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Study for a morphological assessment: Impact of a new project on urban form of Galata, Istanbul

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Abstract

Cities are in a continuous process with the change and re-adaptation of different parts. Cities are deliberately planned under different socio-economic, natural, religious, and political conditions in different historical periods. While cities are growing, new urban projects are planned that will affect urban morphology. Thus, the research problem is that new urban design projects require planning and integrated policy in interaction with the city. One of the aspects of ensuring this is examining the city from the historical point of view and comprehending urban morphology analysis. Within this framework, the Galata Region is chosen as the study area. The main reason for choosing the study area is; that it is thought the planning of the Galataport Project, the characteristics of the district and its impact should be questioned. Therefore, the study aims to first determine the change and development of the Galata Region over time with the Conzenian approach. In this section, historical maps of the area will be examined through the spatial development of the city, and the determination of the areas affected by the planning decisions will be revealed. Morphological region analysis will be done to identify the focus area boundary. Secondly, the aim is to reveal the impact of the Galataport Project on the region and on the use of the coastline by space syntax method. In this part, the effect of the Galataport Project will be explained comparatively by axiality, convexity, integration and intelligibility, and synergy concept through the 1980 and 2020 maps. As a result, it is seen that the study area has its spatial characteristics, cultural values, and historical process. In the general analysis of the area, it is seen that the old city center is seen as a high potential area for transformation due to its central location. The old city center plays a central role in the marketing of the city because of its economic potential. New design projects are done in the study area because of the transformation potential. It is observed that the Galataport project together with the morphological structure led to functional changes in the field and caused differences in the characteristics of the use of space. It has affected the area and old trading functions began to transform the leisure and tourism sector. Lastly, recommendations are given according to the results.

Keywords: Conzenian approach, Galata region, Galataport project, urban morphology, space syntax methodology.

1. Introduction

From past to present, urban form and structure have been one of the major research topics in urban studies. Thus, morphological analysis is the main method effective in examining the city's form and structure. Also, planning and design decisions developed for cities have been issues of strategic importance in terms of understanding the history of cities, understanding their present and future planning approaches, and fictionalizing their future.

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As industrialization and urbanization increase, settlements begin to lose their historical, cultural values, and identity. Cities are facing major challenges because of the rapid rate of population growth and economic development, which require comprehensive strategies to protect the environment and sustainable development. For these reasons, examining the settlements through their forms and morphological characteristics to their dynamic structures stand out as themes that should be emphasized. Also, understanding the physical complexities of various scales and the spatial configuration of cities helps us to understand how towns have grown and developed. While cities are growing new urban projects are planned. Each plan decision and project should be harmonious and integrated. Istanbul, as a port city, includes many port projects. In the region's growth phase, the ports which are integrated with the city need to expand due to increased traffic and urbanization. As a result, ports that grow in parallel with the growth of the city maintained their port city appearance while on the other hand, the ports that are stuck in the city that cannot integrate with the city shrink and become dysfunctional.

Galata Region, which is considered the historical core/port of Istanbul, has also been affected by many planning and design decisions throughout history. A new project like Galata Port Project is planned and done in the area. Galata Port is located in a position that can be described as the entrance gate of Istanbul. Anatolia is rich in architecture and urban structure, reflecting its geographical location and the influence of several civilizations (Kubat,2010). These kinds of planning decisions belong to various historical periods and these planning decisions led to alterations in the morphological framework of the region.

A brief explanation of the emphasis on the research problem is that new urban design projects require planning and integrated policy in interaction with the city.

Accordingly, the main aim is *to analyze the change and development of the Galata Region over time by analyzing the physical layout and syntactic characteristics through historical periods and to reveal the impact of the Galataport project on the coastline use and the region.* Sub aim of the study can be stated as *synthesizing two different morphological approaches (Conzenian morphology and space syntax methodology) to investigate the change and development of the study area.*

Based on the aims the research questions can be summarized*: Is Galataport Project (new port project) effective within the spatial structure and is it a characteristic feature of a region?*

2. Urban Morphology as a Discipline in Urban Studies

A great number of scholars have put forward the definition of urban morphology throughout history. Urban morphology concepts in the literature are presented in Table 1.

Table 1 Definitions of urban morphology by scholars.

The Definition of Urban Morphology	Scholars
"The study of the layout and build of towns viewed as the expression of their origin, growth, and function"	(Dickinson, 1948, p.232)
"A method of analysis which is basic to find(ing) out principles or rules of urban design"	(Marshall & Çalişkan, 2011)
"A method of analysis which is basic to finding out principles or rules of urban design or 'the study of the physical and spatial characteristics of the whole urban structure"	Gebauer & Samuels (1981, cited in Oliveira 2016, p.3)
"The study of the physical (or built) fabric of urban form, and the people and processes shaping it"	(Urban Morphology Research Group, 1990)
"The science of form, or of various factors that govern and influence form"	(Lozano, 1990)
"The study of the physical (or built) fabric of urban form, and the people and processes shaping it"	(Larkham & Jones, 1990)
"The study of the city as human habitat".	(Moudon, 1997, p.3)
"The study of the evolution process of a particular place over time"	(B. Scheer & Scheer, 2002)
"The study of urban form"	(Cowan, 2005)

A "method of urban analysis used to find out basic principles of urban formations and aiming to describe the process of urban formation defined period within a hierarchical order"	(Mıhçıoğlu Bilgi, 2010)
"Morphology claim to be the instrument that connects organically sustainable technologies and formal needs."	(Maretto, 2013)
A study identifying "the repeating patterns in the structure, formation, and transformation of the built environment to help comprehend how the elements work together, notably to meet human needs and accommodate human culture"	(Kropf, 2014, p.41)

As a consequence of these definitions, it can be said that urban morphology is known as the structure of the city. As can be seen from the study of urban morphology, the contributors who have worked in this field have so far studied the city's evolution from history to the present. Thus, the formation of the cities, the transformation process, and the characters of the cities emerge. It can provide a general structure for a deeper analysis of decision-making.

2.1. Different approaches to urban morphology

Kropf (2009) attempts to clarify the methods and elements of urban morphology. He studied the work of some scholars on aspects of urban form and developed principles and techniques for urban form study. He defined four techniques for urban morphology, which are "spatial analytical," "configurational," "typological method" and "historic-geographic". These techniques together provide a comprehensive understanding of the built space (Gokce, 2018) (Figure 1).

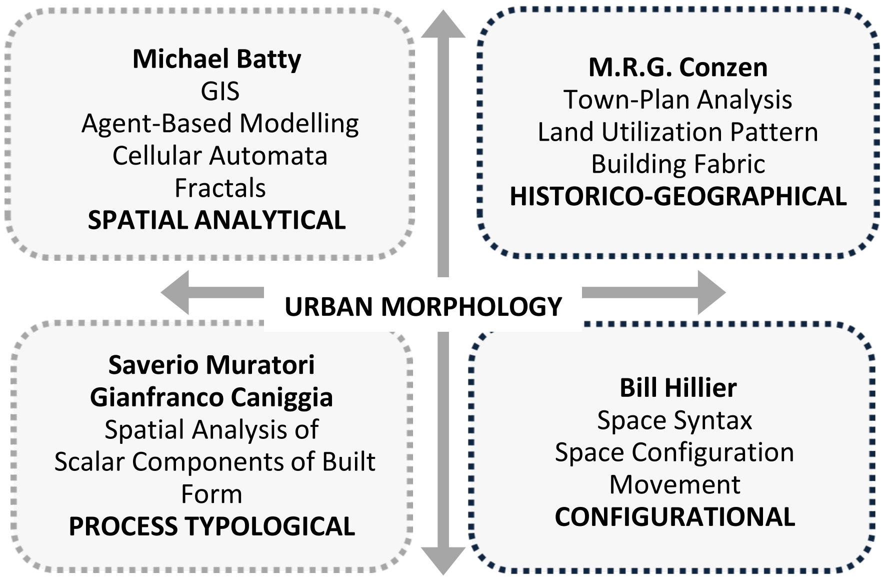

Figure 1 Approaches to urban morphology (adopted from Kropf, 2009).

In the spatial analytical approach, cities are considered to be ordered, but complex entities, and this complexity question can be solved through the study of their spatial structure and dynamics by understanding their emergence and evolution method (K. Kropf, 2009).

In the configurational approach, space syntax is the main method used in urban morphology to analyze the connections between form, function, and perception (K. Kropf, 2009).

The typological approach is rooted primarily in the work of Saverio Muratori, inspired by Giuseppe Pagano (Marzot, 2002). This perspective examines how the built environment develops and what future developments can benefit from its physical structure's evolution over time (K. Kropf, 2009).

The historical-geographical approach is seen as the analysis of the town plan of Conzen, which systematically analyzes the features of the city and its growth through periods to assess the spatial structure and character of the city (K. Kropf, 2009).

Table 2 Similarities and differences among three schools, compiled by the author.

	HISTORICO-GEOGRAPHICAL	PROCESS TYPOLOGICAL	SPATIAL ANALYTICAL	SPATIAL ANALYTICAL
	British School	**Italian School**	**French School**	
Year	The 1950s	The 1950s	The 1970s	The 1970s
Founder	Geographers	Architects	Different Disciplines	Different Disciplines
Adherents	Conzen Whitehand	Saverio Muratori Giafranco Caniggia Aldo Rossi	Michael Batty Lefebre Paneria Caste Depauri	Bill Hillier Julienne Hanson and their colleagues
Focus	Urban morphogenetic process	The design of the urban form	Relationship between urban form and various social phenomena	Relation between space and activity
Intention	How cities are built and why?	How cities should be built?	What should be built and what has been built?	How to predict movement and land use from spatial structure?
Data	Diachronic	Synchronic and diachronic	Synchronic	Synchronic and diachronic
Patterns	Plan units Morphological frame Plot series	Building types Building tissues	Classification of different urban patterns	Syntactic maps
Explored Linkages	Land use, land value, historical periodicity	Cultural region	Social practices	Land use, land value, historical periodicity, Social practices

Thus, the historical-geographical and configurational approach is selected as the methodology of the study. It is aimed to use both of these urban morphology approaches to detect morphological elements and morphological change. By bridging the two approach, better understanding of the region and the applicability of the two methods have been tested.

3. Historico-Geographical and Configurational Approach

3.1. Historico-Geographical Approach

Townscape is “the physiognomy of the urban landscape” (Conzen, 1969). It looks at the changing urban patterns and their contribution to the regional character.

Morphological regions

Conzen uses the concept in townscape analysis as morphological regions that describe the boundaries or regions of the land utilization, building type, and plan unit and place them in hierarchical order. A morphological region is an area that has a unity in respect of its form that distinguishes it from surrounding areas. Boundaries between regions vary in strength (Conzen, 1988).

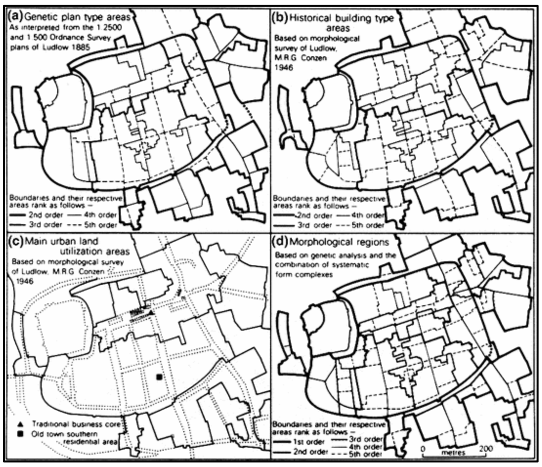

Figure 2 Morphological regions of Conzen’s Ludlow map (Whitehand, 2001).

The five-tier hierarchy of boundaries is described in the Ludlow analysis of Conzen, seen in Figure 2. The elements of urban morphological regions are urban land use, the form of building, and the type of plan divided into four hierarchical ranks.

First-order: the old district as a whole represents the first order. Also, basic historical elements and developments are involved.

Second-order: major plan units, urban districts, or small residential dwellings are involved.

Third-order: intermediate plan units, street units, or land utilization are involved.

Fourth-order: minor plan units, building fabric cells, morphotypes, or the new planning areas are involved.

Plan unit can be conducted at various scales from layouts to individual morphotypes and refers to any region showing internal homogeneity and morphological discord with adjacent plots (Conzen, 1960, p.5).

Land utilization pattern is the order or spatial development of land use. Conzen identified that "the elements of the pattern are the individual units of land utilization occupying discrete plots. Classification of uses is based on the single criterion of purpose" (Conzen, 1988).

Building type is defined as "the elements of the urban land utilization pattern, that is the individual units of land utilization occupying desecrate plots" (Conzen, 1981).

3.2. Configurational Approach

Space syntax theory from the urban morphological tradition perspective was developed between the late 1970s and the early 1980s by Professor Bill Hillier[1] Julienne Hanson and their colleagues at University College London's Bartlet Institute. This special morphological theory—provides a demonstrable frame to understand the urban system and its physical evolution (Kubat, 1999). Answers to such questions were sought. How can space be described? How to predict movement and land use from spatial structure? How to assess an area's design?

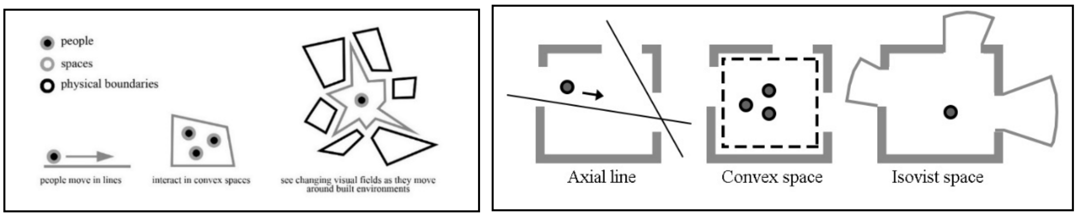

Figure 3 Relation between space and activity: Space is not a background of activity but an intrinsic aspect of it (Hillier, 2004) (left); Axial line, convex space, and isovist space (Hillier, 1984) (right).

The spatial specification allows the social structure to be mapped to itself in space syntax. For example, Figure 3 shows two different types of spatial configuration; building structure and space structure, although in adjacency and number of cells they appear to be similar, underneath topology they are completely different (Hillier, 1996).

The spatial structure measuring is represented by using syntactic maps. These syntactic maps are comprised of axial, convex, and isovist spaces. These are the representation of spaces as shown in Figure 4. These components constitute different types of measurement to detect the configurational properties of urban settlements.

[1] Bill Hillier got his BA and MA in Architecture at the University of Cambridge, in 1961 and 1964. He received his DSC in Built Environment at the University of London in 2003 (Oliveira, 2016).

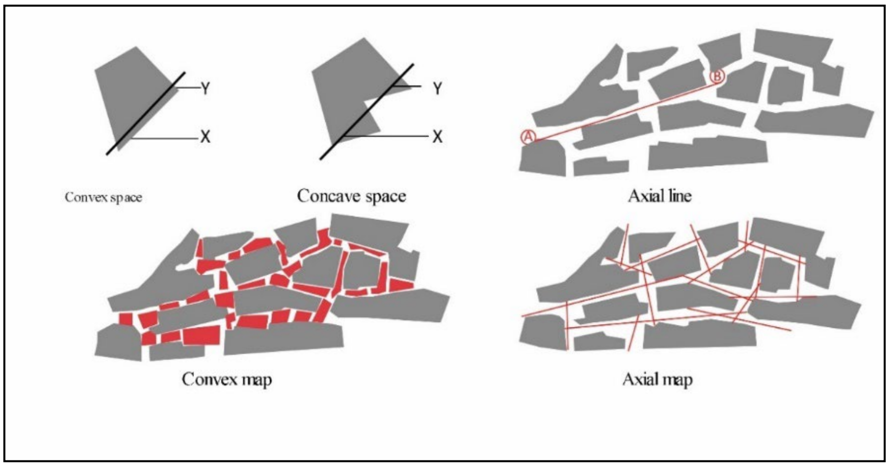

Figure 4 Space syntax tools (Hillier, 1984).

3.3. Measures of space syntax

Since the 1970s, a significant body of researchers has been using the "space syntax" approach to analyze the morphology of the physical city and its relationship with the functional city.

Table 2 summarizes ten related mathematical definitions of measures that are used in the spatial structure of the case studies.

Table 2 Mathematical definitions of measures, complied by (Hillier, 1984; Kubat, 1997).

TERMS	DEFINITIONS	FORMULAE[2]
Axial articulation	Axial integration is a measure of the integration of axial lines. Low values mean an axial line with a high degree of integration. It is measured by dividing the number of axial lines by the number of buildings.	L/number of buildings
Convex articulation	The degree to which the open space of an urban system is broken up into convex space is indicated by the convex articulation value.	C/number of buildings
Axial ringiness	Axial ringiness is a measure of rings in the axial map.	½L−5
Convex ringiness	The ringiness of the convex system R convex is the number of the rings in the system as a proportion of the maximum possible planar rings for that number of spaces.	I/2C−5
Grid axiality	The value is between 0 and 1, a high value indicates a strong approximation to a grid, and a low value a greater degree of axial deformation.	2I1/2 + 2/L,
Grid convexity	This formula compares the convex map to an orthogonal grid. High values indicate little deformation of the grid and low values indicate higher deformations of the grid.	(I1/2 + 1)2/c,
Convex deformation	The degree of convex deformation of the grid can be measured by dividing the number of convex spaces by the number of islands.	C/I
Axial integration	Axial integration is a measure of the integration of axial lines. Low values mean an axial line with a high degree of integration.	L/C
Mean connectivity	Connectivity is a significant measure of an axial map that describes the number of lines connected to or intersecting a given line.	Lower is attributed to a nonorthogonal
Mean global integration	The highest number is the most integrated space in the system, the lowest is the most segregated space in the system.	Integration

3.3.1. Measuring axiality through space syntax

The simplest of all morphological measurements that can be taken from the axial map is the length of any street or space along the longest possible axis. Axiality means the maximum global or

[2] L is the number of axial lines; C is the number of convex space; I is the number of islands.

axial extension of space, as a point, in a straight line (UCL Space Syntax). The axial map is therefore a series of axial lines which are the longest lines in the spatial structure that can be drawn from a random point. (Benech, 2007). Four main measurements are analyzed in the thesis shown in the table. They are axial articulation, axial integration, grid axiality, and axial ringiness.

Axial articulation is the number of axial lines per urban block. About urban blocks, this shows the granularity of a spatial structure. A higher degree of axiality is suggested by a lower axial articulation value and a higher value by a greater axiality breakup.

Axial integration is the reciprocal of the real relative asymmetry (RRA) value of an axial line, which is a function of the mean depth (MD) value of the line. A higher RRA value indicates greater segregation, and a lower value indicates a higher integration of a node with the other nodes in the entire graph. Therefore, a higher integration value, which is the reciprocal of an RRA value, indicates greater accessibility, and a lower value indicates lower accessibility of a node wiconcerninghe other nodes of a graph (Sevtsuk & Davis, 2019).

Grid axiality, or the degree of axial deformation of the grid, is measured by comparing the number of axial lines in a spatial system with the number that could exist in a regular grid with the same number of islands or blocks. According to (Hillier and Hanson, 1984), in general values of 0.25 and above indicate a grid-like system, while values of 0.15 and below denote a more axially deformed system.

Axial ringiness is the number of rings in the axial map of a spatial system as a proportion of the maximum possible planar rings for that number of axial lines. This value may exceed 1 since the axial map is nonplanar. However, in practice values greater than 1 is unusual (Hillier and Hanson, 1984). Axial ringiness is a measure of restrictions indicating how freely one can move in an area.

3.3.2. Measuring convexity through space syntax

The degree to which any space can be extended into two dimensions is described by convexity. There are four main measurements: convex articulation, convex deformation, grid convexity, and convex ringiness.

Convex articulation can be measured by dividing the number of convex spaces by the number of buildings. Grid convexity compares the convex map to an orthogonal grid. High values indicate little deformation of the grid and low values indicate higher deformations of the grid. Convex ringiness of a convex system is R convex is the number of the rings in the system as a proportion of the maximum possible planar rings for that number of spaces and the degree of convex deformation of the grid can be measured by dividing the number of convex spaces by the number of islands (defining an island as a block of continuously connected buildings surrounded by open space).

3.3.3. Measuring intelligibility and synergy through space syntax

“The correlation between connectivity and global integration is an important indicator of how clear an urban system is for its users; and this is referred to as Intelligibility” (Choudhary, 2012). In practice, the value of intelligibility is evaluated by the degree of linear correlation between connectivity and the global value of integration (Hillier and Hanson, 1984). The greater a correlation, from its measurable local relations, the more global configuration of a space can be inferred.

Synergy is similar to intelligibility. The concept of synergy, like the parameter of intelligebility, has been defined as a second-degree value emerging as a result of correlation (Topçu, 2019). The connection between the global value of integration and the value of local integration explains the city's synergy (Thilagam, 2015). Hillier suggests that this is a measure of how the local street network is a reliable indicator of the global configuration. (Dalton, 2010). Synergy's definition is in several respects related to that of intelligibility. Hillier argues that this is also a measure of the correlation between the grid's local structure and the grid's global structure (Dalton, 2010).

3.3.4. Measuring integration through space syntax

Integration is the most significant measure among syntactic measures when applied to the axial and segment maps of space syntax. A static global measure is an integration. As Peponis et al (1997) state: “Integration measures the relationship of each line to the network as a whole”. Space integration is defined as a valindicativeion of the degree to which space is integrated or separated from a system as a whole (global integration) or a partial system consisting of spaces a few steps away (local integration)' (Choudhary, 2012). Integration is not only a structured function but can also help identify how urban structures operate (Hillier, 1996).

4. Historical Evaluation of the Galata Region

Galata region is chosen as the study area for this study. The selected area is chosen based on six parameters. First, in the selected study area, there is a rich historical and cultural history. Second, is the existence of documentation (pervititch maps, historical photographs, aerial photographs, GIS software, etc.). Thirdly, the selected study area has a varied degree of urbanity. Fourth, the selected area has a rich urban pattern that includes apart from each period of urbanization. Fifth, the area is affected by numerous planning and design decisions throughout the historical development and the effects in areas that make up the city's unique character showed themselves. Lastly, the planning of the Galataport Project is also a situation where the characteristics and impact of the district should be questioned.

The Galata region plays a vital role in the spatial structure and operation of the municipality. We can see the strategic importance of the selected area through the introduction of new urban design projects such as the project Galataport project.

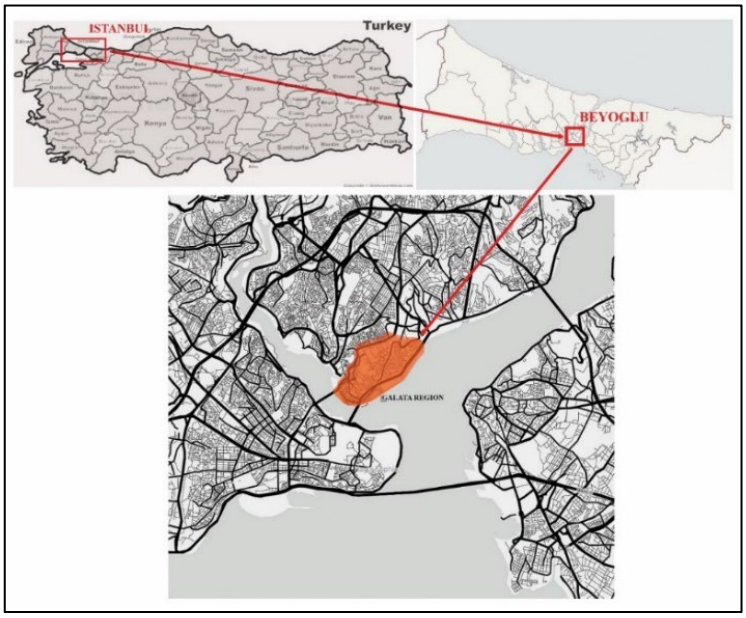

Figure 5 Location of the study area in Istanbul.

It is seen throughout history, that variations of Galata Road systems have been documented. Galata’s corporate image and port accessibility reached a high level of activity as part of this metropolis (Agirbas & Ardaman, 2015).

By the historical maps, the study area reflects the traces of each period and has reached the present day with important historical buildings belonging to each period.

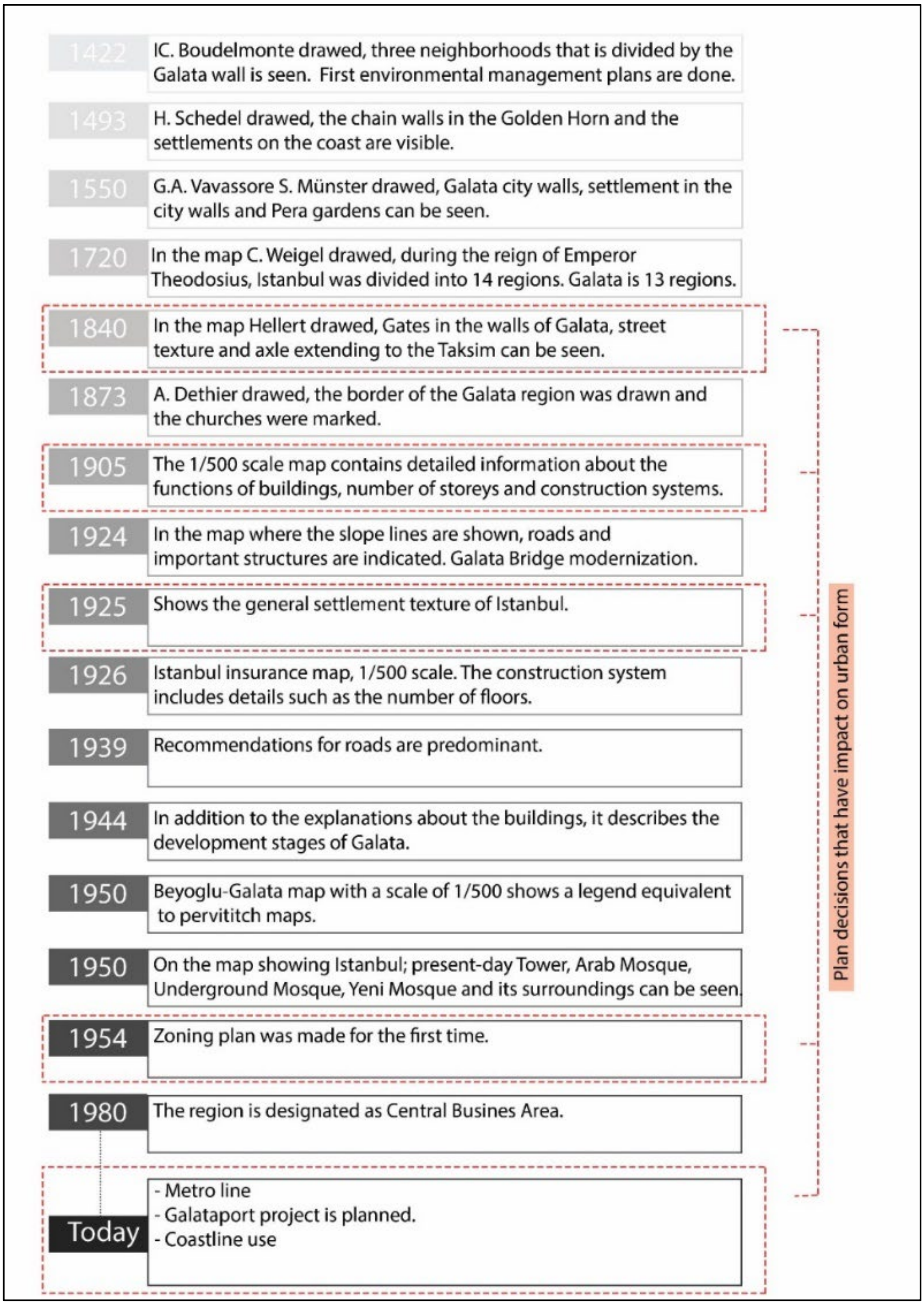

Figure 6 Major developments in the historical process of the Galata region, compiled by the author.

At present, one of the most important developments seen on the 2018 map is the metro line that connects the Historical Peninsula and Karaköy. Karaköy square and the port area have been thought through different planning approaches throughout history. Today, the coastline is planned for pedestrian use with the new projects. The area between the two bridges where the square and the port are located is considered a recreational area. It is seen in the 2020 map, that since the beginning of the 2000s, the approach of marketing in the area has led to megaprojects (Galataport and Haliçport) with port functions which causes morphological transformations in the area.

Figure 7 shows that when historical maps are examined through street patterns, the city walls were demolished after 1453. Afterward, the Pera fire destroyed many houses, shops, and streets including Yüksek Kaldırım Street 1860. We can see in the 1887 map that the grid plan was widely applied to urban regulations after the Pera fire. Later on, in 1913 German map that Yüksek Kaldırım street was enlarged, and some arrangements were made. On the map in 1945, Kemeraltı Street and Bankalar Street became the main roads that connect the main artery which comes through the Galata Bridge. In the 1980 map, we can see that the coastal zone of the region is an important planning area. Important buildings have preserved their importance throughouth history, but it can be said that 1945 was a breakdown. Although fires have greatly affected the urban texture of Galata, surrounded by city walls, the region has preserved its features for many years. In a conclusion, the research showed and made it possible to analyze the increased number of streets and significant structures, as well as the change and the development of the region.

Figure 7 Development of the street pattern for examined periods studied, marked with important changes.

Also, the physical patterns of the study area are seen in Figure 8. It's seen in the street pattern that the main axles that existed till 1887 are Yüksek Kaldırım Street, Kemeraltı Street, Tersane Street, and Bankalar Street. The importance of these streets has been going on for many years. These roads were used as main roads in the past. The core of the region is planned as a traditional organic pattern that can be seen in many historical city centers. But when we look at the edges, we can see a grid pattern. This pattern is also seen in the new project area.

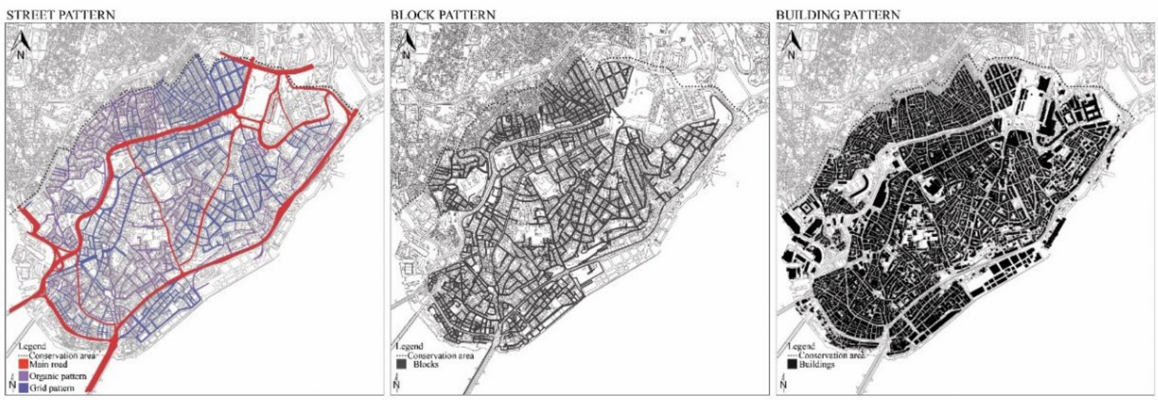

Figure 8 Physical patterns of the study area.

Galata Port from Past to Present

Galata port, which is seen as the gateway of Istanbul to the world, did not have a modern dock until the 19th century. For this reason, the ships that stopped during the period, anchored in pontoons and buoys off Galata.

19. the century that began in the Ottoman Empire in the century also affected the urban life of Istanbul. In fact, in the last years of the century, it was decided to modernize the Port of Istanbul. The main reason for this decision is that the current capacity of the port has been insufficient in the face of the growing volume of trade and technological developments.

Construction of the first modern dock in the port of Galata began in 1892. But due to reasons such as rising flow rate, disease outbreaks, and the formation of some collapses during construction, the construction process has been very difficult. Despite all the difficulties, the Galata pier was completed in 1895. But when it became clear that it was not strong enough, and as a result of various collapses, the dock was repaired again in 1898, and the renovation work was completed in 1900.

In the 20th century, as a result of non-investment, the port of Istanbul started to lose its importance. However, with the Soviet Revolution, the port of Istanbul lost its most important source of income in the Black Sea. Galata docks company was nationalized in the period between 1933 and 1934 and was connected to the General Directorate of sea roads and ports. Since the 1980s, the port in the city center has become unusable due to increased ship traffic and heavy tonnage trucks. Because of these situations, Galata port has started to be used for tourism purposes.

Currently, different planning decisions have been made and implemented for the port. Now, Galataport project is a project covering 1.2 kilometers of coastline from Karaköy Quay to Mimar Sinan University Fındıklı Campus. As part of the project, it is planned to repair or demolish the structures located in this area of the tourist concept of the port and open up space for new facilities. Hotels, restaurants, and all other commercial enterprises to be built in the coastal areas of the port are intended to preserve the historical fabric of the port area and transform the area into a full tourist attraction. With the project “Galataport”, it is thought that the area will gain different functions and become a cultural, tourism, and trade center, thus adding new value to Istanbul.

The entire coastal line is reserved for cruise port use. Functional changes are also planned within the scope of the project. In the region, the historic package Post Office is functioning as a fair and exhibition hall, while the historic inn buildings on the coast are functioning as hotels. On the Tophane side, the Square and the proprietary historical structures and spatial elements behind it are preserved. But new uses such as hotels, office buildings, sales areas, and a marina have been added to the waterfront line. The functional distribution of the coastal band is planned as semi-private uses such as hotels, terminals, and congress centers, where public use is not included.

When analyzed visually, it is seen in Figure 9, that there is no public open space in the area other than Tophane Square. Semi-private uses of hotels and restaurants can be seen in small-scale openings between buildings. The only point in the project that changes the silhouette and creates a public open space is Tophane Square. However, Tophane Square, which is a coastal Square is not fully met with the sea. The Square is again located behind the shoreline and there is a structure planned as an aquarium in front of it in the western direction. Although the rest of the area appears clear in the foreground, the use of the harbor makes the square lose its coastal position. The cruise ships that will dock onshore are the size that completely closes the square and prevents sea–shore perception. The structures planned to replace the four existing warehouses as terminal buildings are larger in scale than the existing ones and they completely covers the shoreline. This means the reproduction of physical tissue on the coast on a larger scale and the formation of a new morphological character in the city.

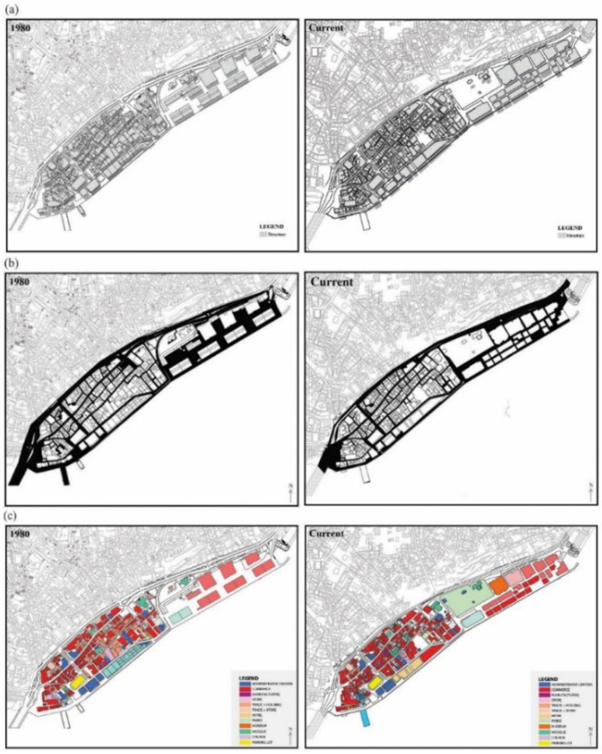

Figure 9 Maps of the area in 1980 (left) and 2020 (right): (a) spatial change; (b) street pattern; (c) land use.

Figure 10 Cruise ships and their impact on the silhouette (Tepeli, 2015).

Figure 11 Impact of the project from the coastal area to the silhouette, the 1900s (top) and 2020 (bottom) (Url, 1).

5. Morphological Change in Galata Region

5.1. Historico-Geographical Analysis

Galata's old city wall comprising the old settlement area is indicated as a first-order, due to its persistence as a multi-level urban fabric from Byzantium to the present. In the second-order, major structural divisions, historical processes, and regions within definite identities are considered according to the direction of urban development. It is seen in the plan unit the region started to parallel the sea. Determining the second-order land utilization of the study area is differentiated as which are residential, commercial, industrial, and community service functions. It is seen that the historical core contains centrally the commercial functions. This is also seen in the planned new design project (Galataport project). Additionally, to determine the second-order, significant buildings from each period are determined. In this analysis, building types and groupings are divided based on six different building periods (Figure 12). It is seen that the region preserves buildings from each period and most of these buildings are clustered regionally.

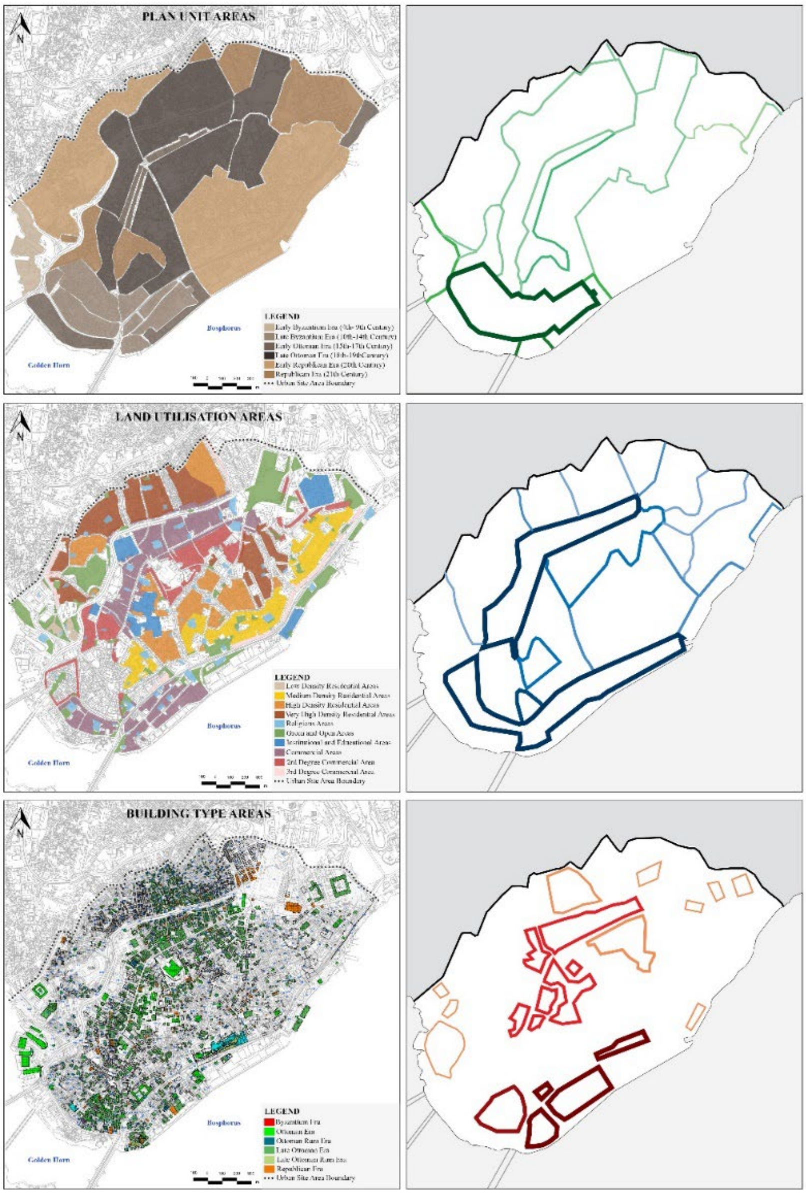

Figure 12 Plan unit, land utilization, and building type regions of Galata Region.

Figure 13 Plan units of Galata district showing general urban fabrics with 2019 aerial photos (first and second orders).

Consequently, according to all of the research, the region is mainly divided into 24 regions with its historical process, land use, and building pattern considered (Figure 13). One of these provides the division containing the Galataport project.

By looking at Figure 13 specific focus area can be determined. It is seen that the selected focus area plays a vital role in the spatial structure as a commercial and transportation zone of the municipality. Based on the boundaries of the area where the author will apply space syntax analysis have been determined.

5.2. Configurational Approach Analysis

Necessary inputs have been created and analyzed for morphological analysis by space syntax. After the determination of these data by applying the necessary formulas the morphological characteristics of the chosen sample area can be ascertained by a comparative analysis of the syntactic measures.

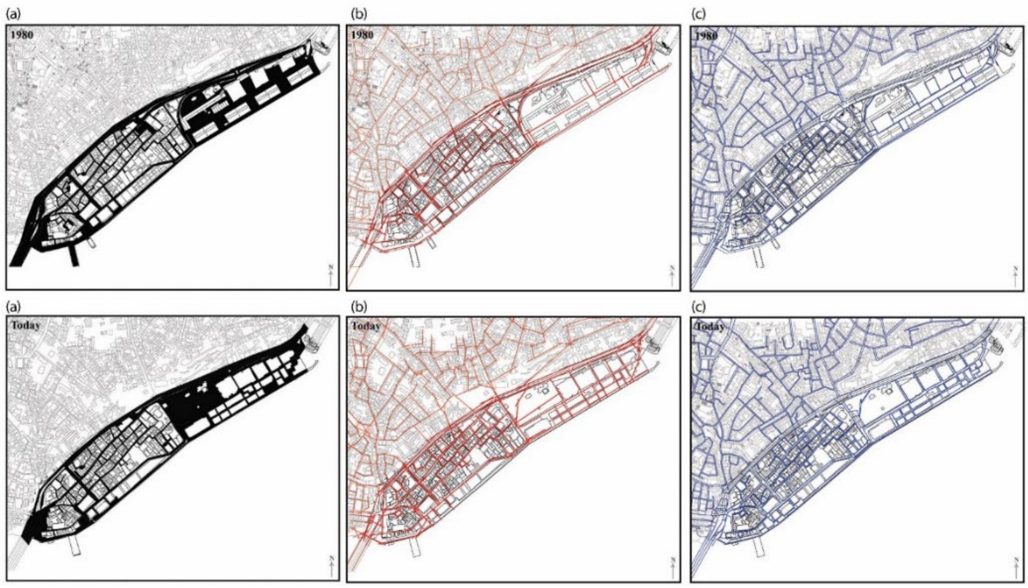

Figure 14 Maps of the area in 1980 (top) and today (bottom): (a) open space map (shown in black); (b) transcription of the plan into the convex map; (c) transcription of the map into an axial map, prepared by the author.

With these findings, the impact of the project on the region and the coastal band can be predicted and interpreted from the findings on whether the new physical tissue that will form on the coast will work as a coastal band that is integrated with the urban fabric, easily accessible and available to the urban people, as mentioned in the project. This comparison will be done by 1980 and the map of 2020.

Table 3 Mathematical values of the study area before and after the Galataport Project, complied by (Kubat, 1997).

Properties	1980	2020	Mean Values
L= Number of axial lines	106	116	111,00
C= Number of convex spaces	231	257	244,00
I= Number of islands	36	48	42,00
B= Number of buildings	316	362	339,00
Measures of convexity			
Convex articulation (C/B)	0,7310	0,7099	0,7205
Convex deformation (C/I)	6,4167	5,3542	5,8854
Grid convexity $((I^{1/2}+1)^2/C)$	0,2121	0,2446	0,2283
Convex ringiness (I/(2*C-5)	0,0788	0,0943	0,0865
Measures of axiality			
Axial articulation (L/B)	0,3354	0,3204	0,3279
Axial integration (L/C)	0,4589	0,4514	0,4551
Grid axiality $((I^{1/2}*2)+2)/L)$	0,1321	0,1367	0,1344
Axial ringiness (I/(2*L-5)	0,1739	0,2115	0,1927
Measures of integration			
Integration	1,1980	1,3970	1,2975
Measures of intelligibility			
Intelligibility	0,4044	0,3344	0,3694
Measures of synergy			
Synergy	0,4589	0,4787	0,4688

Measurement of axiality

Axial articulation can be calculated by dividing the number of axial lines by the number of buildings. Axial articulation value represents the open space structure's curves and angles. This value also shows a higher degree of urban axiality. Axial articulation values for the 1980 map and current map are 0.3354, 0.3204 and the mean value is 0.3279. The area in the 1980 map has an axial articulation value higher than the mean value due to its fragmented and organic urban texture. It clearly shows the growth of non-axial cities. But after the project, it is seen that the area with its low values exhibits a higher degree of axiality and high values show break-ups in the settlement. It gives the conclusion that the deviations in transportation are reduced and that transportation will be provided in the area through more linear moving axles.

The axial integration of convex spaces can also be determined informatively. Axial integration allows us to compare the number of axial lines with the number of convex spaces. Low values indicate a higher degree of axial integration in convex space. Axial integration values for the 1980 map and current map are 0.4589, 0.4514 and the mean value is 0.4551. Values lower than average value indicate a high level of integration of convex space. Today axial integration value indicates that the degree of axial integration of convex spaces is higher and it is seen in previous maps that the regions in the past showed low axial integration consisting of various twists and angular junctions.

Grid axiality is a result between 0 and 1, but higher values suggest a better grid approximation and a higher degree of axial deformation at low values. The mean grid-axiality level of both of the cities is 0.1344, and both the year comparisons are close; nevertheless, close observation of urban patterns shows the fact that these structures are not axially deformed. In the contrast, in the current map grid, the axiality value (0.1416) which is higher than the mean value means a grid layout that follows a simplified pattern by replacing the intersection of streets with more T-junctions, providing a more symbolic and formal spatial pattern for the important buildings in the area. But in the past, the region mainly presents a highly symbolic nature of the street pattern.

To measure the distributed news of the open system, it is necessary to calculate the values for the ringiness in the convex space (Kubat, 1997). Axial ringiness values for 1980 and current map value is 0.1739, 0.2115 and the mean value is 0.1927. This value shows that the connection between the axles is strong in the overall assessment. But to make a prediction, the fact that this value is higher compared to previous periods indicates that the connection between the axles will weaken after the project. These high values also indicate the grid pattern in the project.

Measurement of convexity

Convex articulation can be calculated simply by dividing the number of buildings by the number of convex spaces. Convex articulation values for 1980 and the current map values are 0.7310 and 0.7099 and the mean value is 0.7205. Values lower than the mean value shows fewer breakup and therefore more synchrony in the convex spaces of the area. 1980 map value for convex articulation (0.7310) confirms the asymmetrical and organic pattern with many twists, turns per unit length, and variations in the widths of convex spaces. This causes more breakups and less spatial synchrony (asynchronous) in the open space structure. But the current map value (0.7099) shows fewer breakups and synchrony in the urban structure and also the existence of a continuous linear major axis. This causes more breakups and less spatial synchrony (asynchronous) in the open space structure of the study area.

Convex deformation can be calculated by dividing the number of islands by the number of convex spaces. Convex deformation values for 1980 and the current map are 6.4167 and 5.3542 and the mean value is 5.8854. Higher convex deformation values suggest a more irregular open space network. It can be said that the values are close but in past, the area had more irregular open space. But by looking at a bigger scale., The Galata region’s historic heart has the highest value and therefore has the most unusual open space structure. This is also the cause of steep topography and the curvilinear street layout in the neighborhoods.

The grid convexity formula compares the convex map to an orthogonal grid where convex spaces stretch in one direction across the network, while convex spaces fit in the interstices in the other direction (Hillier & Hanson, 1984). According to Hillier & Hanson, this formula should give a value between 0 and 1, with high values that indicate less grid deformation and low values that indicate a lot of grid deformation. Grid convexity values for 1980 and the current map value are 0.2121, 0.2446, and the mean value is 0.2283. The low syntax value of the study area implies a high deformation of the grid, which means that the city's open space layout is not geometric and the high syntax value for a current map with a higher value shows little deformation of geometrical grids that were applied in historical periods.

Convex ringiness is the number of rings in the system as a proportion of the maximum possible planar rings for that number of spaces (Hillier & Hanson, 1984). 1980 and the current map convex ringiness values are 0.0788, 0.0943 and the mean value is 0.0865. After the project the area has a higher value this shows no bends or curves in the open structure and confirms the more grid-like urban structure observed in this area. But before it is seen from the values and also the maps the area confirms the organic open space structure with gradual curves.

Measurement of integration

Another important way of analyzing the pattern of settlements is integration values. Integration is the key concept of space syntax. The approach allows integration to be represented in numerical values.

Integration shows the degree to which a line is more integrated, or segregated, from a system as a whole. The mean integration values for 1980 and the map of 2020 are 1.1980, 1.3970, and the mean value 1.2975.

From the integration value obtained after the Galataport project and the resulting integration map, it can be read whether the density, accessibility, and relationship with the surrounding texture of the Post-Project region, especially the coastal band, has increased. As it is seen on a global scale the project will indicate a more integrated settlement. But when it is looked at on a local scale it is seen that the value is lower than in the previous period. This indicates that the project is not in a structure that will strengthen the relationship between the coastal zone and urban fabric. On the contrary, in the coastal band, it is seen that the degree of integration of the entire coastal region and the connections reaching this region is low. The low level of integration of the coastal region, where the Galataport project is located shows that this area will be a place that will work indoors, with a weak connection to its environment. In terms of access to the coast and coastal use, access to the coastal band is also seen as low and the intensity of use is predicted to be poor. This results in the fact that the production of an easily accessible urban coastal space open to public use, where the sea-human relationship is strengthened, as targeted in the project, will not occur.

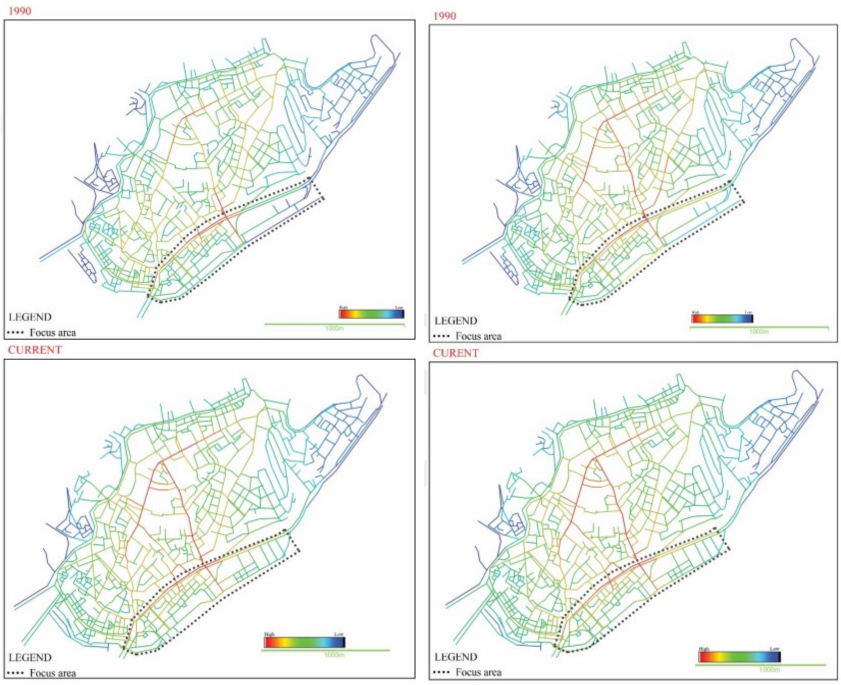

Figure 15 Global integration (Rn 1200) (left) and Local integration map (Rn 800) (right) of the study area.

Figure 16 Detailed representation of local integration map (Rn 800) of the area in 1980 (left) and 2020 (right).

Integration value will also be used to detect major urban spaces or major building interactions with the district.

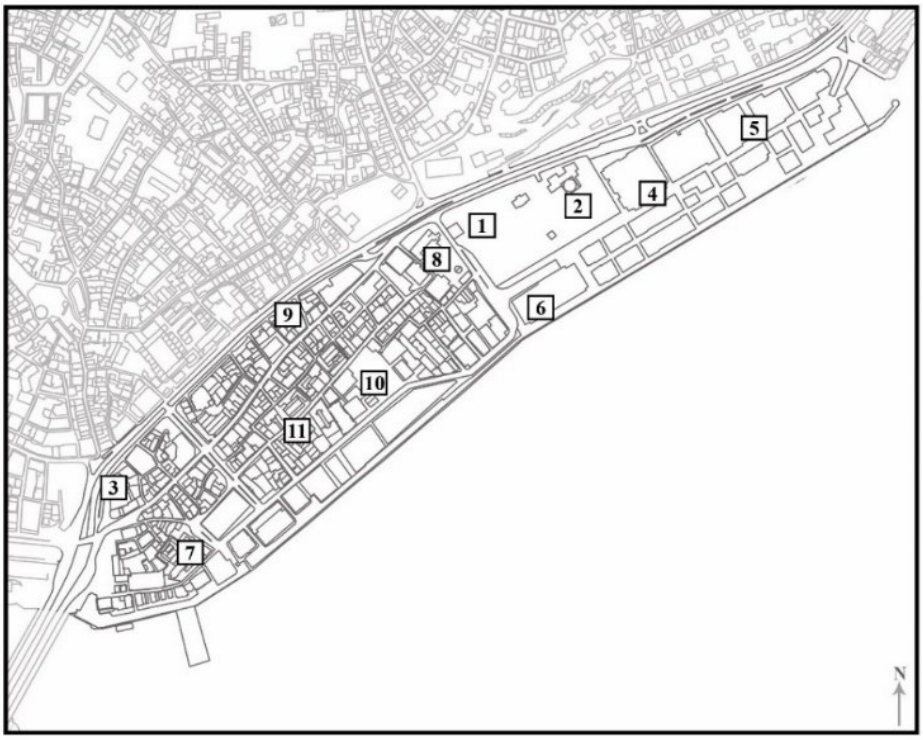

Figure 17 The rank ordering of the major urban space and urban elements of the study area.

Table 4 The rank ordering of the major urban space and urban elements of the study area by the value of global integration.

Rank	Principal urban elements	Global Integration value
1	Tophane Square	2,0160
2	Nusretiye Mosque	1,9105
3	Karaköy Palas	1,6669
4	Museum	1,4720
5	Galataport Project	1,4439
6	İstanbul Modern	1,4120
7	Yeraltı Mosque	1,3981
8	Kılıç Ali Paşa Mosque	1,3585
9	Surp Krikor Church	1,3421
10	French Gateway	1,1915
11	Aya Nikola Church	0,7098

By locating various urban elements on the map, the society-space relations can be analyzed. For this analysis, only major buildings or major urban spaces termed as 'principal elements of the city' occupying a predominant role in the city's history are documented.

It is seen that after the construction Tophane Square has the highest rank, followed by the Nusretiye Mosque which is also affected by the new project. Another significant aspect of the urban structure is remotely located also with the new project; the museum and Istanbul Modern building with a low integration value (Table 4). We can also see that the Galataport Project integration rank is low.

Measurement of intelligibility and synergy

The syntactic intelligibility of an urban system is defined as the degree of correlation between the connectivity and integration values in the system (Topçu & Kubat, 2007). Logically, this means that information about local connectivity in a highly intelligible layout allows a person moving through the system to understand the configuration's overall structure.

The area's low intelligibility shows that it is not comprehensible for city users, and it's not easy to find and walk through it. High intelligibility reveals the areas with higher global integration that are at the same time the city center with inner integration. An intelligible system in another word means well-connected spaces in an urban system. Mostly, economic activities and services in these areas would become denser in the long term.

According to the results of syntactic analysis, the spatial structure of the current map (0.3344) lacks structure and is found to be less intelligible when compared with the past (0.4044) which is more intelligible according to the value higher than the mean value (0.364). This means that the Galataport project will not be intelligible to users.

Synergy is similar to intelligibility. The correlation between the global integration value and local integration value describes the synergy of the city (Thilagam, 2015). Hillier suggests that this is a measure of how much the local street system is a reliable predictor of the global configuration (Dalton, 2010).

The synergy values for 1980 and current map is 0,4589, 0,4787 and the mean value 0,4688. High correlation is explained by two situations: first, according to Medeiros (2006), “to synergy, the larger the system, the smaller the value”; so, for a small system, the synergy value will be higher. Second, the regular orthogonal mesh results in a high convergence of global and local integration scales (Geremia, 2017).

6. Conclusion and Recommendations

In a conclusion, both morphological and land use findings were revealed, such as how the new physical structure of space will work and the impact of space on the urban fabric. With these findings, the impact of the project on the region and the coastal band can be seen and interpreted. It can be analyzed whether the new physical tissue that is formed will work as a coastal band integrated with the urban fabric, easily accessible and available to users as mentioned in the project.

It is believed that it will be helpful in new planned urban studies, especially for the reconstruction of the historical and cultural regions of the cities damaged by industrialization effects and accelerated cycles of urbanization. This is also an important system for new urban design projects. The author wanted to draw attention to the use of these approaches as input in new projects. It is believed that a comparative examination of the historical core conducted in this study would contribute to research on urban morphology, urban design, and urban planning.

As a recommendation, in this context;

- According to the report of the project, it is stated that the project will be an image of the city. But quantitative findings obtained from space syntax analyses showed that the area of the urban shoreline requires a coastal reorganization.
- Looking at the morphological character of the area, the prediction that the new spaces produced in the project do not have the effect of reinforcing the historical texture of the coast, the coastal location of the Square, and the public use of the coast are revealed. It is observed that cruise ships will dock on the 1.2 km coastal line, and this will cause a morphological formation that acts as a wall on the shore.
- The structures planned to replace the four existing warehouses as terminal buildings are larger in scale than the existing ones and are in a size that completely covers the

shoreline. This means the reproduction of physical tissue on the coast on a larger scale and the formation of a new morphological character in the city. It is seen that the physical texture of the port function, which is maintained on the coast, is an obstacle to both public use of the coastal line and the comprehensibility of the coast. By moving the port to another area, solutions can be provided to the problems of the region (such as access to the coast, perception of the sea, and the acquisition of a public dimension of the coast).

- Therefore, based on the historical maps examined, Henri Prost's proposal to move the port area from the coast in the city center to the Marmara coast should be considered in the next planning decisions.
- It is proposed that land use in this area should be regulated for recreational use after moving the port to another area.

As a recommendation for further studies; a certain area was analyzed as a result of morphological region analyses. But it is also possible to select a different study area boundary. The entire coastline of the Galata region which also contains the historical core can be re-worked as a focus area. Therefore, both the impact of the Project on the historical core and as well as the impact on the continuation of the coast will be determined in more detail. Secondly, Galataport is a completed project and the author would like to outline that in the renewal of Haydarpaşa Port or Haliçport Projects these inputs should be considered. In the context of globalization, the renewal of port sites should be planned with urban farsightedness, taking account of the needs of existing social roles, and approached in a format that supports each other without contradicting historical, cultural, or national values.

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Resume

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