municipality for a district in Istanbul was planned for Pera in order to administer the infrastructure implementations in the district. The urban renovation projects in the other parts of the city, however, were "patchy" applications leaving some parts of the built landscape neglected, thus creating another contrast with the newly built Pera (Çelik, 1986, p.xvi and p.79). These distinctions between Pera and the rest of Istanbul also attracted the authors of the Tanzimat novels. The setting created opportunities for writers to take a position vis-à-vis westernization and they presented Pera against the values they were restless to conserve. Nevertheless, Pera represented an attractive poison. Although many writers spent their social and leisure time in the district, the way they represented Pera in the novels was a place of danger, such that the moment a Muslim male protagonist stepped into Pera, he found himself in the chain of events that ruin his life. The black-and-white comparison between Pera and Istanbul was one of the didactic contrasts in their narratives.

Another big change after Tanzimat reforms was the beginning of local and private press activity. 130 Ottoman-Turkish newspapers started publication between 1860 and 1878, whereas there were only two newspapers before (Kologlu, 2013). Confirming political scientist Benedict Anderson's (1983) argument on how crucial print-capitalism proved in the spread of ideologies, Ottomans were fast becoming citizens and finding outlets to their competing worldviews in print culture (Uslu, 2014, p.237). The novel was an important outlet and helped reconstruct this world in two ways. Firstly, novels were all serialized in newspapers first and then printed as books (Moran, 1983, p.17). As newspapers were critical in the establishment of the novel as a genre (Serdar and Tutumlu, 2019), the novels also helped increase the popularity of newspapers. Second, writers of the reformation era were not only engaged in literature, most were either political actors, or significant intellectuals who wrote for or ran newspapers and journals, which is an indication of that their influence criss-crossing the realms of everyday life and literature. The placement of the fictional narrative alongside news from the city, state-cases, or revelations of burglaries or murders further strengthened the didactic element of these 19th century novels (Lund, 1993). If we reference Marshall McLuhan's well-known adage, "the medium is the message" (1964), the publication of these novels in newspapers reinforced both the realism of their narratives and the public sphere they aimed at shaping.

For Tanzimat writers, novels were pedagogical devices that aimed to limit the influence of modernization on their readers. As such novels were used as discursive instruments to negotiate the consolidation of certain boundaries (Tanpınar, 2010 /1956; Moran, 1983; Parla, 1990; 2000, p.73-1112; Esen, 2006). In order to achieve these pedagogical ends, the writers applied the literary strategy of creating sharp contrasts like the one they constructed between Istanbul and Pera. They set dualities between 'Ottomans' and 'Europeans', 'inside' and 'outside' the house, as well as, 'prudent' and 'reckless' men, or 'frivolous' and 'chaste' women. These dualities were quick resolutions to the problem of confronting the urban spaces of modernity, a new social and physical environment, and new line of conduct that, as Marshall Berman states (1988, 15), promised "adventure, power, joy, growth, transformation of (them) selves and the world –and at the same time, (…) (was) threatening to destroy everything (they) have, everything (they) know, everything (they) are."

The normative and didactic style of the novels aimed to guide readers with certain social, political and moral codes and to help them demarcate the limits of socio-cultural transformation. If westernization, (which stood in for the new life-style shaped by consumerism, cosmopolitanism, new institutions and the socio-economic modes that disseminated from Pera) was one paramount issue, the other was women's place in the public realm. The writers however were more ambivalent about the latter. For instance, although the fathers in the novels become more tolerant towards the education of girls, they still clung to the ideal of the mythical wife and mother in the domestic realm. Almost all female characters are expected to read and write, but not continue beyond primary school. Ambivalence was also due to new social conditions that clashed with the ideals that the writers wanted to conserve. An important social dilemma that recurs in the novels is the need to be able to choose one's spouse. But under what conditions could young men and women be permitted to see and meet with each other? What would happen if women were allowed to leave the confines of the house? Promenades, as already popular urban places, were perhaps the best candidate to bring young men and women together, but they were too popular and had already become a marriage market. Writers oscillated between two limits in their discourse. They discerned chaste, happily domesticated women from frivolous, undomesticated women who were either silly or harmful in their plots. And, on the other end, they suggested that chastity could be conserved if women could go to the promenades only on weekdays, when it was less crowded, so that they would prove that they were not interested in seeing and being seen but only enjoying the fresh air and socializing with their kin. Of course, strolling at Pera was never an option for these outings.

As previously mentioned, female novelists also remained loyal to these conventions. Although the first female Ottoman novelists Zafer Hanım, Fatma Aliye Hanım, Behice Ziya, and Fatma Fahrünnisa, who were more powerful than many others in the society (Günaydın, 2017, p.30), and were making women's intellectual contribution to society apparent, continued to work within the prevalent patriarchal discourse. They, too, problematized women's place 'outside the house,' but female writers' "good" female protagonists, like those of their male counterparts, are almost always indoors: inside their rooms, inside a house, inside a confined private garden, or inside a school. Their position is similar to female painters' in the 19th century. Griselda Pollock (1988, p.70-127) argued that female painters avoided coexisting with their subjects in realms that were considered to be male spaces and their themes almost always related to interior spaces. Likewise, female writers of the Tanzimat era never wrote about experiences related to being among strangers in the streets, in cafes, or even in public transportation, although their female protagonists had to leave the house from time to time. By contrast, male writers' protagonists exposed readers sometimes for several pages to their experiences and impressions of the public world.

We do not want to imply that female writers never included promenades in their literary topography, but their perception of sociability in that space was in tune with their male counterparts' ambivalence. They portray their "good" female characters visiting promenades for the sole purpose of taking in fresh air and contemplating. Fatma Aliye's female character Refet, for instance, visits the Fenerbahçe Park only once with her friends; and instead of strolling, they sit at the edge of the park turning their backs to the crowd so they can contemplate the horizon. Behice Ziya's protagonist Pakize, who is only interested in reading books, goes to Millet Park but only once at the insistence of her neighbour; while at the park she refuses to take part in the scene and thinks that every man in the promenade is a womanizer. That said, this one outing allows her for the first time to encounter a man she admires and falls in love with. The plot line exposes a conundrum since if she had not agreed to go to Millet Park, she would not have a love story to tell.

We argue that the male and female writers of the Tanzimat novels knew that women would inevitably leave the house, and attempted to prescribe the scope of potential activities outside. By avoiding the heart of the modern city (Pera) and suggesting that women who socialized outside the house had to take measures to safeguard their honour and status in society, they together reproduced the patriarchal mentality. Toward this end, they gave their female protagonists only conditional permission to encounter life outside the domestic realm and that only through the promenades.

3. Promenades as spaces of leisure, sociability and spectacle

It was not the case that Ottoman crowds entertained themselves elsewhere and then later, in the second half of 19th century, found shelter from the strains of urban life and industrial pollution, noise, and crowdedness in the promenades that appear in Tanzimat novels. For the Ottoman populace, spending time in the promenades, especially on grounds with running waters or close to the sea had always been a common leisure practice (Boyar and Fleet, 2010). Not only in Istanbul, but in many Ottoman towns there were such open spaces: private or communal gardens for growing vegetables and fruit for kitchen use (*bostans*), meadows for picnics in between neighbourhoods or outside the city walls, as well as cemeteries whose trees provided shelter. As the witnesses of the last quarter of the 19th century informs, small or large, these pieces of nature in vicinities of neighbourhoods offered an opportunity for women to spend time outside the house without having to go to city centres, to male-coded spaces, which also played a significant role in their popularity (Abdülaziz Bey, 2002, p.287-299; Balıkhane Nazırı, 2011, p.89-145). On the experiential level, the atmosphere of the promenades created by the land, water, and soundscapes, as well as being the place of social gatherings in nature and sometimes for watching the full moon at summer nights made them unique places offering pleasure, relaxation and recreation, suspending all daily obligations while creating moments of equality for all.

Maurice Cerasi (1985) explains the richness of promenades as lived-spaces – they were not merely grounds for strolling but spaces where a whole family or group of friends could sit for hours and sometimes days. Different groups of people could find a place on the grounds for making music, singing, dancing, and smoking together while having a picnic. There could be temporary structures or vendors serving food and coffee or sherbet.

Architectural historian Shirine Hamadeh (2008) elaborates on how promenades from the 18th century onwards became the centre of daily social and recreational activities. Hamadeh (129) argues that the juxtaposing of spatial and social experience offered by this unique type of space also played a role in the formation of a middle-class identity. As they became public venues, promenading became less related with recreation in nature, but rather became more related to sociability, visibility and networking. These spaces were the primary venues for consolidating one's place in society and demarcating class boundaries during a period of greater social fluidity. Cultural historian David Scobey (1992, 211) states that the same was in practice for mid nineteenth-century New York city where promenading in Central Park was "a peculiar mix of spectacle and restraint, creating a stage on which wealth, refinement and character could be merged (…) (and that) seeing and being seen affirmed members of the society dynamism, prosperity and civility."

In Istanbul (Figure 1), Kağıthane and Göksu were two of the oldest and most popu¬lar promenades, and they appear quite often in Tanzimat novels and the travelogues of foreign travellers. Kağıthane was located at the very end of the Golden Horn (Haliç), while Göksu was on the Asian part of what was then the northern edge of the city. Apart from spending time on lush meadows, another layer of pleasure was added to the experience with the arrival of boat journeys to Kağıthane and Göksu. Kağıthane was where; the court in 18th century went out of the Topkapı Palace for enjoying different seasons and celebrating certain events. It became both popular and was criticized due to the

design of a new palace and a series of gardens, partly likened to the palatial gardens in Paris. With its opening to the general public, the garden and the boat trips on the Kağıthane river became one of the most preferred activities for leisure and recreation, as well as sociability and displays of social status. (Eyice, 1997, p.82-86) In both Kağıthane and Göksu, people could also continue on the river by boat and reach inland meadows or stroll and ride in carriages along the rivers as they could also lounge wherever they pleased. Ahmet Mithat Efendi's novels, *Felatun Bey ile Rakım Efendi* and *Çingene* have notable pieces delineating the Kağıthane promenade and depicting different atmospheres depending on the seasons, times of day, and crowds present.

A series of leisure gardens located beside vineyards that were dotted by the mansions of the elite in between pine groves in Bağlarbaşı and Kısıklı neigborhoods in the Üsküdar district on the Anatolian side of Istanbul was another frequent backdrop to the critical events in the novels. Üsküdar district includes two of the highest hills in the city: Major Çamlıca and Minor Çamlıca both covered in pine groves. The Major Çamlıca was particularly picturesque as it offered the widest panorama of Istanbul starting with the Marmara Sea overlooking the Prince Islands, sweeping Topkapı Palace as a gateway to the walled city and Haliç, and ending with Bebek Bay on the northern half of the Bosphorus. The view from and the exceptional green atmosphere of Çamlıca appear not only in the Tanzimat novels, but also features in poems and songs from different periods (Koçu, 1965). In the long prolegomena to his novel *İntibah,* Namık Kemal describes the natural ambiance of Çamlıca and expresses his admiration for nature, explaining partially why these spaces have been so popular.

The Ottoman Empire also took part in the late-19th century global urban parks movement, establishing six municipal parks in Istanbul. These parks were smaller in area compared to the already existing promenades but featured other amenities such as permanent structures for sitting and stages for concerts and plays, as well as small pools and paved strolling surfaces. One of the first parks in Istanbul was Millet Park, which opened in 1867 and was situated near to the Çamlıca meadows. The role that Millet Park plays in Recaizade Mahmud Ekrem's novel *Araba Sevdası* is more than a setting, to the extent that, literary scholar Jale Parla (1990, 131) argues that it was a metaphor for the Ottoman Empire. Like Namık Kemal, Ekrem also starts his novel with a prolegomena that depicts the enclosing wall and the fences of the park, different kinds of trees, flowerbeds, small buildings, the bower, and the kiosk located on the small island in the artificial lake. He highlights the perfection of the park's design and that the design offered a variety of spaces for different events. But unlike Kemal's emphasis on the awakening of nature in every spring, Ekrem stresses how the park has lost its charm over the years, insinuating that such formal scenery may become popular easily but consumed quickly.

4. Promenades as sites of negotiation for women's outings

Several historians agree that although women were present and visible in the streets and the marketplaces, the only acceptable public space for leisure or entertainment were the promenades (Faroqhi, 2010, p.122; Boyar and Fleet, 2010, p.230-244). Nevertheless, co-presence with unfamiliar men was not acceptable and there was always a demarcated and obligatory female-only space reserved for women even in the promenades (Boyar and Fleet, 208). The adventures of the male protagonists in Ahmet Mithat Efendi's two novels, *Vah!* and *Müşahedat*, for instance, begin with their furtive glimpses through the partitions separating the female-only areas in the ferry and the trams. Hagop Mintzuri's memoirs (2002, p.83) dating to the last days of the 19th century testify that even opening the curtains separating male and female compartments was prohibited. However, breaching these boundaries was easier in the loose spaces of the promenades where men and women could contravene restrictions by exchanging glances, sending letters, or even passing comments and chatting for a short period.

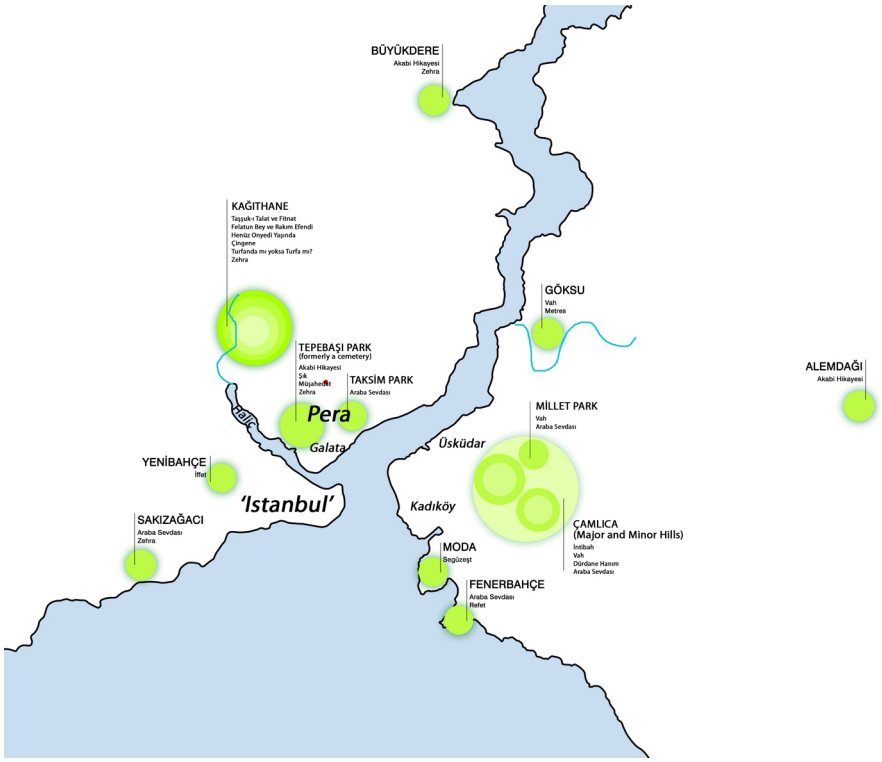

Figure 1. *Certain promenades in Istanbul corresponding to the Tanzimat novels.*

As women began to visit promenades more often, official regulations were established for controlling encounters in public spaces. An early document in 1821 banned women from going to certain promenades, not even allowing them to stop by the gardens and wait in their carriages (BOA, HH, 1236) (3). Fourteen years later in 1835 – four years before the declaration of the Tanzimat Edict – the ban established for women's promenading was lifted, but new rules appeared including precautions for verbal harassment toward women among debates on women's attire either for being too revealing or resembling courtly fashions (BOA, HH, 1250). A decree published two years later focused on the time when women should come back from the promenades (BOA, HH, 1252). Although the mingling of men and women was not addressed as an issue in these documents, a decree published in 1849 prohibited women's presence in certain promenades and further reported that although women and men were segregated, men were seen taking advantage of garden topography and vistas to peep on women. The same document stated where women and men were seen together and declared separate days for men and women's promenading. The decree ends with a detailed description for the location of the curtain separating women and men's sections (BOA, SDK, 1266). These legal documents indicate the struggle authorities faced in attempting to prevent the public enjoying the freedom that accompanied the modernization of the city, especially new public transportations and consumption trends. Several policies existed: some places were off-limits to women altogether, others were open to them on certain days, and still others allowed women in the garden as long as they remained hidden in a separate section. The main concern of these rules was the monitoring of women's public presence, which was blamed for causing men to lose their rational faculties in the face of physical attraction and, thus, was regarded as morally corrupting for society in general. Official disapprobation evident in the legal documents, ambivalence toward women's freedom of movement, and the constant negotiations of women's public presence echo the discourse found in Tanzimat novels.

The inconsistent laxity in policies regulating the promenades discussed above was not extended to other parts of the city. During the early years of the Sultan Abdülaziz era (1861-1876), a se-

ries of bills from 1862 banned women from going or sitting inside shops while shopping as well as from being on the street at night regardless of their religion or ethnicity; the law also banned women from going to promenades that were frequented by men (Alkan, 1990, p.85-95). Nonetheless, there was a "compromise" on the statement regarding the promenades, as it was uncertain which ones were popular among men and when. Such vagueness can be associated with the Tanzimat writers' ambivalence on the matter and insinuated "tolerance" for women's presence in the promenades as long as they did not visit popular gardens.

Several anecdotes written in travelogues and memoirs testify to how regulations were implemented. Traveler Edmondo de Amicis, who visited Istanbul in 1872, wrote that he was puzzled by the apparent rules on women's freedom of movement. Amicis (2013, 202) observed that women were independent in their choice to go anywhere they liked, even alone, as long as they did not mingle with men. Almost twenty years later Alexander van Milligen (2003, p.182), who lived and worked in Istanbul from 1861 until his death in 1915, criticized the surveillance apparatus that controlled women in Göksu and Kağıthane and condemned police officers for following women as if they were children who needed to be chaperoned. He pointed out that a policeman could order a woman to close her carriage window if he thought she was attracting admiring looks or that the police could abruptly stop a group of women from sailing on the Bosphorus in the evening and force them to return to their houses (183). Van Milligen lamented that such restrictions made educated Turkish women's lives difficult and shameful (183). The author Dorina Neave (1933, p.145), who lived in Istanbul between 1881 and 1907 where her father worked for the Supreme Consular Court, described the striking contrast between Muslim and non-Muslim women's freedom in their outdoor lives and speculated on how Muslim women perceived these differences.

While women's appearance in public was an important part of modernization for the supporters of reformation, conservative commentators considered it a sign of degeneration (Göle, 1997). Basiretçi Ali Efendi and Ebüziyya Tevfik Bey, two journalists of the era, wrote extensively on how women and men should behave in public. In his weekly column, Basiretçi Ali Efendi (2001, p.142) condemned any kind of observable communication between women and men in the promenades and in Pera. He further complained about how women spent extended periods in certain spots, about their inviting gestures, and about their inappropriate dress (143). Interestingly, Basiretçi argued that Muslim women were not on the same level of decency as European women, and they were abusing the opportunity that had been granted to them. Ebuzziya Tevfik Bey, on the other hand, complained about the Europeanization of Muslim women's attire and body language (Balıkhane Nazırı, 2001, p.109) and bemoaned the disappearance of decent Ottoman culture. Nevertheless, even conservative social critics struggled to make sense of the changing norms on co-existence, shared public space, and women's increasing education. For example, Basiretçi could be ambivalent in his discussion of Muslim and non-Muslim women's equality. While in one article he celebrated the ban on Muslim women walking the main streets of Pera (2001, p.128), in another he complained about the restrictions towards Muslim women in Taksim Park and expressed regret regarding the inequality in spatial practices for Muslim and non-Muslim women (48-49).

The contested arguments that we disclose here demonstrates that if Muslim women in Istanbul had to be tolerated in public spaces, then natural spaces were less threatening than urban spaces, particularly Pera. Pera not only hosted nightlife, prostitution, gambling, as well as questionable sites of socialization, and hotels, but also strangers. The dominant presence of the other in Pera prohibited it as a respectable place for the Muslim middle class. Although literary scholar Gülçin Ambros (2016) points out that promenades had niches enclosed with trees,

where it was rather easy to hide from the surveillance of onlookers, officials still policed promenades, which were easier to survey than the crowded streets of Pera. Compared to Pera's obvious moral degeneration, natural spaces were rendered asexual and childish, similar to how writers –as the voice of the patriarchy- portrayed the ideal Muslim woman.

5. Discussion: Nature and women in the modern city

We argue that promenades were "acceptable" venues for Muslim women's sociability in the discourse of the Tanzimat novels, not only due their existent popularity, but because they were understood as a neutral space between the possibly dangerous public realm and the limited options of the domestic realm. Whether a designed park, a loosely arranged leisure garden or a meadow in between districts, nature in the city belongs to an interesting spatial category of modern urbanization. In discussing the life and perception of parks in the 19th century Paris, art historian Nicholas Green (1990, p.128) avers that "(u)nlike many ideological domains where we can point to materially-located institutions as the sites from which power is exercised, nature, it seems, hangs in a vacuum." In this sense, we can refer to Michel Foucault's (1986) concept of heterotopia, which posits that what is unacceptable or illicit in the city becomes somewhat acceptable in the "space that remains" or in the "vacuum" suspending social restrictions. Architecture theorist Galen Cranz (1982, p.242) supports this interpretation and writes that "while parks are mechanisms of social control, they manage to express a life force independent of social order. Plants subliminally represent the uncontrollable nature of the life force; (…) house plants, urban greenery, and park planting alike remind people whether consciously or not, that they too have an irrepressible life force within them. Parks will always be associated with the related ideas of spontaneity and freedom."

The place of promenades in the constructed division between private and public space in bourgeois ideology is parallel to the ideological distinction between nature and culture. Environmental studies scholar Margaret Fitzsimmons (1989) has argued that nature provides one pole of all the great enlightenment antinomies: nature versus society, and nature versus culture. As culture is all that is "man-made," then the summit of this cultural development, the city, is definitely "man's" territory.

Fleeting and anonymous social interactions made possible by urban anonymity became sources of anxiety and fear for the patriarchal mentality, to the extent that, many 19th-century commentators and observers advocated women's restriction to the domestic sphere as part of a natural sexual order. (MacDowell, 1999, p.154). Drawing from Simone de Beauvoir (1973), Fox Keller (1985), and Hélène Cixous and Catheriné Clement (1986), feminist theoretician Gillian Rose (1993, p.17-40) argues that women's immediate association with the house and the case for her to be protected or saved from the "outside world" is grounded in dichotomist thinking that reduces woman to her biological features. She states that such a "particular reading of (women's) bodies meant that women were represented as natural creatures, beyond culture and society, compelled to remain in the private domestic sphere by their natural maternal instinct" (1993, p.74).

The patriarchal reflex to modernity was not simply a cultural issue. Woman's presence in the public realm and her insurgence to become a subject were more related to moral norms of the bourgeoisie rather than the religious codes practiced in the Ottoman Empire. For instance, stated in his speech "Of Queens' Gardens" (1865), public speaker and art critic John Ruskin stated that home was "the place of peace" for a woman, in which "she is protected from all danger and temptation (1913, p.137)." Ruskin's public lecture has been problematized extensively and accepted as the paragon of conservative statements that consolidate the divide between the public and private realms and their identification with the masculine and the feminine (Millet, 1971, p.93; Wolff, 1990, p.77; Rose, 1993, p.45). What is remarkable for our purposes is Ruskin's use of nature

as a metaphor in the title of his speech. In his critical essay on Ruskin's speech, literary historian Walter Houghton also stresses his use of the garden as a metaphorical sphere for the woman, where certain virtues are protected from the crushing forces of modern life (Houghton 1963, 343 as cited in Roman 1992, 1). Similarly, the identity that was bestowed upon Muslim women and the meaning of promenades coincided in the Tanzimat novels, because both were regarded as "innocent" and "unspoiled." That only in the public spaces of "nature" were women allowed to appear.

6. Conclusion

Early Ottoman/Tanzimat novels offer us a critical perspective for reflecting on how dominant patriarchal mentality was sustained and reproduced through the discourse embedded in their narratives. What has been a particular interest in their discourse for this article has been the construction of public spaces in relation to gender. We discern that in these public spaces, the writers offer promenades as sites of negotiation for the infiltration of modern sociability outside the house, significantly against women's potential anonymity in the cosmopolitan city. Tanzimat novels were not simply representing city life but delivered almost like urban guides for the rising middle class to help them navigate the changing conditions that arrived with the emergence of a more inclusive public realm. From the mid-19 century onward, Ottoman women took advantage of urban anonymity, mobility via modernized public transportation, and new and advanced educational institutions. They were not only becoming more visible in the public spaces of the city, they were also becoming active subjects, participating in society and thereby contributing to the making of a truer public realm. Where and how women are portrayed in the settings of the early Ottoman novels testify to how Tanzimat writers as public intellectuals were reacting to women's claim to the urban public realm.

Counted among old as well as emerging public spaces, promenades became sites of negotiation in establishing social distinction and demarcating the spatial limits of women's publicness. Even if most commentators and writers remained unsure about the suitability of women's entry into public spaces, promenades as "natural" spaces were seen to be more innocent and neutral like a protected space in the threatening public life of the modernizing city. Not only it was more appropriate than urban, male-coded territories, it was also easier to survey and regulate compared to crowded spaces of Pera. Thus, as a guide to new urban forms of sociability, Tanzimat novels presented promenades as acceptable spaces of sociability -spaces that existed beyond the domestic realm but not quite in the city.

Endnotes

[1] Mesire was an all-encompassing Ottoman-Turkish term that is synonymous with promenade. Derived from the Arabic verb syr, it means both to promenade (verb) and the grounds for strolling (noun). The activities were never, however, restricted to strolling in natural spaces. We elaborate on the particularities of promenades and their differences from the parks in the fourth section.

[2] The name Pera literally means the other side. From the vantage point of the walled city of Istanbul, Ottomans saw the area housing the Galata tower and the Genoese walls as the other.

[3] All documents cited from the Ottoman State Archives are translated by Dr. Ömer Karakaş.

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References

Abdülaziz Bey (2002). *Osmanlı Adet, Merasim ve Tabirleri* (K. Arısan & D.A. Günay, Eds.). İstanbul: Tarih Vakfı Yurt Yayınları.

Ahmet Mithat Efendi (2016). *Felatun Bey ile Rakım Efendi.* Syracuse: Syracuse University Press. (Original work published 1875)

Ahmet Mithat Efendi (2007). *Henüz 17 Yaşında.* Ankara: Elips Kitap. (Original work published 1880)

Ahmet Mithat Efendi (2010). *Dürdane Hanım.* İstanbul: Paraf Yayınları. (Original work published 1882)

Ahmet Mithat Efendi (2000). *Vah!.* Ankara: Türk Dil Kurumu Yayınları. (Original work published 1882)

Ahmet Mithat Efendi (2001). Çingene. *Letaif-I Rivayat*, İstanbul: Çağrı Yayınları. (Original work published 1887)

Akın, N. (1998). *19. Yüzyılın İkinci Yarısında Galata ve Pera.* Istanbul: Literatür Yayınları.

Akkach, S. (2010) Leisure Gardens, Secular Habits: The Culture of Recreation in Ottoman Damascus. *METU Journal of the Faculty of Architecture 27*(1), 67-80.

Aksan, V., & Goffman, D. (2007). Situating the early Modern Ottoman World. In V. Aksan, & D. Goffman (Eds.), *The Early Modern Ottomans, Remapping The Empire* (pp.1-12). Cambridge: Cambridge University Press.

Alkan, M. Ö. (1990, Yaz). Tanzimattan Sonra Kadının Hukusal Statüsü. *Toplum ve Bilim* 50, 85-95.

Ambros, G. (2016). Frivolity and Flirtation, In E. Boyar, & K. Fleet (Eds.), *Ottoman Women in Public Space* (pp.150-186). Leiden: Brill.

Anderson, B. (1999). *Imagined Communities.* New York: Verso.

Balıkhane Nazırı Ali Riza Bey (2017). *Eski Zamanlarda İstanbul Hayatı* (A. Ş. Çoruk, Ed.). İstanbul: Kitabevi Yayınları.

Basiretçi Ali Efendi (2001). *İstanbul Mektupları* (N. Sağlam, Ed.). İstanbul: Kitabevi.

Başbakanlık Osmanlı Arşivi. Hatt-ı Hümayûn. 300/17864

Başbakanlık Osmanlı Arşivi. Hatt-ı Hümayûn. 319/18712

Başbakanlık Osmanlı Arşivi. Hatt-ı Hümayûn. 493/24223

Başbakanlık Osmanlı Arşivi. Sadaret Divân Kalemi.1266/64

Başlı, Ş. (2010). *Osmanlı Romanının İmkanları Üzerine.* İstanbul: İletişim Yayınları.

Berman, M. (1998). *All That Is Solid Melts Into Air.* New York: Penguin Books.

Boyar, E., & Fleet, K. (2010). *A Social History of Ottoman Istanbul.* Cambridge: Cambridge University Press.

Cerasi, M. (1985) Open Space Water and Trees in Ottoman Urban Culture in the 18th-19th Centuries. *Journal of the Islamic Environmental Design Research Centre* 2, 36-49.

Cixous, H., & Clement, C. (1986). *The Newly Born Woman.* Manchester: Manchester University Press.

Cranz, G. (1982). *The Politics of Park Design.* Cambridge: MIT Press.

Çakır, S. (2016). *Osmanlı Kadın Hareketi.* İstanbul: Metis Yayınları.

Çelik, Z. (1986). *The Remaking of Istanbul.* Berkeley: University of California Press.

De Amicis, E. (2013). *İstanbul.* İstanbul: Yapı Kredi Yayınları.

De Beauvoir, S. (1971). *The Second Sex.* New York: Knopf.

Esen, N. (2006). *Modern Türk Edebiyatı Üzerine Okumalar.* İstanbul: İletişim Yayınları.

Evyapan, G. A. (1999). *Old Turkish Gardens Old İstanbul Gardens in Particular.* Ankara: ODTÜ Mimarlık Fakültesi Yayınları.

Eyice, S. (1997). İstanbul Halkının ve Padişahların Ünlü Mesiresi: Kâğıthane. In M. Armağan (Ed.), *İstanbul Armağanı 3: Gündelik Hayatın Renkleri* (pp.75-96). İstanbul: İstanbul Büyükşehir Belediyesi Kültür İşleri Daire Başkanlığı Yayınları.

Faroqhi, S. (1997). *Osmanlı Kültürü ve Gündelik Yaşam,* Tarih Vakfı Yayınları, İstanbul.

Fatma Aliye Hanım (2010). *Muhadarat.* İstanbul: Paraf Yayınları. (Original work published 1892)

Fatma Aliye Hanım (2019). *Refet* (F. Altuğ, Ed.). İstanbul: Turkuaz Kitap. (Original work published 1898)

Fatma Fahrünnisa (2018). *Diharap* (R.Tutumlu & A. Serdar, Eds.). Istanbul: Koç Üniversitesi Yayınları. (Original work published in serials 1896-1897)

Felski, R. (2008). *Uses of Literature.* Oxford: Blackwell.

Fitzsimmons, M. (1989). The Matter of Nature. *Antipode* 21(2), 106-320.

Foucault, M. (1986). Of Other Spaces. *Diacritics* 16(1), 22-27.

Gilbert, S., & Guba, S. (1979). *The Madwoman in the Attic.* New Haven: Yale Unv Press.

Green, N. (1990). *The Spectacle of Nature.* Manchester: Manchester University Press.

Göle, N. (1997). *The Forbidden*

Modern. Ann Arbor: University of Michigan Press.

Gül, M. (2009). *The Emergence of Modern Istanbul.* London: I.B.Tauris.

Gülersoy, Ç. (1993). *Tepebaşı Bir Meydan Savaşı.* İstanbul: İstanbul Büyükşehir Belediyesi Yayınları.

Günaydın, A. U. (2007). Tanzimat Romanında Kamusal Alan ve Serbest Zaman Etkinlikleri (unpublished master thesis). Bilkent University Institute of Economy and Social Sciences, Ankara.

Günaydın, A. U. (2017). *Kadınlık Daima Bir Muamma.* İstanbul: Metis Yayınları.

Gürbilek, N. (2004). *Kör Ayna Kayıp Şark*, İstanbul: Metis Yayınları.

Hamadeh, S. (2008). *The City's Pleasures: Istanbul in the Eighteenth Century.* Seattle: University of Washington Press.

Houghton, W. (1963). *The Victorian Frame of Mind 1830-1870*. New Haven: Yale University Press.

Keller, F. (1985). *Reflections on Gender and Science*, New Haven: Yale University Press.

Koçu, R. E. (1965). Kağıthane. *İstanbul Ansiklopedisi 7* (pp. 3709-3113). İstanbul: Ercan ve Hamle Matbaaları.

Koloğlu, O. (2013). *Osmanlı'dan 21. Yüzyıla Basın Tarihi.* İstanbul: Pozitif Yayınları.

Kollar, B. Z. (2019). *Pakize* (R.Tutumlu & A. Serdar, Eds.). Istanbul: Koç Üniversitesi Yayınları. (Original work published in serials 1895-1896)

Lund, M. (1993). *America's Continuing Story: An Introduction to Serial Fiction, 1850-1900. Detroit: Wayne State University Press.*

McDowell, L. (1999). Gender Identity and Space: *Understanding Feminist Geographies.* Minnesota: University of Minnesota Press.

McLuhan, M. (1964). *Understanding Media: The Extensions of Man.* New York: McGraw and Hill.

Mehmet Celal (2001). *Bir Kadının Hayatı.* İstanbul: Anka Yayınları. (Original work published 1890)

Mintzuri, H. (2002). *İstanbul Anıları* 1897-1940. İstanbul: Tarih Vakfı Yurt Yayınları.

Millet, K. (1971). *Sexual Politics.* London: Hart-Davis.

Mizancı Mehmet Murat (2010). *Turfanda mı yoksa Turfa mı?* İstanbul: Paraf Yayınları. (Original work published 1891)

Moran, B. (1983). *Türk Romanına Eleştirel Bir Bakış I: Ahmet Mithat'tan A.H. Tanpınar'a.* Istanbul: İletişim Yayınları.

Nabizade Nazım (2010). *Zehra.* İstanbul: Paraf Yayınları. (Original work published 1896)

Namık Kemal (2010). *İntibah.* İstanbul: Paraf Yayınları. (Original work published 1876)

Neave, D. L. (1933). *Twenty Six Years on the Bosphorus.* London: Grayson & Grayson.

Ortner, S. (1974). Is Female to Male as Nature Is to Culture? In M. Z. Rosaldo, & L. Lamphere (Eds.), *Woman, Culture, and Society* (pp. 68-87). Stanford: Stanford University Press.

Quataert, D. (1994). Overview of the Nineteenth Century. In H. İnalcık, & D. Quataert (Eds.), *An Economic and Social History of The Ottoman Empire 2* (pp. 761-765). Cambridge: Cambridge University Press.

Parla, J. (1990). *Babalar ve Oğullar: Tanzimat Romanının Epistemolojik Temelleri.* Istanbul: İletişim Yayınları.

Parla, J. (2000). *Don Kişot'tan Bugüne Roman.* Istanbul: İletişim Yayınları.

Pollock, G. (1988). *Vision and Difference: Femininity, Feminism and the Histories of Art.* London: Routledge.

Recaizade Mahmut Ekrem (2014). *Araba Sevdası* (F. Altuğ, Ed.). İstanbul: İletişim Yayınları. (Original work published 1898)

Roman, M. (1992). *Sarah Orne Jewet Reconstructing Gender.* Tuscaloosa: University of Alabama Press.

Rose, G. (1993). *Feminism and Geography: The Limits of Geographical Knowledge.* Oxford: Polity Press.

Ruskin, J. (1913). *Sesame and Lilies.* London: George Allen & Sons.

Samipaşazade Sezai (2010). *Sergüzeşt.* İstanbul: Paraf Yayınları. (Original work published 1889)

Scobey, D. (1992). Anatomy of the Promenade: The Politics of Bourgeois Sociability in Nineteenth-Century New York. *Social History 17*(2), 203-227.

Serdar, A., Tutumlu R. (2019). Tradition of Serial Novels in Ottoman/

Turkish Literature. *ATINER's Conference Paper Series.* https://www.academia.edu/9169458/Tradition_of_Serial_Novels_in_Ottoman_Turkish_Literature

Şemsettin Sami (2014). T*aaşşuk-ı Talat ve Fitnat.* İstanbul: Papersense Yayınları. (Original work published 1872)

Tanpınar, A. H. (2012). *On Dokuzuncu Asır Türk Edebiyatı Tarihi.* İstanbul: Dergah Yayınları.

Uslu, M. F. (2014). 19. Yüzyıl Osmanlı Dünyasında Tarihsel Dram ve Kamusal Alan. In M.F. Uslu & F. Altuğ (Eds.), *Tanzimat ve Edebiyat* (pp. 233-249). İstanbul: İş Bankası Yayınları.

Vartan Paşa (1991). *Akabi Hikyayesi* (A. Tietze, Ed.). İstanbul: Eren Yayıncılık. (Original work published 1851)

Van Millingen, A. (2003). *İstanbul.* İstanbul: Alkım Yayınları.

Wolff, J. (1990). *Feminine Sentences: Essays on Women and Culture.* Berkeley: University of California Press.

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Housing arrangement transformation and the cultural revolution

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Abstract

This study links between the transformations of houses and the revolution of culture in the Gaza context. It investigates the changes in houses in Gaza starting, from traditional houses until now, in terms of the inner arrangement and openness of spaces and tries to link these changes with changes in culture. It aims to clarify the change in the inner housing design mainly and the reasons behind this.

To achieve the aim, descriptive analysis for houses from different periods was used. A questionnaire to new graduates of the architectural department at the Islamic University of Gaza was used to find out their preferences in housing arrangement. Interviews with academic staff members and architects working in engineering offices as designers were essential to investigate their opinion about how and why these changes happened as experts in the field. The results show gradual transformation in house arrangement in general and a recent trend towards openness. There was a tendency towards openness among the new graduates from the architecture department. The academics and the architects working in engineering offices confirmed this tendency among their students or clients. But there is a desire by the majority to isolate the guest's space by moveable barriers. The reasons behind this tendency diverse. The open-plan concept is considered sustainable by many with some hesitation from others.

Keywords
Cultural revolution, Housing arrangement, Openness, Transformation, Trends.

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1. Introduction

Residential buildings are considered the most important among all architectural building types as they constitute the largest proportion of the total buildings, as well as the shelter that contains family members and brings them together for long times. Gaza City in Palestine is one of the most densely populated places in the world with about 678,669 people in 2019 and an area of 74 km² (Palestinian Central Bureau of Statistics, 2019). The population density is about 9,171 people /km².

Undoubtedly, residential buildings, like other buildings, evolve and change over time to keep pace with developments in other fields such as the development of building materials and construction, technology, architectural education, and the customs and traditions' changing that are part of the culture of societies. Estaji (2017) denoted that changing housing design followed social and cultural conditions changing, the economic situations and technical innovations which also affect lifestyles. As the cultural factor is a powerful engine in influencing the orientation of architectural design, this study is concerned with studying the stages of transformation of the residential houses in Gaza City in Palestine and linking this with the cultural change of society. The importance of the study stems from being a feedback for designers on the job market and academics of the department of architecture. It will explain the recent trends of the society regarding the arrangement of the residential houses and its sustainability expectation in the future by linking it with theories of cultural development.

The study used the term open-plan to refer to combining the kitchen, living room, guest room and dining room into a single great room without barriers or walls. Alfirević and Simonović-Alfirević (2016) investigated the development of the open-plan concept from the flexibility of integrating certain rooms into a combined space, which is more stressed in smaller apartments, to open-plan concept in other apartments and houses to have internal openness among spaces without any fixed or sliding partitions. They stated that open-plan with an open kitchen was widely used in the 1960. Estaji (2017) recommended for further studies in assessing the flexibility in houses using quantitative research.

2. Culture definition and change

It worth to define the culture at the beginning. The Cambridge English online Dictionary (n. d.) defines culture as the way of life, especially the general customs and beliefs, of a particular group of people at a particular time. While Merriam-Webster's online dictionary (n. d.) defines it as "the customary beliefs, social forms, and material traits of a racial, religious, or social group". Varnum and Grossmann (2017) define culture "as a set of ideas, beliefs, norms, and behaviors shared by or common to a group inhabiting a geographic location." Culture is "a set of beliefs, knowledge, education, customs, and values that society has developed them based on their own beliefs" (as cited in Ettehad, Karimi Azeri, & Kari, 2015). The whole previous definitions share the same items, however, some definitions add the time and a group of people as variables which have their importance for the definition.

Some researchers connected between culture and architecture. Ettehad et al. (2015) considered architecture as an image for the culture of a country combined with the social life of the society human life, and it has a deep impact on it. Estaji (2017) stated that the house should be a flexible system that can adapt to residents' needs and their physical and cultural environment changes. He added that the problem is the inability to guess and control these changes. However, the psychological anthropologist Wallace, known for his analysis of social changes caused by technological change, defined five stages of the revitalization process; steady-state where there is stress but most people tolerate it; period of individual stress when people cannot adapt to increasing stress well and there is a need for changing the culture to be satisfactory for them; period of cultural distortion when flexible people tried to make changes in the culture to be satisfied; period of revitalization in which the functions of maze-way reformulation and cultural transformation happened; and finally; new steady state when the new culture system proved its

viability (Wallace, 1956). In the case of architectural change in the Gaza case, the stress is the new orientation in the house as a result of being affected by other's architecture. The changes represent to some extent the acceptance of the new type of design. However, can we say that there is a cultural distortion that causes architectural distortion or could we expect to reach a steady state in architectural style when the new culture system proved its viability? Maybe in the future, the answer would be clear practically. Currently, we have many styles attributed to the difference in the influence of householders with new ideas. Some householders accept or like changes and other think much before accepting or refusing changes.

The change in culture was investigated for a long time by many socialists. Ibn Khaldun stated, in his introduction, that the conditions of the world and nations and their customs do not last as it is, but they vary on days and times. He added that the weak are often fond of following the powerful and dominant as they believe in dominant's perfection (Ibn Khaldun, 1976). This may be an explanation of the effect of Western architecture on Arab world architecture which minimizes the individuality, regional, and identity. The advancement of internet technology helps in transferring data fast. Nasrah (2008) assured that the change in Western architecture came in successive steps until it reached its current state. However, in the Arab architecture, the change sometimes came in by copying the final result reached by the West; so, it lost its identity.

3. Culture and architecture

Ettehad et al. (2015) considered architecture as a true measure of the culture of a society and the culture of the society in role is responsible for the space arrangement of a building. In the Gaza context, we can register the change of local architecture from the courtyard house with an orientation towards inside, and all rooms open towards it to a house with outside garden and orientation towards it. This was associated with the appearance of regulations that demand setbacks. Accordingly, the courtyard changed into a roofed living space. Then, sleeping spaces were isolated from the living room with a special lobby. And this was acceptable from residents.

A later aspect of change in the house is, related to privacy inside the house, using an open-plan that combines the living room, kitchen, dining area, and guest room into a single great room. There are different perspectives regarding privacy; some support privacy and others do not care about it.

Liu (2013) concluded that understanding the relationship between what he called architectural culture and architectural design is vital and can improve the spiritual side of architecture design. There are societies' features that encourage or discourage cultural change.Varnum and Grossmann (2017) indicated that some of these features such as the degree to which society adheres to social norms, the amount of ethnic homogeneity in society, and the amount of community contact and openness to other cultures. Despite the blockade imposed on Gaza for years, openness through social media and the Internet, in general, is available, as in many countries. Likewise, there was openness to other cultures with the return of the displaced Palestinians to their homeland following the Oslo Accords in 1994.

Eldemery (2009) stated that globalization means to some architects a way to unify the world through the media and customer cultures, and the result is a similar architecture everywhere losing the place identity. He added that the current building in Arab cities reflect a conflict between heritage values and imported ideas, and has begun to lose its locality. This is due to the fact that they give the building a distinctive shape, a manifestation of progress, and a direction towards the future. Nasrah (2008) indicated that there is a need to balance between what is local and what is coming from Western architecture, and she assured the importance of openness towards others away from the unconscious copying but with conscious selection according to residents' needs, taking into account the local constants and achieving the desired benefit. She pointed out for the futility of imitating the literal heritage because of the change in the needs following the

change in the time, and the futility of literal copying of the Western architecture because of different needs following the change in place and culture.

4. Technology and culture

Varnum and Grossmann (2017) demonstrated that as norms change, new technologies influence people's life inside and outside their houses. The influence of globalization on society is one of the factors that affect architectural transformation. Ayna (2011) defined three aspects of this influence on society life styles and practices which are culture, economic and technology. The global culture is transferred through Medias such as the TV, cinema and the internet.

The lifestyle of most families has been affected by technology and its instruments. Before the appearance of the TV device the family spends a lot of time talking together on different issues, parents have an effect on their children and solve their problems. The TV device take part of this relationship between family members to gather them around it to watch different programs. Anyway, they still sit together in the living room and may have some comments on the program they watch. The living room still has its importance in the house. After the appearance of other technological devices such as laptops and cell phones, the importance of living rooms decreases and the importance of bedrooms increases. The new social media attract many family members to use them. They can choose to talk or write; they can choose the person to contact. Even laptops give them more choices than TV. Actually, this sure affects the need for spaces. Accordingly, do we expect less importance and area for the living room in the future or to delete or merge guest room with living room as communication between people become through the media?

5. Methodology

The study uses different approaches. To clarify the transformation in the inner housing design, the study analyzes the transformation in houses' arrangement using architectural plans from different periods. The author make contacts with some of the engineering offices in Gaza to compare plans of houses, from different years, from their archive. The plans in the figures of the analysis section are part from these plans. To find out the new generation perspective, which represent the future orientation, there was a questionnaire for around 120 new graduates from the department of architectural engineering at the Islamic University in Gaza. The Islamic University in Gaza is the oldest university in Gaza that has graduated architects since 1997. An electronic questionnaire was allowed to about 120 students. The collected number was 86 as it was voluntary. Interviews with seven architects who are working in the design field, at the local market, is another tool to get an idea about the transformation in their designs for houses. Academic staff perspective was essential to get an understanding of the students' projects transformation since the start of the department and its reasons from their experience. Ten from the academic staff were chosen for these interviews. The study addresses two main issues regarding housing arrangement. The first is related to the openness of houses' spaces and the other is the reasons behind this.

6. Analysis and results

This section includes three parts. The first explains housing transformation in Gaza- Palestine. The second analyses the questionnaire, and the third analyses the interviews with some of academic staff and with some of architects who work as designers at local engineering offices.

6.1. Housing transformation in Gaza-Palestine

There is a need to clarify that the population of Gaza city increased from 466,311 in year 2008 to 585,299 in year 2015, with a population growth rate of 3.3% per a year, while the available land is limited (Gaza Municipality, 2019). This affects the transformation from sprawl to vertical. In addition, the culture of extended family at the same house changed and most of new married spouses prefer to live in a new unit far from the parents' unit. We cannot neglect the effect of globalization and that the architects and residents are aware of all types

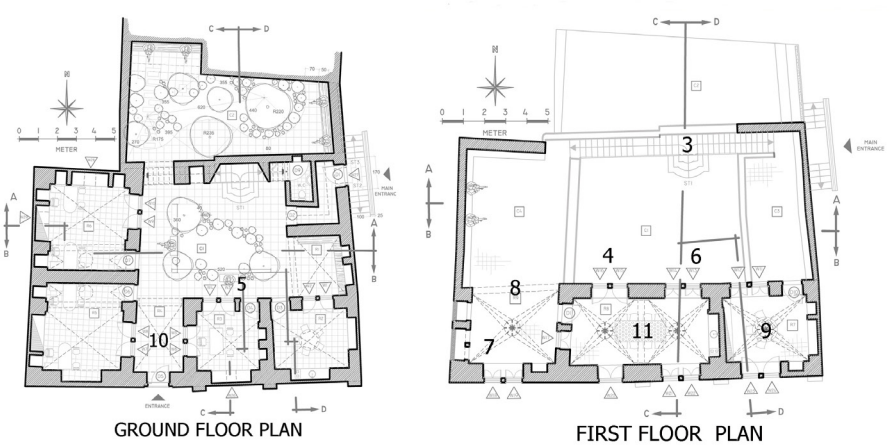

Figure 1. *A traditional house plan (Source: Architectural Centre for Heritage -IWAN, 2016).*

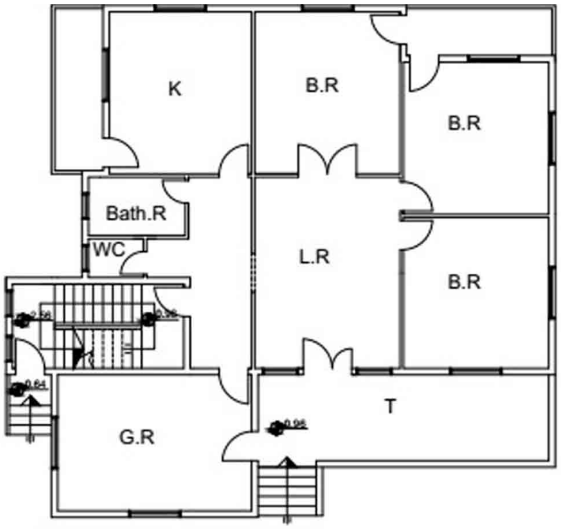

Figure 2. *An example of a house before 1980.*

of houses available around the world. The economic situation of households affect their amount of expenditure on their houses.

Housing attributes have changed over the years following the changes in society's lifestyle and the appearance of new construction materials and development in building techniques. The traditional house in Gaza has an open courtyard surrounded by rooms which have their natural ventilation and light from it as the houses were attached to each other from sides. Residents tried to get the privacy from people in the street using the indirect entrance and by opening all spaces towards the inner courtyard (Figure 1). Source: (Center for Architectural Heritage (IWAN), 2016, May 19)

After the First World War in (1917), the courtyard converted to a covered living room with a concrete slab. The living room was a major space from which all bedrooms open and they get natural ventilation and light from the setbacks. At this time the municipality regulations require setbacks (Figure 2).

Residents tried to get the privacy by using an external door for visitors from a balcony to get into the guest room (Figure 2). The position of the living room in the middle of the house, like a lobby, with many doors open to other rooms make furnishing it difficult.

After 1981 the architectural departments at local universities started and the number of architects increased locally. Few years later, the plans of houses began to change gradually towards separating the bedrooms to a private zone with doors open towards a small lobby not towards the living room which became a distinct space.

After 1994, the multi-storey residential buildings became commonplace after the arrival of the Palestinian National Authority in 1994 to cope with the increasing need of housing due to the normal increase in population and the return of the Palestinian people to their homeland. Jabareen and Carmon (2010) believed that this multi-storey housing from three to four apartments per floor was against the prevailing traditional cultural detached houses (Figure 3).

This type of building spread fast and it became familiar for the new generation. Residents tried to get the privacy using entrance hall to separate the visitors' space while having a defined space for living (see apartment 1 in Figure 3). However, some apartments do not have this entrance hall and the

Figure 3. *Example1 of apartments of a multi-storey building.*

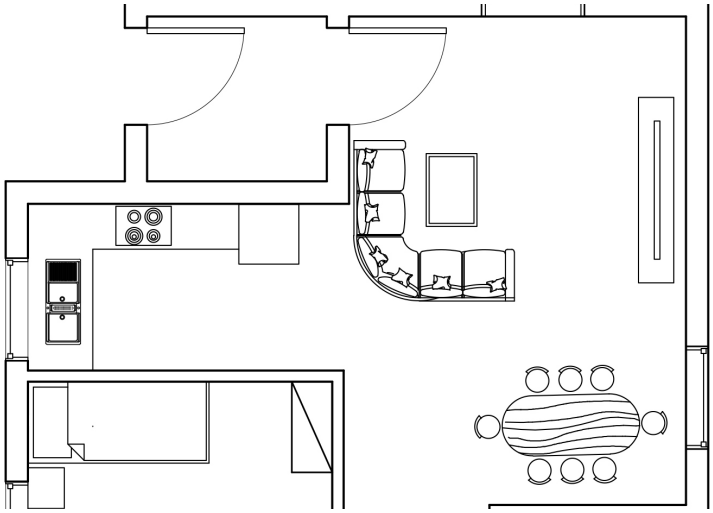

Figure 4. *Example2 of apartments of a multi-storey building.*

family members and the guest enter the living and dining space (see apartment 2 in Figure 3). Sliding dividers is used between the guest and living rooms is a flexible solution that allow privacy and partially open-plan characteristics when needed (Figure 3).

A few years later, other new changes occurred such as open kitchen merging guest space with living space (Figure 4). Many of the new generation of architectural students prefer this open-plan concept as noted by the author during her academic work. This type of arrangement was not accepted before for many reasons. The open kitchen can distribute the cooking smell to the living and other spaces. The living room is used for relative visitors and the kitchen is a private space. Using a heating device in winter will cost more in case of the open kitchen. Open-plan cause noise to travel more.

Another change related to the economic aspect and affects the area of the apartment which is minimized and avoid using balconies (Figure 5). This may relate to benefit from the balcony space for another space; life quality of residents have less time to sit in balconies; in addition, there is no good view in front of houses as a result of low setbacks between buildings.

In Figure 6, the designer used the open-plan concept to get one wide space for a living area, dining area, and kitchen. This open space is isolated from the bed rooms' area.

Regarding the interior spaces, there is an interest in making gypsum or wood decorations. These decorations are used to give some definitions for different spaces that are used as one wide space.

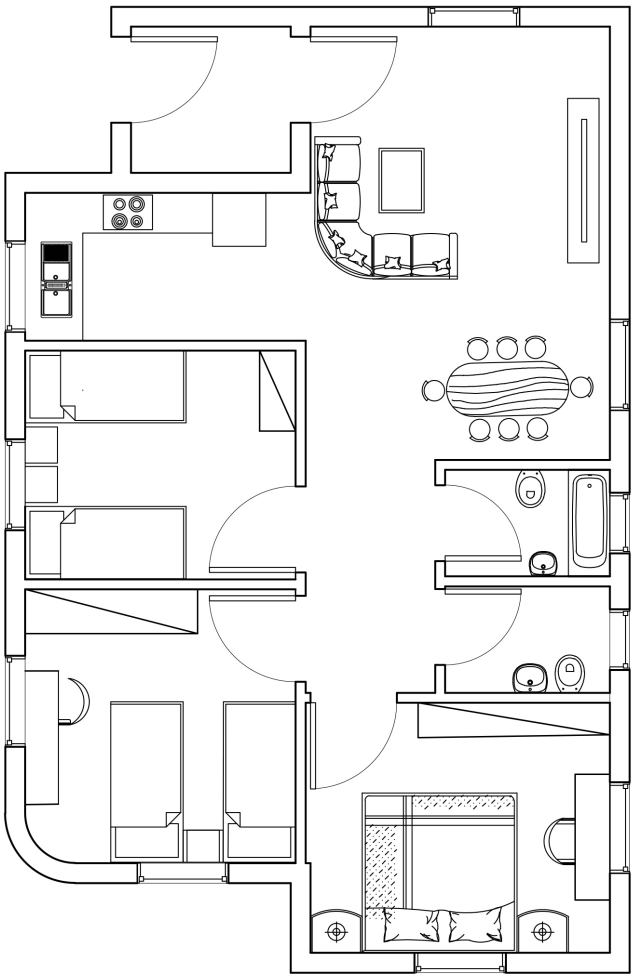

Figure 5. *An example of small area apartments.*

No doubt that the social relations among neighbors decreased relating to the appearance of many social media. This minimizes the importance of guest rooms. Housing tenure is a highly significant factor for accepting the small apartment area.

To summarize, the changes that happened include: change in the orientation of the house's spaces from inside to outside, change in the regulations regarding the setbacks, change in the house type from sprawl to vertical, change in the extent of using open-plan concept inside the house, change in the used material.

6.2. Questionnaire analysis

The questionnaire consists of two parts (see the Appendix). The first part investigates the respondents' preference of open plan in a direct question and most of the respondents (60.5%) support using open-plan in designing houses. There was another question investigating their preferences in detail using the five-point Likert scale in which the choices range from strongly agree to strongly disagree to get a holistic view of respondents' opinions. The results in Table 1 show scores out of five for the preferences as follows. Having temporary separation solutions such as wooden partitions, horizontal or vertical folding separators between the guest and living spaces is a more appropriate solution than full openness

Figure 6. *An example of decoration inside the apartment.*

with a score of (4). The open-plan of the kitchen space to the living space corresponds to my desires have a score of (3.8). Having a dining area within a kitchen space is better have a score of a score of (3.7). And no need for a special external entrance for the guest room have a score of a score of (3.5).

The less accepted preferences were for the properness of: the open-plan of the dining room to the guest room and living room with a score of (3.1). Merging the guestroom with the living space without partitions with a score of (2.8). No need for an entrance hall for the house and the house can be accessed through a dining space or a guest room with a score of (2.8). Two choices were almost not accepted which are: no need for an independent toilet for guest (2), and a separate guest room for the house is not necessary got a score of (2.6) and was refused by 60% of respondents. The answers assure the preference for open-plan except for the guest space which still need to be separated from the family spaces.

The second part of the questionnaire investigated the reasons using the Five-point Likert scale used in question one to assess how powerful the reason in affecting their preference of the open-plan concept (Table 2). The reasons that got high satisfaction over 4 were five. First, it makes a feeling of house wideness with a score of (4.4). Second, the open-plan provides flexibility to change the use of spaces as needed overtime with a score of (4.2). Third, the open-plan gives more opportunity to various ideas in interior design with a score of (4.1), it is easy to get natural light and ventilation for all combined spaces with a score of (4.1), the open-plan is proper for times of relatives' meeting and on occasions with a score of (4.1). The open-plan offers aesthetic advantages, the desire to change from the traditional style, the open-plan compensates for the compact external closure of the buildings which prevent external plan openness, and the open-plan creates visual social contact in the home got scores of 3.8, 3.8, 3.8, and 3.7 respectively.

Most responses refused the choice of no need for privacy according to our social lifestyle with a score of (2.4).

Table 1. *Degree of preference of housing characteristics.*

	The item	The mean
1	A separate guest room for the house is not necessary	2.6
2	No need for a special external entrance for the guest room	3.5
3	No need for an entrance hall for the house and the house can be accessed through a dining space or a guest room	2.8
4	Merging the guestroom with the living space without partitions.	2.8
5	The open-plan of the kitchen space to the living space corresponds to my desires	3.8
6	The open-plan of the dining room to the guest room and living room	3.1
7	Having a dining area within a kitchen space is better	3.7
8	No need for an independent toilet for guest	2
9	Having temporary separation solutions such as wooden partitions, horizontal or vertical folding separators between the guest and living spaces is a more appropriate solution than full openness	4

Table 2. *The reasons affecting people's preference of the open-plan concept.*

	The reasons	The mean
1	The desire to change from the traditional style	3.8
2	The open-plan offers aesthetic advantages	3.8
3	The open-plan compensates for the compact external closure of the buildings which prevent external plan openness	3.8
4	The open-plan creates visual social contact in the home	3.7
5	It is a measure of urbanization and openness to the outside world	2.7
6	It makes a feeling of house wideness	4.4
7	The choice of no need for privacy according to our social lifestyle	2.4
8	It is easy to get natural light and ventilation for all combined spaces	4.1
9	The open-plan is proper for times of relatives' meeting and on occasions	4.1
10	The open-plan gives more opportunity to various ideas in interior design	4.1
11	The open-plan provides flexibility to change the use of spaces as needed overtime	4.2

And the choice of, it is a measure of urbanization and openness to the outside world with a score of (2.7), got a moderate answer.

The last question shows four different plans that represent different levels of openness and the respondents were asked to choose one from these plans, which they prefer, to assure the preferences in the first question. The four plans range from fully enclosed spaces as a first option to open-plan as a fourth option: the first has fixed partition between guest, living & dining and kitchen with doors and got (10.5%) of the choices; the second has an open plan for living, dining and kitchen and got (36%) of the choices; the third has an open plan for living, dining and kitchen and with movable partition between guest and living and got (48.8%) of the choices; and the fourth has an open plan for guest, living, dining and kitchen and got (4.7%) of the choices. These answers are in accordance with the first question answers.

It is clear that there is a general orientation towards openness. However, the openness of the guest room to the living and dining spaces is still refused by many. This does not contradict the privacy culture of occupants from the guests. However, the stereotype of closed spaces is almost unaccepted by the new generation of architects.

6.3. Interviews analysis

There were two interviews; the first addressed the academic staff from the department of architecture at the Islamic University of Gaza, and the second addressed architects who work as designers at local engineering offices.

Both interviews examined the interviewees' preferences of open-plan concept, and to what extent their preferences affect students, for academic staff, or the clients' projects for the designers at local engineering offices. In addition, it asked about the transformation of students' or the clients' projects throughout their years of working and the reasons behind that. The last question asked if the phenomenon of preference for open-plan possess sustainability, and why.

6.3.1. Interviews analysis of the academic staff

The first type of interviews was conducted with ten members from the academic staff at the architectural department at the Islamic University in Gaza. They were first asked if they reflect their opinion and preferences to their students during the teaching process and if the students are affected by their opinion and preferences. All of them agree about the first question and the degree of their opinions effects on their students ranged from medium to large degree.

Most respondents agree that students' tendency towards using open-plan in their houses' design become more common during the last few years. They attributed this tendency to the following reasons.

- Open-plans provide magical solutions to many of the design problems faced by the designer, especially the beginner, such as natural ventilation and lighting for inner spaces, family's need for a special dining space despite the limited space, the difficulty of providing a space for the entrance hall.
- Social and cultural changes that have been affected by Media and social media, Arab and Western TV Series and films, foreign books and magazines.
- Create interactive spaces for the family members in light of technological development that encourage isolation.
- An attempt to change their experience of living in closed-spaces plans.
- Blind imitation of others considering it a type of progress without thinking of its suitability locally.
- The size of the apartments in which they live is generally limited, and the closed guest room is considered to be underutilized except for small periods.
- Overcrowding of building with limited setbacks which reduce the opportunity to view open and wide spaces externally.
- The development in interior design especially for kitchen furniture.
- The tendency of men and youth to meet outside houses in cafes or open spaces which reduces the need for a closed guest room.
- Weak interest in privacy issues and considering it as something old and not beautiful, although it is possible to design a beautiful modern house that is, socially and culturally appropriate.

Actually, the last reason contradict most graduates' refusal in their answers to a question about having a separate guest room is not necessary, and a small percentage of them chose the apartment with a guest space open to living as a preferred solution among the four options in the questionnaire. However, the reason regarding the culture of men and youth' meeting outside houses in cafes or open spaces was a logical justification.

In sum, the reasons were related to the resources of information for students: the instructors, books and internet websites, the family and society culture and the environment where they live in. All these resources have contributed to students' tendency to favor open-plan.

The answers of the last question about if the phenomenon of preferring for open-plans possess sustainability, and why diverse.

The reasons for considering it sustainable: its acceptance by many, its flexibility as it can be divided easily by using movable partitions or curtains, good natural lighting and cross ventilation for all open-spaces, and the other reasons mentioned in the previous question. The negative aspects of being unsustainable are: not the best for local social life, the increase in cost for heating in winter and cooling in summer.

6.3.2. Interviews analysis of the architects of engineering offices

The second type of interviews was with seven architects who are working in the design field. They were first asked if they prefer open-plan, and most of them agree. Some of them make a condition that the guest room is not included in the open-plan. Then, they were asked if they reflect their opinion and preferences to their clients and if the clients are affected by their opinion and preferences. All of them agree about the first question and the degree of their opinions effects on their clients ranged from a medium to large degree.

Most the respondents agree that clients' tendency towards using open-plan in their houses' design become more common during the last few years, although this concept was refused by many at the beginning of the change. Some of them declared that most of their clients prefer open-plan for living, dining and kitchen spaces. They excluded guest room which can be opened by using movable partitions, curtains or doors. One of the architects stated that some clients prefer openness between living and guest spaces and excluded kitchen. They attributed the tendency towards openness to the following reasons.

- It gives the residents a psychological and aesthetic comfort.
- Some architects prefer this concept and affect their clients.
- It is a type of modernity in design.
- A result of openness to the West societies.
- To keep pace with the development in the interior design decoration works.
- The size of the apartments is generally limited, and open-plan give a feeling of wideness.
- There is a functional communication between these spaces.
- The open-plan concept is flexible and the spaces can be closed at any time.
- Canceling some walls saves costs.
- To provide adequate lighting for all spaces.
- Overcrowding of building with limited setbacks and limited exterior open spaces.
- Social and cultural changes that have been affected by Media and social media, Arab and Western TV Series and films, foreign books and magazines.
- Relative openness in social relations, especially with the increase in the percentage of working women and the mixing between the sexes.
- Aesthetic appearance in case of the open-spaces.
- Technological development in building materials.

Most of the respondents considered that the open-plan concept is sustainable because it has several advantages such as flexibility, visual wideness, providing natural ventilation and lighting, and beautiful interior design, and reducing costs.

There are many similarities in answers between academic staff and architects working at engineering offices regarding the reasons, however, some differences are related to differences in the working environment.

7. Conclusion

Residential plans transformation usually follow residents' needs and desire. As such, it is much affected by the culture of the society which also changes over the years. In the Gaza case, there is a new orientation towards the open-plan concept which includes kitchen, dining and living spaces or living, dining and guest room and in other cases, kitchen dining, guest and living spaces. The study used several tools to verify the extent of the residents' tendency to openness in the housing spaces. The

first tool was to analyze the transformation of housing in Gaza City from ancient times to the present by reviewing a number of architectural drawings in engineering offices in recent years. There was a gradual transformation in houses arrangement in general and a recent trend towards openness. In another tool that targeted the new graduates from the architectural department, there was a trend towards openness, but there is still a desire by many for a special space for guests separated from the living and dining space by movable barriers to the possibility of openness in case of no guests.

The academics have confirmed the existence of this trend among students in recent years compared to older generations. As well as, the architects working in engineering offices, confirmed the recent trend of clients towards openness, with the exception of the guests' space. The reasons behind this tendency diverse. They include: openness towards the world by through various Media, a feeling of house wideness, flexibility to change the use of spaces as needed over time, magical solutions to many of the design problems faced by the designer, especially the beginner, such as: natural ventilation and lighting for inner spaces, aesthetic comfort, and interactive spaces. On the whole, we note that some of the reasons were related to the regulations, functional or aesthetical aspects, cultural and social changes, There is no doubt that all reasons have contributed to the change of culture from closed-spaces to open- plan spaces concept that preserves the privacy of residents from guests.

As for the open-plan concept sustainability, many agree as it has many advantages and its acceptance by residents. However, some still hesitate about this. As such, there is a need to repeat such a study in other countries and in Gaza after many years to expect the future of houses' interior openness. Another study that targets non-architecture students would enhance this orientation towards the open-plan concept.

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References

Alfirević, Đ., & Simonović-Alfirević, S. (2016). Open-plan in housing architecture: Origin, development and design approaches for spatial integration. *Arhitektura i urbanizam*(43), 45-60.

Ayna, A. (2011). The Impact of Globalization on Architecture-Environment Relations: Housing Projects and Design Approaches. *The Scale of Globalization,* 17.

Cambridge English online Dictionary. (n. d.). Culture definition. Retrieved 10 Jan, 2020, from https://dictionary.cambridge.org/dictionary/english/culture

Center for Architectural Heritage (IWAN). (2016, May 19). A meeting of IWAN project coordinator, Gaza.

Eldemery, I. M. (2009). Globalization challenges in architecture. J*ournal of Architectural and Planning Research,* 343-354.

Estaji, H. (2017). A review of Flexibility and Adaptability in Housing Design. *International Journal of Contemporary Architecture*" *The New ARCH", 4*(2), 37-49.

Ettehad, S., Karimi Azeri, A. R., & Kari, G. (2015). The role of culture in promoting architectural identity. *European Online Journal of Natural and Social Sciences: Proceedings, 3*(4 (s)), pp. 410-418.

Gaza Municipality. (2019). A table showing the population of Gaza City. Retrieved Dec. 29, 2019, 2019, from https://www.gaza-city.org/index.php?page=Vm1wS2QxTXhTWGRPV0U1cFVtMTRWbGx0ZEV0amJGWnhVbXhrVDFGVU1Eaz0=

Ibn Khaldun, A. R. (1976). *The introduction of Ibn Khaldun* (Vol. 3). Beirut: The Lebanese Book Publishing House.

Jabareen, Y., & Carmon, N. (2010). Community of trust: A socio-cultural approach for community planning and the case of Gaza. *Habitat International, 34*(4), 446-453.

Liu, J. S. (2013). *The Influence of Architectural Culture on Architectural Design*. Paper presented at the Applied Mechanics and Materials.

Merriam-Webster's online dictionary. (n. d.). Culture definition. Retrieved 10 Jan., 2020, from https://www.merriam-webster.com/dictionary/culture

Nasrah, M. (2008). *Transformations of architectural thought in the twentieth century and its impact on the formation of architecture in Arab countries- Architecture in Syria as a model.* (Ph. D.), Aleppo University.

Palestinian Central Bureau of Statistics. (2019). Estimated mid-year population for Gaza governorate, according to cluster 2017-2021. Retrieved Dec 29, 2019, 2019, from http://www.pcbs.gov.ps/Portals/_Rainbow/Documents/GazaA.html

Varnum, M. E., & Grossmann, I. (2017). Cultural change: The how and the why. *Perspectives on Psychological Science, 12*(6), 956-972.

Wallace, A. F. C. (1956). Revitalization Movements. *American anthropologist, 58*(2), 264-281.

Appendix

The questionnaire's questions

Part 1: Please clarify your degree of preference for each of the following items.

	The item	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	A separate guest room for the house is not necessary					
2	No need for a special external entrance for the guest room					
3	No need for an entrance hall for the house and the house can be accessed through a dining space or a guest room					
4	Merging the guestroom with the living space without partitions.					
5	The open-plan of the kitchen space to the living space corresponds to my desires					
6	The open-plan of the dining room to the guest room and living room					
7	Having a dining area within a kitchen space is better					
8	No need for an independent toilet for guest					
9	Having temporary separation solutions such as wooden partitions, horizontal or vertical folding separators between the guest and living spaces is a more appropriate solution than full openness					

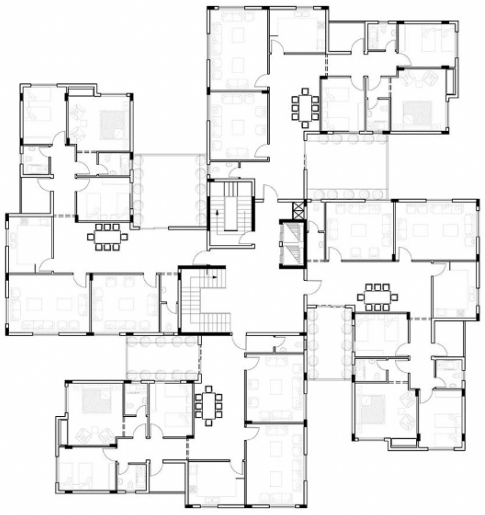
Do you support the open plan "the openness of the spaces on each other"?

Yes	No

Part 2: Please choose how powerful each of the following reasons in affecting people's preference of the open-plan concept

	The reasons	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	The desire to change from the traditional style					
2	The open-plan offers aesthetic advantages					
3	The open-plan compensates for the compact external closure of the buildings which prevent external plan openness					
4	The open-plan creates visual social contact in the home					
5	It is a measure of urbanization and openness to the outside world					
6	It makes a feeling of house wideness					
7	The choice of no need for privacy according to our social lifestyle					
8	It is easy to get natural light and ventilation for all combined spaces					
9	The open-plan is proper for times of relatives' meeting and on occasions					
10	The open-plan gives more opportunity to various ideas in interior design					
11	The open-plan provides flexibility to change the use of spaces as needed overtime					

Part 3: In the four figures presented below are examples of four types of solutions for apartments that vary in the degree of openness of the spaces to each other. Please choose the model you prefer in case you choose an apartment for yourself in the future.



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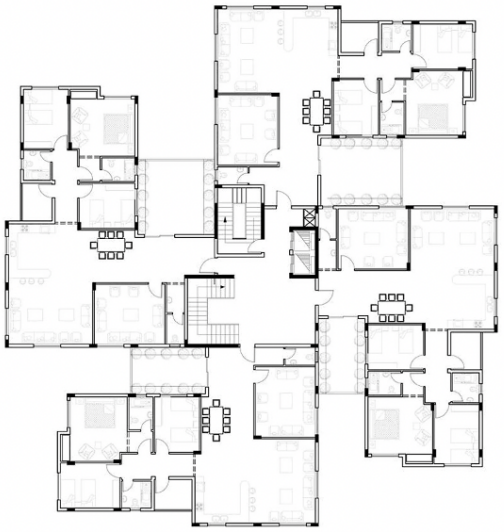

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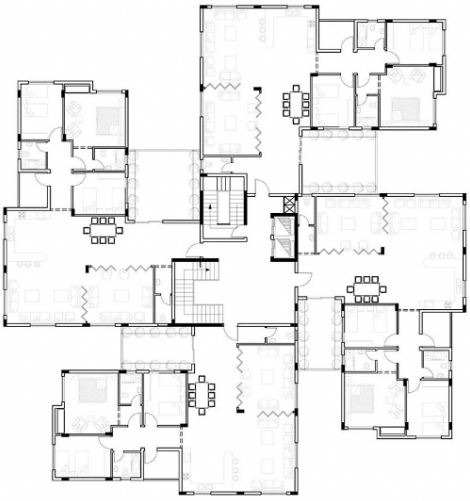

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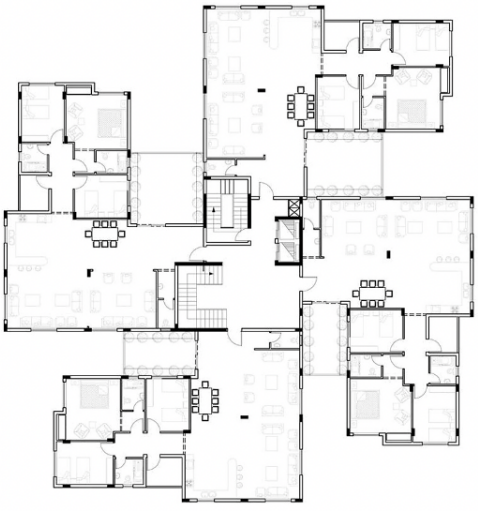

Type 4

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Decision-making method for choosing best alternatives for internal walls based on cost and sound insulation performance

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Abstract

The main objective for architects is to improve building quality for occupants. For user comfort and physical performance, primarily parameters of building elements such as sound insulation, thermal insulation, resistance to fire and moisture are evaluated. However, especially on walls, applications made to enhance these parameters such as designing a double wall, can be in contradiction with some other parameters such as cost, weight and thickness which are desired to be minimized. This reveals the problem of decision-making in the selection of building elements for architects.

This study aims to find the optimum internal wall that complies with the Acoustic Regulation of Turkey and maximizes the airborne sound insulation performance while minimizing other parameters (cost, weight, thickness). In this research, starting from the simplest single wall type, number 509 of non-load bearing masonry interior wall alternatives made of brick and autoclaved aerated concrete (AAC) blocks were generated. Values of the sound insulation, cost, weight and thickness parameters of the walls were calculated, and then optimal alternatives were selected by one of the most used MCDM (Multi-Criteria Decision Making) method namely as TOPSIS (The Technique for Order Preference by Similarity to Ideal Solution) method. Moreover, Copeland technique was used to aggregate the data obtained for different similar weighting values in the application of the TOPSIS Method. As a result, it was demonstrated that the combined method used in the study is a convenient method for decision making and yields satisfactory results.

Keywords
Copeland method, Cost, Sound insulation, TOPSIS method.

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1. Introduction

Growth in the construction industry has led to many environmental problems and has increased the need for sustainable building design in recent years (KPMG Türkiye, 2018). The main purpose of sustainable buildings is to concentrate on energy conservation and provide comfortable environments for occupants. User comfort, which can be defined as the state of wellbeing amongst building users, is achieved by controlling factors such as fire, sound, heat, light and water (Tekin et al, 2014). In Turkey, in order to meet these parameters, it is mandatory to comply with the relevant regulations and standards.

To ensure sound insulation, the "Regulation on Protection of Buildings Against Noise" was published on 31 May 2017 by the Turkish Ministry of Environment and Urbanization. In this regulation, sound insulation limit values are defined, in accordance with acoustical performance class ranging from A to F. Every building should comply with the minimum requirements. For new buildings, at least C acoustic performance class should be provided (Regulation, 2017).

However, modifications in building elements to achieve the desired class values of the regulation affect other design parameters as well. First, all practices affect "cost" which is an important criterion in evaluating the function of a building. Considering that resources are limited, minimizing cost is always the main objective in projects. Second, additional layers added to building elements to increase sound insulation increase weight as well. But, designing lightweight buildings is crucial in Turkey since 92% of the country is in earthquake zones (Declaration, 2018).

Lightweight wall materials decrease pressure on load-bearing systems and increase resistance to earthquakes. Third, designing thicker elements to increase sound insulation performance increases both unit cost and the weights. It also changes heat gains and losses in buildings and affects total energy consumption. For this reason, determination of the optimum thickness of elements is essential in design.

The aim of this study is to find the optimum internal wall complying with the Acoustic Regulation and maximizing the airborne sound insulation performance while minimizing other parameters (cost, weight, thickness). In this study, non-load-bearing masonry single walls, double walls and walls with linings were developed as types of interior wall alternatives. Then, values of all parameters of the walls were calculated and a decision matrix was created with the obtained values. Optimal wall selection according to the given criteria weights (importance levels) were selected through the TOPSIS method which is one of the well-known MCDM methods. While weighting criteria, a subjective evaluation in which sound insulation is the first, cost is second, weight and thickness are equally third, were considered (Sound Insulation > Cost > Weight = Thickness). Among the three different weightings that meet these evaluation conditions, sorting was calculated by using the Copeland method.

2. Methodology

In this study, numerous non load-bearing masonry interior wall alternatives maximizing sound insulation values were generated. Then, values of sound insulation, cost, thickness and weight parameters of walls were calculated. Walls that did not comply with

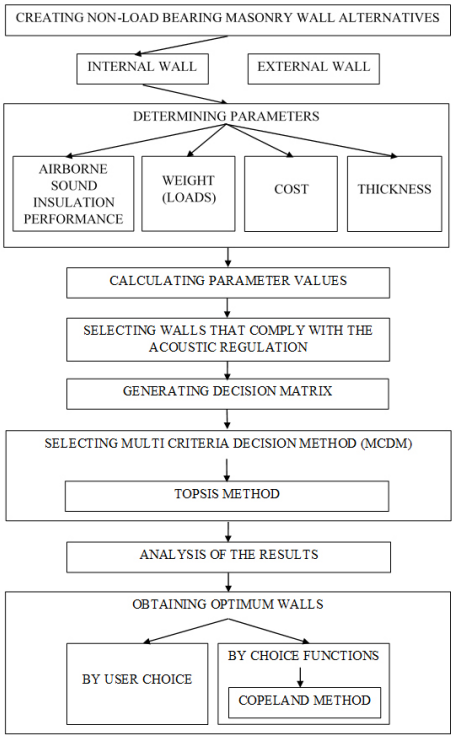


Figure 1. *General steps of methodology.*

the limits of the Acoustic regulation were eliminated. To find out the optimum wall type, all calculation results were brought together in a decision matrix and analyzed with a multi-criteria decision-making technique, TOPSIS. In this method, in order to reach a result, criteria were given importance levels (weights). The user can come to a result by either using a preferred criterion weighting through the TOPSIS method or by using the Copeland ranking method which brings together different weightings. General steps of methodology of the study are given in Figure 1.

2.1 Parameters, objectives and limit values

In Turkey, based on the latest statistical building census, 75% of buildings are used as housing. In addition, 51% of buildings are built in masonry, 48.4 %through frame system, and 0,6% through other construction systems (TUIK, 2001). In this research, residential buildings with masonry walls were studied.

Airborne sound insulation performance was calculated at the partition wall between the bedroom of a simple residential building (receiver room) and an adjacent room (source room). The volume of the receiver room was considered as 50 m^3 and wall dimensions have taken as length (l): 4 m, height (h) 2,7 m (approximately 10 m^2) as specified in the ISO 10140-5 standard (ISO, 2010).

Source and receiver rooms have been calculated to have equal internal temperatures. Thus, thermal insulation and condensation parameters were not analyzed. For protection against fire, in order to comply with "Regulation on Fire Protection in Buildings", all construction elements were selected as Class A1 non-combustible material (Regulation, 2007).

Wall types and building materials were selected to be the most widely used types and materials in Turkey. Sound insulation performance (D_{nTA}, dB), cost (Euro/m^2), weight (kN/m^2), and thickness (cm) parameters of the walls were calculated and analyzed.

2.1.1 Airborne sound insulation

Minimum airborne sound insulation values to be provided according to source and receiver room specifications ($D_{nT,A}$, dB) are determined in "Regulation on Protection of Buildings against Noise" given in Table 1 (Regulation,2017). As specified in Table 1, first, buildings are categorized based on their noise sensitivity and noisiness. Then, sound insulation values are defined in accordance with the combinations of different levels of noisiness and sensitivity. In this study, receiver room properties were selected as a residential bedroom that is highly sensitive to noise (Degree I) and adjacent source room was regarded as moderately noisy (MN). In this combination, the limit values are 52 dB for C-Class, 58 dB for B-Class and 62 dB for A-Class as highlighted in Table 1.

To provide A, B or C Class limits, it is necessary to primarily make improvements on the airborne sound insulation performance of the building elements. To improve sound insulation, general principles can be summarized as 1- increasing mass and density by means of increasing thickness 2- designing double walls 3-providing flexible connections 4- introducing an air gap between layers 5- increasing the air gap thickness 6- using porous elements in the

Table 1. *Minimum airborne sound insulation values to be provided according to source and receiver room specifications (D*nT,A*, dB) Limits for MN-I.*

Source Room Noisiness Level	Receiver Room Sensitivity Level	Acoustical Performance Class					
		A	B	C	D	E	F
High Level of Noisiness (HN) $L_{AF,max}$ > 75 dB	I - high	68	64	58	54	50	46
	II – moderate	65	61	55	51	47	43
	III - low	62	58	52	48	44	40
Moderate Noisiness (MN) 75 ≥ $L_{AF,max}$ > 55 dB	I - high	62	58	52	48	44	40
	II – moderate	59	55	49	45	41	37
	III - low	56	52	46	42	38	34
Low Level of Noisiness (LN) $L_{AF,max}$ ≤ 55 dB	I - high	56	52	46	42	38	34
	II – moderate	53	49	43	39	35	31
	III - low	50	46	40	36	32	28

Decision-making method for choosing best alternatives for internal walls based on cost and sound insulation performance

cavity 7- avoiding factors that will form a sound bridge between walls, such as insulating the connection points of the elements like service pipes and ducts passing through the walls etc. (Mehta et al,1999).

*D*nT,A value was obtained from the following formulas (Hassan,2009).

$$D_{nT,A} = D_{nT,w} + C \ \ dB \quad (1)$$

and

$$D_{nT,w} = R'_w + 10\log\left(\frac{0,16\,V}{T_0 S_s}\right) = R'_w + 10\log\left(\frac{0,32\,V}{S_s}\right) \quad (2)$$

where

S_s: Area of partition wall, m^2

T_0 : Reference reverberation time (0.5s for houses)

V: Volume of receiver room, m^3

$$R'_w = R_w - C_F \quad (3)$$ and

C_F: Correction value was calculated by the ratio of the unit weight of partition element (X) to average unit weight of all elements causing flanking transmissions (Y). For x=X/Y then C_F value was as following: for $x \leq 1$ $C_F = 0$, for $1 < x \leq 2$ $C_F = 2$, for $2 < x \leq 3$ $C_F = 4$ and for $3 < x$ $C_F = 6$ (Hassan, 2009).

In order to determine Rw (C; C_{tr}) values, INSUL sound insulation prediction software was used. INSUL is based on models created by applying mass law theory that considers the critical frequency and approaches developed by B.H. Sharp, Cremer, Fahy, Ljunggren, Rindel and others. It was noted that the program reliably predicts sound insulation values with a 3-5 dB approximation (INSUL,2019).

In the calculation of C_F values, it was accepted that unit weights of the walls were equal. The lower and upper floors were considered as 15 cm reinforced concrete.

2.1.2. Cost

For construction cost estimation, "Construction Unit Price Methodology" by the Ministry of Environment and Urbanism is commonly used. Within the scope of construction unit price method; inputs of unit price are labor, machinery-equipment and material. A short description of the work for each of the inputs (laborer, mason etc.), machinery-equipment (excavator, bulldozer etc.) and material (brick, sand, cement etc.) were listed, unit and unit price of the work was determined with a code number given in the Construction and Installation Unit Prices Book (MoEU, 2017). An example of a unit price cost estimation is given in Table 2. Values were calculated in Turkish Lira (TRY) at first and then converted into Euro (EUR) (CBRT, 2019).

2.1.3. Weight (Loads)

Loads in a structure are generally classified as imposed (live) loads, permanent (dead) loads, horizontal loads and other loads such as load caused by temperature difference. Live loads, such as traffic loads may vary. Dead loads refer to the structure's self-weight and generally remain constant during the structure's life. Earthquake load and wind load are examples of horizontal loads (Toy-

Table 2. *Example of unit cost calculation.*

Item No	Analysis Name				Unit
15.220.1003	Building walls using 200-mm horizontally perforated bricks				m^2
Item No	Definition	Unit of Measure	Quantity	Unit Price	Amount (TRY)
	Material:				
10.130.2010	250 x 250 x200-mm horizontally perforated bricks (Including losses)	Qty	15,00	1,06	15,90
19.100.2416	Preparing lime mortar (with slaked lime bags)	m^3	0,018	141,40	2,55
10.130.9991	Water	m^3	0,01	6,84	0,07
	Labor:				
10.100.1013	Master bricklayer	h	0,68	15,70	10,68
10.100.1062	Unskilled worker (Construction worker)	h	1,36	11,50	15,64
	(Including loading, horizontal and vertical handling unloading at the construction site)				
	Material + Labor Cost:				44,84
	25% contractor's profit and overheads				11,21
	Price per m^2				56,05 (1)
(1) 56,05 TRY=8,89 Euro (18 Sep 2019- CBRT Exchange Rates)					

demir et al, 2000). In this study, only permanent-self loads of the non-load bearing walls were calculated. Total load of the wall was calculated as the sum of all elements' weights constituting the wall such as a block, mortar, plaster, steel studs, rockwool, gypsum board etc.

2.2. Creating non-load bearing masonry internal wall alternatives

Generating wall types started with the design of a single wall. Afterwards, alternatives were multiplied considering the general principles for improving sound insulation such as increasing mass and density by means of increasing thickness, adding layers, designing a double wall, introducing an air gap between layers, increasing the air gap thickness and using porous elements in the cavity.

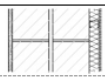
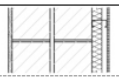
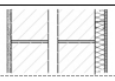
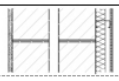
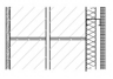
Alternatives are presented in Table 3 below. Paint application on wall is not included in the study because it depends on subjective preferences in projects.

2.3. Building materials

In Turkey, the most commonly used infilling wall material is brick for masonry buildings (TUIK, 2001). In addition, Turkey is one of the biggest global AAC producers in Europe (TGUB, 2019). Therefore, brick and AAC blocks were chosen as wall materials for the study. Bricks used in this study are categorized in EN 771-1 as clay masonry units with LD (low gross dry density) and Category I (Level of confidence). Type of bricks are vertically perforated (VP), horizontally perforated (HP) Class-AB, horizontally perforated (HP) Class-W (CEN, 2016). AAC blocks were selected as non-reinforced blocks in EN 771-4 (BSI, 2015).

While determining the thickness and densities, the Ministry of Environment and Urbanization Unit Prices Book (which gives information about the most frequently produced materials) was taken into consideration (MoEU, 2017). Since the aim was to provide minimum wall thickness, blocks larger than 15 cm were not calculated for dou-

Table 3. *Internal wall alternatives.*

Alternatives						
	Type 1 (1)		Type 2(1)			
	Single Wall (SW)		Double Wall (DW)			
						
Cons_ truction Code	SW		DW		DW	DW
			2 cm airgap		5 cm airgap	5 cm Rockwool
Airgap Properties Code			a2		a5	r
	Type 3 (2) (3)		Type 4 (2) (3) (4)			
	Single Wall+ Wall Lining		Double Wall+ Wall Lining			
						
Wall Lining Code	-5-G	-7,5-G	(a2)-5-G	(a2)-7,5-G	(a5)-5-G	(a5)-7,5-G
						
Wall Lining Code	-5-2G	-7,5-2G	(a2)-5-2G	(a2)-7,5-2G	(a5)-5-2G	(a5)-7,5-2G

(1) Cement plaster on two side
(2) Cement plaster on one side
(3) G: Gypsum board
5 - G: 5 cm rockwool in 5 cm airgap + single layer gypsum board
7,5 - G: 5 cm rockwool in 7.5 cm airgap + single layer gypsum board
5 - 2G: 5 cm rockwool in 5 cm airgap + double layer gypsum board
7,5 - 2G: 5 cm rockwool in 7.5 cm airgap + double layer gypsum board
with DU50 or 75 and DC50 or 75 metal cladding profiles
(4) a2: 2 cm airgap / a5: 5 cm airgap

ble walls. The density and thickness of the bricks and AAC blocks are given in Table 4.

Other properties are the following: Elasticity Modules (E, GPa): 2,5 for HP, 3 for VP-650kg/m^3, 4 for 750kg/m^3,1,75 for AAC 400 kg/m^3, 2,25 for AAC 500 kg/m^3 and 2,75 for AAC 600kg/m^3. Loss factors are 0,01 for both bricks and AAC blocks. Poisson's Ratio's (σ) are 0,25 for both bricks and AAC blocks. Properties of the other materials are: Gypsum board: 1,25 cm - 640 kg/m^3, Rockwool: 5 cm 50kg/m^3, Cement Plaster: 2 cm 2000 kg/m^3, Brick Mortar: Lime Cement Mortar-1800 kg/m^3. For AAC Block instead of mortar, a special adhesive was used.

2.4. Calculation of number of alternatives

Regarding the multiplication of the type, number of density and number of thickness, it was calculated that number of alternatives were 60 for Type 1, 19 for Type 2a, 19 for Type 2b, 19 for Type 2c, 240 for Type 3, 152 for Type 4 in Table 4. Hence, total amount of calculated walls was 509.

2.5. Multi-criteria decision making (MCDM) method

Decision-making is defined in literature as the process of selecting one or more of the various alternatives available in accordance with certain criteria and conditions, taking into account the expectations of decision-makers in order to solve a specific problem and to reach a desired goal (Beldek, 2009; Cristobal & Ramon, 2012). Each decision is made in a decision environment where information, alternatives, values and preferences come together at the time of decision making (Cristobal & Ramon, 2012). One of the main problems in decision making is the comparability of options (different systems, system states, different values of decision variables, etc.). The aim is to develop a measure that allows the establishment of a preference sequence over the options (Cristobal & Ramon, 2012; Kuru,2011).

Multi-criteria decision-making (MCDM) is referred to as the electoral process that a decision-maker makes by using at least two criteria in a set of finite or uncountable numbers without subjective judgments (Kuru, 2011; Öztel, 2016). This method is a tool that allows the best choice to be found in a variety of ways among the alternatives in the decision-making situations where there are often many conflicting criteria (Kuru, 2011; Triantaphyllou, 2000). The MCDM techniques used to solve the problems of different alternatives usually consist of the following stages: defining the problem, generating alternatives and creating criteria, selection of criteria, weighting, evaluation, selecting the appropriate MCDM and ultimately sequencing alternatives (Cristobal & Ramon, 2012; Öztürk, 2011). Belton and Stewart (2002) summarize these stages in three key stages: defining and constructing the problem, establishing and running the model and developing action plans (Belton & Stewart, 2002; 1000minds Ltd., 2017).

In literature, a wide range of MCDM methods have been formed depending on the type of problem. Some of these methods are; WSM (Weighted Sum Model) (Fishburn, 1967), SAW (Simple Additive Weighting) (MacCrimmon & Rand, 1968), MAUT (Multi-Attribute Utility Theory), MAVT (Multi-Attribute Value Theory) (Keeney & Raiffa, 1976), ELECTRE (ELimination Et Choix Traduisant la REalité) (Roy, 1968), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) (Hwang & Yoon, 1981), PROMETHEE (Preference Ranking Organization Method

Table 4. *Properties of the materials.*

Material	Code		Dry Density (kg/m^3)	Thickness (cm)	
					(Not calculated for double walls)
Brick	HP		600	10 - 12 - 13,5	19 - 20 - 24 – 25
	VP	W	650 - 750	11,5 - 14,5	17,5 - 19 - 24 - 25 - 30
		AB		-	19 - 24 - 29
AAC	AAC		400 - 500 - 600	10 - 12,5 - 13,5 - 15	17,5 - 19 - 20 - 22,5 - 25 - 30 - 35

For Enrichment Evaluations) (Brans et al., 1984), AHP (Analytic Hierarchy Process) (Saaty, 1988), SMART (Simple Multi-Attribute Rating Technique) (Edwards & Barron, 1994), ANP (Analytic Network Process) (Saaty, 1996), VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) (Opricovic,1998), WPM (Weighted Product Method) (Triantaphyllou, 2000), COPRAS (Complex Proportional Assessment Method) (Zavadskas & Antucheviciene, 2007), ARAS (Additive Ratio Assessment) (Zavadskas & Turskis, 2010), MACBETH (Measuring Attractiveness by a Categorical Based Evaluation TecHnique) (Bana e Costa et al., 2012), MOORA (Multi-Objective Optimization on the basis of Ratio Analysis) (Brauers & Zavadskas, 2006), MULTIMOORA (Brauers & Zavadskas, 2010) and MOOSRA (Multi-objective Optimization On The Basis Of Simple Ratio Analysis) (Brauers, 2004).

MDCM methods are grouped in different ways in literature regarding their approaches, and operations. Ishizaka and Nemery (2013) divided the MCDM methods into 3 groups depending on their approaches as "Full aggregation approach", "Outranking approach" or "Goal, aspiration or reference level approach" (Ishizaka & Nemery, 2013; Tscheikner-Gratl et al., 2017). In "Full aggregation approach", a score is evaluated for each criterion and then they are synthesized into a general score. Based on this score, all the options can be compared and ranked from the best to the worst case. AHP, ANP, MAUT, MAVT, MACBETH, WSM, SMART are the examples of this group. "Outranking approach" is based on pairwise comparisons like PROMETHEE and ELECTRE. "Goal, aspiration or reference level approach" sets a target for each criterion and defines the closest options to the ideal target or reference level. TOPSIS, COPRAS, ARAS, SAW, MOORA, MULTIMOORA, MOOSRA and VIKOR are examples of this approach (Ishizaka & Nemery, 2013).

There are cases where each method is superior to the others. For this reason, in selecting which MCDM method to be applied, the type of the problem, options, evaluation scale, uncertainty, dependence between qualifications, expectations of the decision-maker and quality of the data should be taken into consideration (Arıbaş & Özcan, 2016).

The most common method used by researchers to determine the criteria weight is the AHP method (İlter, 2016). However, depending on the number of criteria and alternatives, the method can be complex and time-consuming. So, it is not recommended for problems with a high number of alternatives (Velasquez & Hester, 2013). Another MCDM technique which is known for its ease of use is the TOPSIS method (Hwang & Yoon, 1981).

TOPSIS method

TOPSIS was first introduced by Hwang and Yoon (1981) as an alternative to the ELECTRE method. Afterwards, developed by Yoon (1987) and Hwang et al. (1993). TOPSIS is based on the concept that the chosen alternative should have the shortest geometric distance from the positive ideal solution (PIS) and the longest geometric distance from the negative ideal solution (NIS). PIS is a solution that maximizes the utility/maximum criterion and minimizes the cost/minimum criterion (Ertuğrul & Özçil, 2014; Yıldırım & Önder, 2015).

The advantages of the TOPSIS method are summarized as follows: It is relatively simple, rational and comprehensible (Çatı et al., 2017; Ertuğrul & Özçil, 2014; Sanjay et al., 2019). It does not include complex algorithms and complex mathematical models (Yıldırım & Önder, 2015). It is suitable for large-scale data (Arıbaş & Özcan, 2016; Thor et al., 2013) and can be applied directly on data without a qualitative conversion if the necessary data are numerical values (Velasquez & Hester, 2013). It has good computational efficiency (Sanjay et al., 2019; Thor et al., 2013) allows evaluation criteria to be weighted (Çakır & Perçin, 2013; Ertuğrul & Özçil, 2014). It identifies the best alternative quickly (Arıbaş & Özcan, 2016; Sanjay et al., 2019) and interpretation of results is easy (Yıldırım & Önder, 2015). A disadvantage is that thresholds of criteria are not considered (Eray, 2015).

The TOPSIS method has been compared to some other MCDM methods in literature and has mostly been evaluated as more appropriate. For instance, İlter (2016) indicated that the TOPSIS method gives more stable results than the COPRAS method due to the difference between their normalization techniques. Ertuğrul and Özçil (2014) aimed to compare TOPSIS and VIKOR methods and found that the results of the TOPSIS method were healthier and more reliable. Benyoucef et. al. (2014) compared SAW, WPM, AHP and TOPSIS. The results demonstrate that TOPSIS gives results which are close to ideal. According to Kuru (2011) and Ertuğrul & Karakaşoğlu (2008) SAW, TOPSIS and VIKOR compared, TOPSIS and VIKOR have the ability to better distinguish the results of evaluation.

TOPSIS has been used extensively in business and marketing management (Mohammadi Dehcheshmeh, 2018; Saldanlı & Sırma, 2014), finances (Yıldırım & Önder, 2015), engineering systems such as sustainability assessment, renewable energy options and water resources management (Ömürbek et al., 2015, Štreimikienė & Baležentis, 2013; Yazdani-Chamzini et al., 2013), human resources management (Karakış, 2016), problems regarding selection of the most appropriate option among alternatives such as laptop, air conditioner or composite laminates (Ertuğrul & Özçil, 2014; Çakır & Perçin, 2013; Pekkaya & Aktoğan, 2014; Sanjay et al., 2019) and in areas such as transportation, education and health which require decision support (Arıbaş & Özcan, 2016; Yıldırım & Önder, 2015; Özkan, 2007).

However, in architecture or the construction sector there is not much research on TOPSIS. Some examples are: performance evaluation of panel curtain wall systems (İlter, 2016), energy efficiency of a public building renovation and reconstruction (Rasiulis et al., 2016), construction projects and their overall risks under incomplete and uncertain situations (Taylan et al, 2014), and cultural heritage renovation projects in Bulgaria (Tupenaite, 2010).

This research will be an example of TOPSIS application in the field of architecture.

TOPSIS procedure consists of the following steps (Yıldırım & Önder, 2015):

Step 1: Creating a decision matrix for the ranking. The problem of MCDM can be expressed as in the following matrix format (4)

$$A_{ij} = \begin{array}{c} \\ a_1 \\ a_2 \\ \cdots \\ a_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \end{array} \quad (4)$$

where

A_{ij} is the decision matrix

C_1, C_2, …, C_n,, the columns are the criteria by which the alternative performance is measured

a_{ij} is the qualification of the alternative with respect to the criterion C_j

m is the number of the alternatives

n is the number of evaluation criteria

Step 2: Determining the normalized decision matrix and the normalized value r_{ij} is obtained using the formula (5).

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}} \quad (5)$$

for i=1,2,....,m and j=1,2,....,n

where

a_{ij} and r_{ij} are the original and normalized score of the decision matrix

The standard decision matrix indicated by R is obtained as in (6)

$$R_{ij} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \quad (6)$$

Step 3: Determining the weighted normalized decision matrix (V) and weighted normalized value v_{ij}. v_{ij} is obtained using the formula (7).

$$V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \cdots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \cdots & w_n r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ w_1 r_{m1} & w_2 r_{m2} & \cdots & w_n r_{mn} \end{bmatrix} = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ v_{m1} & v_{m2} & \cdots & v_{mn} \end{bmatrix} \quad (7)$$

where

w_{ij} is the relative weight of the ith criterion or attribute

Sum of the weight values w_i should be equal to 1 (8).

$$\sum_{i=1}^{m} w_i = 1 \quad (8)$$

Step 4: Calculating the PIS (a*) and NIS (a-). The maximum and minimum values are determined in each column of the weighted normalized decision matrix as (9 and 10)

$$a^* = \{v_1^*, v_2^*, \ldots, v_k^*\} \text{ (maximum values)} \quad (9)$$

and

$$a^- = \{v_1^-, v_2^-, \ldots, v_k^-\} \text{ (minimum values)} \quad (10)$$

If the target is maximization, maximum values in the column are the ideal solution values and if the target is minimization, minimum values in the column are the ideal solution values. NIS is the value of the opposite target.

Step 5: Calculating the separation measures for each alternative by determining the separation measure value using n-dimensional Euclidian distance method. The separation of each alternative from the ideal solution is given as (11)

$$S_i^* = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^*)^2} \quad i=1,2,\ldots,n \quad (11)$$

Similarly, separation from the NIS is given as (12)

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \quad i=1,2,\ldots,n \quad (12)$$

Step 6: Determining the relative closeness to the ideal solution, and the relative closeness of the alternative C_i^* with respect to S_i^+ and S_i^- is obtained using the formula (13)

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \quad (13)$$

and $0 \leq C_i^* \leq 1$

Step 7: Ranking the preference order. The alternative C_i^* closest to 1 indicates greatest relative closeness to the ideal solution.

2.6. Choice theory

Choice theory is an important issue in group decision making. Social choice theory deals with assembling individual preferences over a set of alternatives into a collective decision via a social choice mechanism. The social choice mechanism takes the preferences as input and typically outputs a single alternative as the winner. This theory consists of voting methods and social selection functions (Anshelevich et al., 2015) which have been addressed by many authors who have worked on voting order and social preferences. The most well-known functions can be categorized as; Condorcet's function (Condorcet, 1785), Borda's function (Borda, 1784), Copeland's function (Saari & Merlin, 1996), Nanson's function (Nanson, 1907), Dodgson's function (Dodgson, 1876), and Kemeny's function (Hwang & Lin, 1987).

Condorcet selection procedure is based on the results of one-to-one comparisons between candidates. If a candidate is preferred over all other candidates, it is a Condorcet winner and must be selected (Condorcet, 1785). Borda's function orders the alternatives according to the sums of individual preferences of voters (decision-makers) (Lamboray, 2007). The Copeland Method is the extension of the Borda method. It calculates the number of losses for all alternatives as well. It determines the score by subtracting the losses from the winnings and offers a new order of importance (Saari & Merlin, 1996). Kemeny's rule is also an extension of the principles consisting of linear orders that are closest to the rankings of the profile according to the symmetric difference distance (Lamboray, 2007). In Dodgson's function, candidates are scored in accordance with the smallest number of changes needed in voters' preference orders to create a simple majority winner (Dodgson, 1876). Nanson's function discusses the modification of Copeland method. It deletes only the lowest Borda score candidate(s) at each stage (Hwang & Lin, 1987).

Copeland method

The Copeland method proposed by Copeland at the University of Michigan and later investigated in detail by Saari and Merline (1996) has the advantage of facilitating the analysis of very large data sets. It is rapid, systematic, has simpler mathematical requirements and allows for the possibility of categorical or relative ranking. It has proven to be unsusceptible to variations in the data. So, it can be applied where it is desired to rank objects. It is indicated that it may lose some information during

the aggregation, but this disadvantage is observed in other choice theories as well (Al-Sharrah, 2010; Saari & Merlin, 1996).

This aggregation method selects the alternative with the largest Copeland score in pairwise comparisons. The Copeland score for a given alternative is defined as the difference between the number of times the alternative is ranked higher than other alternatives (victories) and the number of times that alternative is ranked lower than other alternatives (defeats) (Çakır, 2015; Çakır, 2017; Hwang & Lin, 1987).

The Copeland method consists of the following steps (Saari & Merlin, 1996):

Step 1: Pairwise comparisons are made between alternatives. The alternative discussed receives "1" votes if it is higher than the others in the ranking and 0 votes if it is lower as in formula (14).

Between c_j and c_k

$$s_{j,k} = \begin{cases} 1 & \text{if } c_j \text{ beats } c_k \\ 1/2 & \text{if } c_j \text{ and } c_k \text{ are tied} \\ 0 & \text{if } c_k \text{ beats } c_j \end{cases} \quad (14)$$

Step 2: The Copeland score for each c_j defined as (15);

$$C(j) = \sum_{k \neq j} s_{j,k} \quad (15)$$

Step 3. Consequently, the total order of the objects is evaluated.

In literature, there are some researches where MCDM methods and Copeland method are used together. For instance, Çakır (2015) selected the most appropriate six sigma project by Fuzzy VIKOR, Fuzzy TOPSIS and Fuzzy COPRAS integrating the ranking scores obtained from each method through the Copeland method. Sugiartawan & Hartati (2018) combined AHP and Copeland Model to rank popular tourism objects in Bali. Arslan (2018) integrated TOPSIS, GRA, VIKOR and MOORA methods with the Copeland method to rank countries according to data from 23 OECD member countries. Tajvidi Asr et al. (2015) integrated SAW, TOPSIS, LA (Linear Assignment) methods with the Borda and Copeland techniques to select a proper support system for Beheshtabad water transporting tunnel from among the six proposed support systems. Supçiller and Deligöz (2018) combined AHP, VIKOR, SAW, GRA (Grey Relational Analysis), MOORA, ELECTRE II, M-TOPSIS (Modified TOPSIS) with Borda and Copeland techniques to comprise a solution for a supplier selection problem.

However, these combined methods have not been employed in the field of architecture. This study will contribute to literature in this respect.

3. Study

In this research, 509 non load-bearing masonry interior wall alternatives aiming to maximize sound insulation values have been generated. Then, values of sound insulation, cost, thickness and weight parameters of walls were calculated. According to sound insulation calculation, 54 walls were eliminated for not complying with MN-I C-Class limit of the regulation. So, 455 wall type calculation results were evaluated. A decision matrix representing the values of each criterion with each alternative were formed and analyzed with TOPSIS. All calculations were performed via Microsoft Office Excel.

3.1. TOPSIS method

The application of the method is described below using the formula steps given in section 2.5.1. As Step 1, to create a decision matrix, it is necessary to specify a short code for the walls. In the present study, wall codes were given depending on layers forming wall types as: Construction (Single Wall-SW or Double Wall- DW) – Block Type (Brick or AAC) – Airgap properties – Wall Lining properties. Airgap and wall lining codes are presented in Table 3. Block type codes are given as following:

- BHP: Brick, Horizontally Perforated – Dry Density: 600 kg/m3
- BVPW1: Brick, Vertically Perforated – W Class – Dry Density: 650 kg/m^3
- BVPW2: W Class – Dry Density: 750 kg/m^3
- BVPAB1: Brick, Vertically Perforated – AB Class – Dry Density: 650 kg/m^3
- BVPAB2: Brick, Vertically Perforated – AB Class – Dry Density: 750 kg/m^3

- AACG2: Aerated Autoclaved Concrete – G2 Class – Dry Density: 400 kg/m^3
- AACG3: Aerated Autoclaved Concrete – G3 Class – Dry Density: 500 kg/m^3
- AACG4: Aerated Autoclaved Concrete – G4 Class – Dry Density: 600 kg/m^3

To exemplify, coding for wall types number 241 and 342 is presented in Table 5.

Decision matrix for interior walls is given in Table 6. Since the table will be too long for 455 walls, only some of them are included in the table.

For sample wall number 241 calculations are given in Table 7. As Step 2, to determine the normalized decision matrix, the normalized value r_{ij} was obtained using the formula (5). For sample wall number 241 calculations are given in Table 7. As Step 3, to determine the optimum wall, given weights have a great importance in the criteria. In this study, the importance levels were determined as: sound insulation is first, cost second, weight and thickness equally third (Sound Insulation > Cost > Weight = Thickness). Similar weights can meet these evaluation conditions. Examples of three alternatives that are close to average per each alternative (0,25) were selected. Total weighting is 1 as indicated in formula (8).

Table 5. *Coding examples for wall types numbers 241 and 342.*

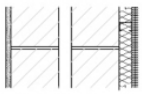
Wall No: 241	Wall No: 342
	
SW-AACG3-10-P7,5-2G	DW-BHP-13,5-a5-P5-2G
Single Wall, 10 cm Aerated Autoclaved Concrete G3 Class – Dry Density: 500 kg/m^3, wall lining with 5 cm rockwool in 7,5 cm airgap (profile)+ double layer gypsum board. Cement plaster on one side.	Double Wall, 13,5 cm Brick, Horizontally Perforated – Dry Density: 600 kg/m^3 5 cm airgap between bricks, wall lining with 5 cm rockwool in 5 cm airgap (profile)+ double layer gypsum board. Cement plaster on one side.

Table 6. *Coding examples for wall types numbers 241 and 342.*

Layer No	Layer Code (construction - block type - block thickness – airgap – profile - gypsum board	Sound Insulation $D_{nT,A}$ (dB)	Cost (EUR)	Weight (m^2/kN)	Thickness (cm)
1	SW-BVPW1 - 30	52	16,30	2,81	34
2	SW-BVPW2 - 30	54	14,80	3,10	34
3	SW-BVPAB1 - 29	52	14,70	2,75	33
.	.	.	.	.	.
.	.	.	.	.	.
117	SW- BVPAB2-29-P7,5-G	62	17,90	2,82	39,75
118	SW- BHP-10-P5-2G	59	15,70	1,25	19,50
.	.	.	.	.	.
.	.	.	.	.	.
241	SW-AACG3-10-P7,5-2G	60	17,00	1,25	22
242	SW-AACG4-10-P5-2G	60	17,10	1,35	19,50
.	.	.	.	.	.
.	.	.	.	.	.
303	SW-AACG4-35-P7,5-2G	66	26,90	2,87	47
304	DW-BHP-10-a2-P5-G	61	19,10	1,81	30,25
.	.	.	.	.	.
.	.	.	.	.	.
342	DW-BHP-13,5-a5-P5-2G	72	21,4	2,42	41,5
343	DW-BHP-13,5-a5-P7,5-2G	74	21,6	2,42	44
.	.	.	.	.	.
.	.	.	.	.	.
454	DW-AACG4-15-a5-P5-2G	73	27,0	2,85	44,5
455	DW-AACG4-15-a5-P7,5-2G	75	27,3	2,85	47

Next steps will be described using Alternative 1 weighting. As Step 4, to find out positive (a^*) and negative (a^-) ideal solutions, first, minimum and maximum x_{ij} values were calculated for the Alternative 1 criterion weightings. In determining a^* value, because sound insulation should be maximized, maximum x_{ij} values were selected. Likewise, because cost, weight and thickness should be minimized, minimum x_{ij} values were selected for

a^* (Table 7). A- values were taken for the reverse situation. After determining a^* and a^- values, as in Step 5, separation measures S_i^* and S_i^- were calculated according to the formulas (11-12). C_i^* value was obtained as 0,7441 by formula (13). This is given in Table 8 below.

Optimum Results

Top 10 wall types obtained from the calculations with the Alternative 1-2-3 criteria weights for 455 walls are given in Table 8.

3.2. Analysis and Copeland method

While determining the optimum options, the final decision belongs to the user. In this case, the user can choose any of the rankings of alternatives 1, 2 or 3 and decide. If it is not possible to decide between alternatives, it is feasible to reach a conclusion using social selection functions. In this study, Copeland method was applied to rank the alternatives.

Looking at the findings in Table 8, rankings are quite similar. For these alternatives, Copeland method was applied to the first 6 rankings, the walls with numbers 118,119, 239, 65, 240 and 238. Any number of sequences can be made.

Pairwise comparisons made in accordance with the Copeland method are given in Table 9. In these comparisons, for example, for wall type 118 in alternative 1 it received 1 point because it was superior to the others, but in the alternative 2, it received 0 points because it was not superior to 119. For wall number 240 in alternative 1 it scored 0 on 118 but 1 on 65. There is no relation between alternatives, so none of the candidates is awarded with ½ point.

Table 7. *Example of calculations of sample wall with number 241 and code: SW-AACG3-10-P7,5-2G.*

Calculations	S.I $D_{nT,A}$ (dB)	C. (EUR)	W. (m^2/kN)	T. (cm)		
Values obtained by calculations Decision Matrix (4) a_{ij}	60	16,98	1,25	22		
a_{ij}^2	3600	288,24	1,57	484		
$\sqrt{\sum_{i=1}^{m} a_{ij}^2}$ (for m=436 , all walls)	1348,6	434,53	46,26	734,67		
r_{ij} (5)	0,0445	0,0391	0,0271	0,0299		
Criteria Weights for providing Sound Insulation > Cost > Weight = Thickness principle						
w_i *Alternative 1*	*0,35*	*0,25*	*0,20*	*0,20*		
w_i *Alternative 2*	*0,375*	*0,275*	*0,175*	*0,175*		
w_i *Alternative 3*	*0,28*	*0,26*	*0,23*	*0,23*		
For Alternative 1 w_i Criteria Weights:						
v_{ij}	0,0156	0,0098	0,0054	0,0060		
Maximum v_{ij} (of all 436 walls)	0,0195	0,0157	0,0145	0,0128		
Minimum v_{ij} (of all 436 walls)	0,0135	0,0080	0,0046	0,0050		
a^*	0,0195	0,0080	0,0046	0,0050		
a^-	0,0135	0,0157	0,0145	0,0128		
relative closeness to the PIS	$(v_{ij} - v_j^*)^2$				$\sum_{j=1}^{k}(v_{ij} - v_j^*)^2$	(S_i^*)
	1,51548E-05	3,0188E-06	6,6038E-07	1,04E-06	1,98762E-05	0,0045
relative closeness to the NIS	$(v_{ij} - v_j^-)^2$				$\sum_{j=1}^{k}(v_{ij} - v_j^*)^2$	(S_i^-)
	4,3107E-06	3,5443E-05	8,19228E-05	4,63187E-05	0,00017	0,0130
C_i^*						0,7441

Table 8. *Top 10 wall alternatives obtained according to the TOPSIS Method - Weight Alternative 1-2 and 3.*

Alternative 1							
Rank	No	Code	S. I. $D_{nT,A}$ (dB)	C. (m^2/EUR)	W. (m^2/kN)	T. (cm)	C_i^*
1st	118	SW- BHP-10-P5-2G	59	15,7	1,25	19,50	0,7579
2nd	119	SW- BHP-10-P7,5-2G	60	16,0	1,25	22,00	0,7561
3rd	239	SW-AACG2-10-P7,5-2G	60	16,7	1,15	22,00	0,7549
4th	240	SW-AACG3-10-P5-2G	59	16,7	1,25	19,50	0,7473
5th	238	SW-AACG2-10-P5-2G	58	16,4	1,15	19,50	0,7468
6th	65	SW- BHP-10-P7,5-G	57	14,6	1,17	20,75	0,7458
7th	242	SW-AACG4-10-P5-2G	60	17,1	1,35	19,50	0,7441
8th	241	SW-AACG3-10-P7,5-2G	60	17,0	1,25	22,00	0,7441
9th	243	SW-AACG4-10-P7,5-2G	61	17,4	1,35	22,00	0,7396
10th	175	SW-AACG3-10-P7,5-G	57	15,6	1,17	20,75	0,7387
Alternative 2							
Rank	No	Code	S. I. $D_{nT,A}$ (dB)	C. (m^2/EUR)	W. (m^2/kN)	T. (cm)	C_i^*
1st	119	SW- BHP-10-P7,5-2G	60	16,00	1,25	22,00	0,7337
2nd	118	SW- BHP-10-P5-2G	59	15,72	1,25	19,50	0,7336
3rd	239	SW-AACG2-10-P7,5-2G	60	16,67	1,15	22,00	0,7296
4th	65	SW- BHP-10-P7,5-G	57	14,62	1,17	20,75	0,7220
5th	240	SW-AACG3-10-P5-2G	59	16,69	1,25	19,50	0,7203
6th	238	SW-AACG2-10-P5-2G	58	16,38	1,15	19,50	0,7189
7th	241	SW-AACG3-10-P7,5-2G	60	16,98	1,25	22,00	0,7188
8th	242	SW-AACG4-10-P5-2G	60	17,10	1,35	19,50	0,7182
9th	67	SW- BHP-12-P7,5-G	58	14,83	1,31	22,75	0,7167
10th	243	SW-AACG4-10-P7,5-2G	61	17,39	1,35	22,00	0,7155
Alternative 3							
Rank	No	Code	S. I. $D_{nT,A}$ (dB)	C. (m^2/EUR)	W. (m^2/kN)	T. (cm)	C_i^*
1st	118	SW- BHP-10-P5-2G	59	15,72	1,25	19,50	0,8084
2nd	119	SW- BHP-10-P7,5-2G	60	16,00	1,25	22,00	0,8013
3rd	65	SW- BHP-10-P7,5-G	57	14,62	1,17	20,75	0,8012
4th	239	SW-AACG2-10-P7,5-2G	60	16,67	1,15	22,00	0,8004
5th	238	SW-AACG2-10-P5-2G	58	16,38	1,15	19,50	0,7999
6th	240	SW-AACG3-10-P5-2G	59	16,69	1,25	19,50	0,7966
7th	175	SW-AACG3-10-P7,5-G	57	15,60	1,17	20,75	0,7940
8th	173	SW-AACG2-10-P7,5-G	56	15,29	1,07	20,75	0,7935
9th	177	SW-AACG4-10-P7,5-G	58	16,01	1,27	20,75	0,7903
10th	241	SW-AACG3-10-P7,5-2G	60	16,98	1,25	22,00	0,7882

Table 9. *Copeland calculation of wins and defeats with the results.*

No	118			239			119			65			240			238		
	a1	a2	a3	a1	a2	a3	a1	a2	a3	a1	a2	a3	a1	a2	a3	a1	a2	a3
118	---	---	---	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
239	0	0	0	---	---	---	0	0	0	1	1	0	1	1	1	1	1	1
119	0	1	0	1	1	1	---	---	---	1	1	1	1	1	1	1	1	1
65	0	0	0	0	0	1	0	0	0	---	---	---	0	1	1	0	1	1
240	0	0	0	0	0	0	0	0	0	1	0	0	---	---	---	1	1	0
238	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	---	---	---

Calculation Results:

No	118	239	119	65	240	238	Sum	Copeland Ranking
118	---	3	2	3	3	3	14	1st
239	0	---	0	2	3	3	8	3rd
119	1	3	---	3	3	3	13	2nd
65	0	1	0	---	2	2	5	4th
240	0	0	0	1	---	2	3	5th
238	0	0	0	1	1	---	2	6th

Looking at the results presented in Table 9, the candidate with the most points is wall number 118, second candidate is wall number 119 and third candidate is wall number 239.

4. Conclusion

As stated in the Regulation on Protection of Buildings Against Noise, sound insulation should be provided in all kinds of buildings. Since there is a classification in the regulation, it is required to choose the most appropriate type of building element that maximizes sound insulation performance.

However, in order to improve sound insulation performance, acoustic applications like increasing mass or designing double walls affect other important design parameters like cost, weight and thickness that should be minimized. Having conflicting criteria appears to be a design problem for the construction sector. Therefore, multi-criteria decision making (MCDM) methods that allow the best choice to be found among the alternatives in decision-making situations were used in the study. Within MCDM methods TOPSIS method was preferred because it is suitable for large-scale data and identifies the best alternative quickly. In addition, to evaluate several TOPSIS results together and rank objects, Copeland method was applied. This aggregation method selects the alternative with the largest score in pairwise comparisons.

In this research, internal non-load bearing brick and AAC block wall alternatives were examined. Internal wall was designed to be approximately 10m^2 between source and receiver rooms. Wall construction alternatives were formed starting with single wall and developed as double walls and walls with cladding. Brick and AAC types, their thickness and densities were selected from types that are only produced in Turkey and have cost information in the Construction and Installation Unit Prices Book by The Ministry of Environment and Urbanism. The total amount of calculated walls is 509 regarding the number of construction type, density and thicknesses.

Insulation limits for walls were specified considering the source room was highly sensitive to noise (degree I) and the receiver room was moderately noisy (MN). According to the regulation, for Degree I-MN sensitivity noisiness combination, the required limit $D_{nT,A}$ (dB) is 52 dB for C Class. After all parameters were calculated, 54 wall types found to be less than 52 dB were excluded from the analysis. So, a number of 455 walls was analyzed respectively.

Among 455 walls, to choose the optimum wall TOPSIS method was applied. As specified by this method, subjective weight was given to each criterion to emphasize its importance. In the present study, the importance level of sound insulation was considered as the first. Cost was evaluated as second while weight and thickness

were equally third (Sound Insulation > Cost > Weight = Thickness). Three different weights meeting this condition were given to parameters and three similar results were found. Accordingly, users could choose of one of these three results. Alternatively, afterwards, to evaluate the alternatives together and rank objects, Copeland method was applied.

According to the Copeland calculation results, optimum wall was found to be as following: the wall number 118, code: SW- BHP-10-P5-2G having section single wall construction made of 10 cm and 600 kg/m^3 dry density horizontally perforated brick, 2 cm 2000 kg/ m^3 cement plaster on one side, wall cladding on the other side consisting of double layer gypsum board 5 cm rockwool inside 5 cm airgap constructed with DU50 and DC50 metal cladding profiles.

The results reveal that co-application of TOPSIS and Copeland method facilitate decision making for architects and engineers at the design stage. The implementation of the optimum walls will not only provide acoustic comfort in buildings but reduce construction costs and contribute to the national economy as well. In this study, interior walls were studied but in future studies this methodology can be used in the construction industry for other selection problems such as choosing exterior walls, glass types, floors, finishing materials etc. among the alternatives. In addition, by changing the criteria weights or by selecting more or different parameters, researchers will be able to obtain different information and results. Especially giving the cost parameter higher weight will prevent large losses in construction budgets.

References

Al-Sharrah, G. (2010). Ranking using the Copeland score: A comparison with the Hasse diagram. *Journal of Chemical Information and Modeling,* 50, 785–791.

Anshelevich, E., Bhardwaj, O.& Postl, J. (2015). Approximating optimal social choice under metric preferences, *Proceedings of the 29th AAAI Conference on Artificial Intelligence,* Austin, Texas, January 25-30.

Arıbaş, M., & Özcan, U. (2016). Akademik araştırma projelerinin AHP ve TOPSIS yöntemleri kullanılarak değerlendirilmesi. *Politeknik Dergisi,* 19 (2),163-173.

Arslan, R. (2018). Çok kriterli karar verme yöntemlerinin karşılaştırılması ve bütünleştirilmesi: OECD verileri üzerine bir uygulama (Doktora tezi). Sivas Cumhuriyet Üniversitesi, Sosyal Bilimler Enstitüsü, Sivas.

Bana e Costa, C.A., De Corte, J.M., & Vansnick, J.C. (2012) MACBETH. *International Journal of Information Technology & Decision Making, 11*(02), 359–87.

Beldek, U. (2009). Design and improvement of multi-level decision-making models (Ph.D. thesis). Middle East Technical University, The Graduate School of Natural and Applied Sciences, Ankara.

Belton, V., & Stewart, T. (2002). *Multiple criteria decision analysis: An integrated approach.* Berlin Heidelberg: Springer Science & Business Media.

Benyoucef, L., Hennet, J.C., & Tiwari, M.K. (Eds.). (2014). *Applications of multi-criteria and game theory approaches: manufacturing and logistics.* London: Springer-Verlag.

Borda, J.C. (1784). *Memoire sur les elections au scrutin.* Paris: Histoire de I'Academie Royaledes Sciences

Brans, J. P., Mareschal, B., & Vincke, P. (1984). PROMETHEE: A new family of outranking methods in multicriteria analysis, *Operational Research,* 3, 477-490.

Brauers, W. K. M. (2004). Optimization methods for a stakeholder society. *A revolution in economic thinking by multiobjective optimization.* Boston, MA: Kluwer.

Brauers, W. K. M., & Zavadskas, E. K. (2006). The MOORA method and its application to privatization in a transition economy. *Control and Cybernetics, 35* (2), 445–469.

Brauers, W. K. M., & Zavadskas, E. K. (2010). Project management by MULTIMOORA as an instrument for transition economies. *Technological and Economic Development of Economy,16*, 5–24.

BSI British Standards Institution. (2015). *Specification for masonry units - Part 4: Autoclaved aerated concrete masonry units* (BS EN 771-4:2011+A1).

CBRT Central Bank of the Republic

of Turkey Head Office. (2019). CBRT Exchange Rates [Website]. Retrieved Sep 18, 2019 from: https://www.tcmb.gov.tr/wps/wcm/connect/en/tcmb+en

CEN European Committee for Standardization. (2016). *Specification for masonry units-Part 1: Clay masonry units* (EN 771- 1+A1).

Condorcet, M. D. (1785). *Essay on the application of analysis to the probability of majority decisions,* Paris: Imprimerie Royale.

Cristobal, S., & Ramon, J. (2012). *Multi criteria analysis in the renewable energy industry,* 43-72. Berlin Heidelberg: Springer Science & Business Media.

Çakır, E. (2015). Bulanık çok kriterli karar verme yöntemlerinin altı sigma projeleri seçiminde uygulanması (Doktora tezi). T.C. Adnan Menderes Üniversitesi, Sosyal Bilimler Enstitüsü, Aydın.

Çakır, E. (2017). Kriter ağırlıklarının SWARA – Copeland yöntemi ile belirlenmesi: bir üretim işletmesinde uygulama. *Adnan Menderes University, Journal of Institute of Social Sciences*,4 (1), 42-56.

Çakır, S., & Perçin, S. (2013). Çok kriterli karar verme teknikleriyle lojistik firmalarında performans ölçümü. *Ege Akademik Bakış,* 13(4), 449-459.

Çatı, K., Eş, A., & Özevin, O. (2017). Futbol takımlarının finansal ve sportif etkinliklerinin Entropi ve Topsis yöntemiyle analiz edilmesi: Avrupa'nın 5 büyük ligi ve süper lig üzerine bir uygulama. *Uluslararası Yönetim İktisat ve İşletme Dergisi,*13 (1),199-222.

Declaration of Council of Ministers. (2018). Decree on Earthquake Hazard Map of Turkey and Parameter Values. *Official Gazette of the Republic of Turkey,* 30364, 18 Mar. (in Turkish).

Dodgson, C. L. (1876). *Method of taking votes on more than two issues.* Oxford: Clarendon Press.

Edwards, W., & Barron, F. H. (1994). SMARTS and SMARTER: Improved simple methods for multi attribute utility measurement. *Organizational Behavior and Human Decision Processes, 60,* 306–325.

Eray, E. (2015). İnşaat sektöründe tedarikçi seçiminde kullanılan çok amaçlı karar destek yöntemlerinin karşılaştırılması (Yüksek Lisans tezi). İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

Ertuğrul, İ., & Karakaşoğlu, N. (2008). Banka şube performanslarının VIKOR yöntemi ile değerlendirilmesi. *Endüstri Mühendisliği Dergisi, 20* (1), 19-28.

Ertuğrul, İ., & Özçil, A. (2014). Çok kriterli karar vermede TOPSIS ve VIKOR yöntemleriyle klima seçimi, *Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 4*(1), 267-282.

Fishburn, P.C. (1967). Letter to the editor-additive utilities with incomplete product sets: application to priorities and assignments. *Operations Research, 15*(3), 537-542.

Hassan, O. (2009). *Building acoustics and vibration: Theory and practice.* Singapore: World Scientific Publishing.

Hwang, C.L., Lai, Y.J., & Liu, T.Y. (1993). A new approach for multiple objective decision making. *Computers and Operational Research, 20* (8), 889–899

Hwang, C.-L., & Lin. M.-J. (1987). *Group decision making under multiple criteria: methods and applications.* Berlin Heidelberg: Springer-Verlag.

Hwang, C. -L., & Yoon, K. (1981). *Multiple attribute decision-making methods and applications: A state of the art survey.* Springer-Verlag: New York.

ISO International Organization for Standardization. (2010). *Acoustics-Laboratory measurement of sound insulation of building elements - Part 5: Requirements for test facilities and equipment* (ISO 10140-5:2010).

INSUL sound insulation prediction software (http://www.insul.co.nz/).

Ishizaka, A., & Nemery, P. (2013). *Multi-criteria decision analysis: Methods and software,* New York: Wiley.

İlter, E. (2016). Gerçek boyutlu cam panel cephe sisteminin uzun dönem taşıyıcılık ve sızdırmazlık performansının değerlendirilmesi (Doktora tezi). İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

Karakış, E. (2016). Bankaların ticari kredi verme davranışlarının bulanık mantık TOPSIS ve bulanık analitik hiyerarşi süreci ile incelenmesi (Doktora tezi). Cumhuriyet Üniversitesi, Sosyal Bilimler Enstitüsü, Sivas.

Keeney, R.L., & Raiffa, H. (1976). *Decision making with multiple objec-*

tives preferences and value tradeoffs. New York: Wiley.

KPMG Türkiye (2018). Sektörel Bakış – İnşaat [pdf]. Retrieved Mar 9, 2019 from: https://assets.kpmg/content/dam/kpmg/tr/pdf/2018/01/sektorel-bakis-2018-insaat.pdf

Kuru, A. (2011). Entegre yönetim sistemlerinde çok kriterli karar verme tekniklerinin kullanımına yönelik yaklaşımlar ve uygulamaları (Doktora tezi). T.C. Marmara Üniversitesi, Sosyal Bilimler Enstitüsü, İstanbul.

Lamboray, C. (2007). A comparison between the prudent order and the ranking obtained with Borda's, Copeland's, Slater's and Kemeny's rules, *Mathematical Social Sciences, 54*(1),1-16.

MacCrimmon, K. R., & Rand, C. (1968). *Decision making among multiple-attribute alternatives: A survey and consolidated approach.* Santa Monica, California: Rand Corp.

Malczewski, J., & Rinner, C. (2015). *Multicriteria decision analysis in geographic information science,* Berlin Heidelberg: Springer-Verlag.

Mehta, M., Johnson, J., & Rocafort, J. (1999). *Architectural acoustics: Principles and design.* USA: Prentice Hall.

MoEU Ministry of Environment and Urbanization. (2017). Detailed analysis of construction unit prices [Website]. Retrieved Jan 15, 2018 from: https://birimfiyat.csb.gov.tr/

Mohammadi Dehcheshmeh, A. (2018). Country risk assessment by applying multi-criteria decision-making methods: a case study ranking countries in the Middle East & North Africa (Master thesis). T.C Istanbul Aydın University, Institute of Social Sciences, Istanbul.

Nanson, E. J. (1907). *Methods of elections.* UK: British Government.

Opricovic, S. (1998). *Multicriteria optimization of civil engineering systems* (in Serbian), 302, Belgrade: Faculty of Civil Engineering.

Ömürbek, N., Makas, Y., & Ömürbek, V. (2015). AHP ve TOPSIS yöntemleri ile kurumsal proje yönetim yazılımı seçimi. *Süleyman Demirel Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 1*(21), 59-83.

Özkan, Ö. (2007). Personel seçiminde karar verme yöntemlerinin incelenmesi: AHP, ELECTRE ve TOPSIS örneği (Yüksek Lisans tezi). Dokuz Eylül Üniversitesi, Sosyal Bilimler Enstitüsü, İzmir.

Öztel, A. (2016). Çok kriterli karar verme yöntemi seçiminde yeni bir yaklaşım (Doktora tezi). Gazi Üniversitesi, Fen Bilimleri Enstitüsü, Ankara.

Öztürk, B. (2011). Çok kriterli karar verme tekniklerinden bulanık TOPSIS ve bulanık analitik hiyerarşi süreci (Doktora tezi). Uludağ Üniversitesi, Sosyal Bilimler Enstitüsü, Bursa.

Pekkaya, M., & Aktoğan, M. (2014). Dizüstü bilgisayar seçimi: DEA, TOPSIS ve VIKOR ile karşılaştırmalı bir analiz. *Ekonomik ve Sosyal Araştırmalar Dergisi, 10* (1), 107-125.

Rasiulis, R., Ustinovichius, L., Migilinskas, D., Cepurnaite, J., & Virbickas, A. (2016). Energy efficiency of a public building renovation and reconstruction using base model passive house and BIM technology. *Engineering Structures and Technologies, 7*(3), 114-125.

Regulation on fire protection in buildings. (2007). *Official Gazette of the Republic of Turkey*, 26735, 19 Dec. (in Turkish).

Regulation on protection of buildings against noise. (2017). *Official Gazette of the Republic of Turkey*, 30080, 31 May. (in Turkish).

Roy, B. (1968). Classement et choix en présence de points de vue multiples (la méthode ELECTRE). *La Revue d'Informatique et de Recherche Opérationelle (RIRO),8*, 57–75.

Saari, D., & Merlin, V. (1996). The Copeland method. I. relationships and the dictionary, J*ournal of Economic Theory, 8*, 51–76.

Saaty, T. L. (1988). What is the analytic hierarchy process? In Mitra, G., Greenberg, H.J., Lootsma, F.A., Rijckaert, M.J. & Zimmermann, H.J. (Eds.), *Mathematical models for decision support, 48,* 109–121. Berlin Heidelberg: Springer.

Saaty, T. L. (1996). Decision making with dependence and feedback: The analytic network process: *The organization and prioritization of complexity*. Pittsburgh: RWS Publications.

Saldanlı, A., & Sırma, İ. (2014). TOPSIS yönteminin finansal performans göstergesi olarak kullanılabilirliği.

Marmara Üniversitesi Öneri Dergisi, 11(41),185-202.

Sanjay, M.R., Jawaid, M., Naidu, N.V.R., & Yogesha, B. (2019). TOPSIS method for selection of best composite laminate, In *Modelling of damage processes in biocomposites, fibre-reinforced composites and hybrid composites,* 199-209, US: Woodhead Publishing.

Štreimikienė, D., & Baležentis, A. (2013). Integrated sustainability index: the case study of Lithuania, *Intelektinė Ekonomika, 7* (3), 289-303.

Sugiartawan, P.& Hartati, S. (2018). Group decision support system to selection tourism object in bali using analytic hierarchy process (AHP) and Copeland score model. *3rd International Conference on Informatics and Computing (ICIC),* Palembang, Indonesia, October 17-18.

Supçiller, A. A., & Deligöz, K. (2018). Tedarikçi seçimi probleminin çok kriterli karar verme yöntemleriyle uzlaşık çözümü. *Uluslararası İktisadi ve İdari İncelemeler Dergisi, 18*, 355 – 368.

Tajvidi Asr, E., Hayaty, M., Rafiee, R., Ataie, M., & Jalali, S. E. (2015). Selection of optimum tunnel support system using aggregate ranking of SAW, TOPSIS and LA methods. *International Journal of Applied Operational Research,5* (4), 49-63.

Taylan, O., Bafail, A.O., Abdulaal, R., & Kabli, M.R. (2014). Construction projects selection and risk assessment by fuzzy AHP and Fuzzy TOPSIS methodologies, *Applied Soft Computing, 17,* 105-116.

Tekin, Ö. F., Eşit, M., Kamil B., &Varınca, K. B. (2014). Proposed solutions to environmental concerns in the construction industry: sustainability and green building. *Proceedings of 2nd International Symposium on Environment and Morality,* (651-661). Adıyaman, Turkey, October 24-26.

TGUB Turkish Autoclaved Aerated Concrete Association (http://tgub.org.tr/homeeng).

Thor, J., Ding, S.H., & Kamaruddin, S. (2013). Comparison of multi criteria decision making methods from the maintenance alternative selection perspective. *The International Journal of Engineering And Science (IJES), 2*(6), 27-34.

Toydemir, N., Gürdal, E., & Tanaçan, L. (2000). *Yapı elemanı tasarımında malzeme,* 158. İstanbul: Literatür Yayıncılık.

Triantaphyllou, E. (2000). *Multi-Criteria decision-making methods: a comparative study*. US:Springer.

Tscheikner-Gratl, F., Egger, P., Rauch, W., & Kleidorfer, M. (2017). Comparison of multi-criteria decision support methods for integrated rehabilitation prioritization. *Water, 9*, 68.

TUIK State Institute of Statistics Prime Ministry Republic of Turkey. (2001). Building Census 2000. 24-464, Ankara: State Institute of Statistics Printing Division.

Tupenaite, L. (2010). Multiple criteria assessments of the built and human environment renovation projects (Ph.D. thesis). Vilnius Gediminas Technical University, Technological Sciences, Vilnius.

Velasquez, M., & Hester, P.T. (2013). An analysis of multi-criteria decision making methods, *International Journal of Operations Research, 10* (2), 56 66.

Yazdani-Chamzini, A., Fouladgar, M., Zavadskas, E. K., & Moini, S. H. (2013). Selecting the optimal renewable energy using multi criteria decision making. *Journal of Business Economics and Management, 14* (5), 957-978.

Yıldırım, B.F., & Önder, E. (Eds.). (2015). *Operasyonel, yönetsel ve stratejik problemlerin çözümünde çok kriterli karar verme yöntemleri,* Türkiye: Dora Basım Yayın Dağıtım.

Yoon, K. (1987). A reconciliation among discrete compromise situations. *Journal of Operational Research Society, 38* (3), 277–286.

Zavadskas, E. K., & Antucheviciene, J. (2007). Multiple criteria evaluation of rural building's regeneration alternatives. *Building and Environment, 42,* 436–451.

Zavadskas, E. K., & Turskis, Z. (2010). A new additive ratio assessment (ARAS) method in multicriteria decision-making. T*echnological and Economic Development of Economy, 16* (2), 159–172.

1000minds Ltd. (2017). What is MCDM / MCDA? [Website]. Retrieved May 10, 2017 from: https://www.1000minds.com/sectors/academic/mcdm

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