

The morphological history of Istanbul

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Abstract. *Istanbul's old core has been influenced by several cultures: Roman, Byzantine, Ottoman and Turkish. This reflects the city's position at the meeting point of the continents of Europe and Asia. The paper examines the characteristics of the morphological periods associated with each cultural influence. In addition to assessing the morphological history of the core of the city by using space syntax, the city's social history is explored, especially in terms of the city's ceremonial and symbolic nature.*

Key Words: urban morphology, urban design, space syntax,
urban history, Istanbul

Cultural, social and administrative structures and religious beliefs affect the forms of settlements. Organic settlements realize in space quite different social schemes and priorities from those of symbolically-ordered settlements. In organic settlements, the movement of people shapes the structure of space and the configuration of the streets reinforces those movements. As space plays an instrumental role in these settlements, they show different characteristics from those of towns in which space is organized more in relation to buildings of symbolic importance. In instrumental towns, space tends to be intensively used. In symbolic towns, many important spaces are much more sparsely used (Hillier, 1989, p. 12).

In the historical peninsula of Istanbul, both types of spatial structures can be perceived. The symbolic type first became dominant during the Byzantine period. This is expressed fundamentally through the main axis, which is handled as a symbol, linking the main forums to each other. This

symbolic structure continued under Muslim-Ottoman rule, although the lack of underlying geometry is generally evident in creations of this period when compared with those of the Byzantine period.

In the Ottoman period, under the rules of Islam, the ceremonial functions of the major streets tended to lose their importance. However, in Istanbul, which maintained its character as an imperial capital, the major streets acquired greater importance while major transportation routes were built and new monuments were created. Thus the city is still symbolic, although it is also instrumental in parts where an Islamic lifestyle is evident.

The method

The morphogenetic structure of the historical peninsula is examined through the use of space syntax. The aim behind the technique is to describe different aspects of relation-

ships between the morphological structure of man-made environments and social structures and events. Thus space syntax (Hillier and Hanson, 1984; Hanson, 1989; Hillier *et al.*, 1983; Peponis *et al.*, 1989) offers a theory and method for investigating society-space relations. The main theoretical argument is that settlement patterns originate in the social life of the user. Accordingly, the analysis of the spatial patterns of settlements can lead to knowledge about the social norms of societies. The analytical method is based on the transformation of plans into graphs and the quantifying of the spatial qualities of nodes using mathematical formulae. Such a method offers a simple objective procedure for describing, comparing and interpreting settlements.

A number of characteristics make this method a powerful research tool. First, it provides a simple, analysable, and realistic spatial model of a settlement. Secondly, it entails analysis of the elements of a city as related parts of a system. Thirdly, it gives quantitative values to elements and provides statistical and graphical comparisons within the system. Finally, its computations provide values that allow systems of different sizes to be compared.

Apart from the diagrammatic representation of plans, the analytical procedures of space syntax offer a variety of mathematical measurements that quantify various attributes: integration, connectivity, control and intelligibility values of spatial patterns.

The plans of settlements are represented graphically and compared in terms of their patterns of continuous open space in order to analyse the patterns of the urban layouts syntactically. Figure 1 shows the street plan of Istanbul's historical core.

The *axial map* is the basis of the settlement layout analysis. This represents how far observers can have an uninterrupted impression of visibility and permeability as they move about the town and look from a distance towards various directions. An axial map will consist of the fewest and longest straight lines that cover the entire surface of

the town, taking into account how far one can see and walk. As a way of seeing and experiencing a town, an axial map offers the most 'globalizing' perspective, since an axial line will extend as long as at least one point is visible and directly accessible from it. The size of a settlement system is measured in terms of the number of lines.

An axial map of the open space structure of a settlement is the 'least set' of straight lines, which passes through each convex space and makes the axial links (Figure 2). The *convex map* is the set of 'fattest' spaces that covers the open space structure of the urban system (Figure 3). Analysing the convex structure of the urban layout makes it possible to compare the different urban space structures according to the degree of axial and convex extension of their parts and according to the relation between these two forms of extension. For example, convex spaces may become as long as axial spaces if the system is very regular.

The central concept of space syntax is *integration*. The configurational pictures of the city from the point of view of its constituent lines can be measured exactly through the measure of 'integration'. The technique allows one to express integration in numerical values. In common with many other measures of spatial structure, these values are dependent upon the size of the urban area. The integration of space is a function of the mean number of lines and changes of direction that need to be taken to go from a given space to all of the other spaces in the settlement system. The integration value of a line is a mathematical way of expressing the depth of a line from all other lines in the system. Integration is, therefore, about syntactic, not about metric, accessibility and the word 'depth' rather than 'distance' is used to describe how far spaces lie axially from one another (Hillier and Hanson, 1984). After calculating depth, these integration values can be mapped to produce an overall integration map of the whole city (see, for example, Figure 4). Since this kind of integration corresponds to all parts of the system, it can be termed *global integration*.

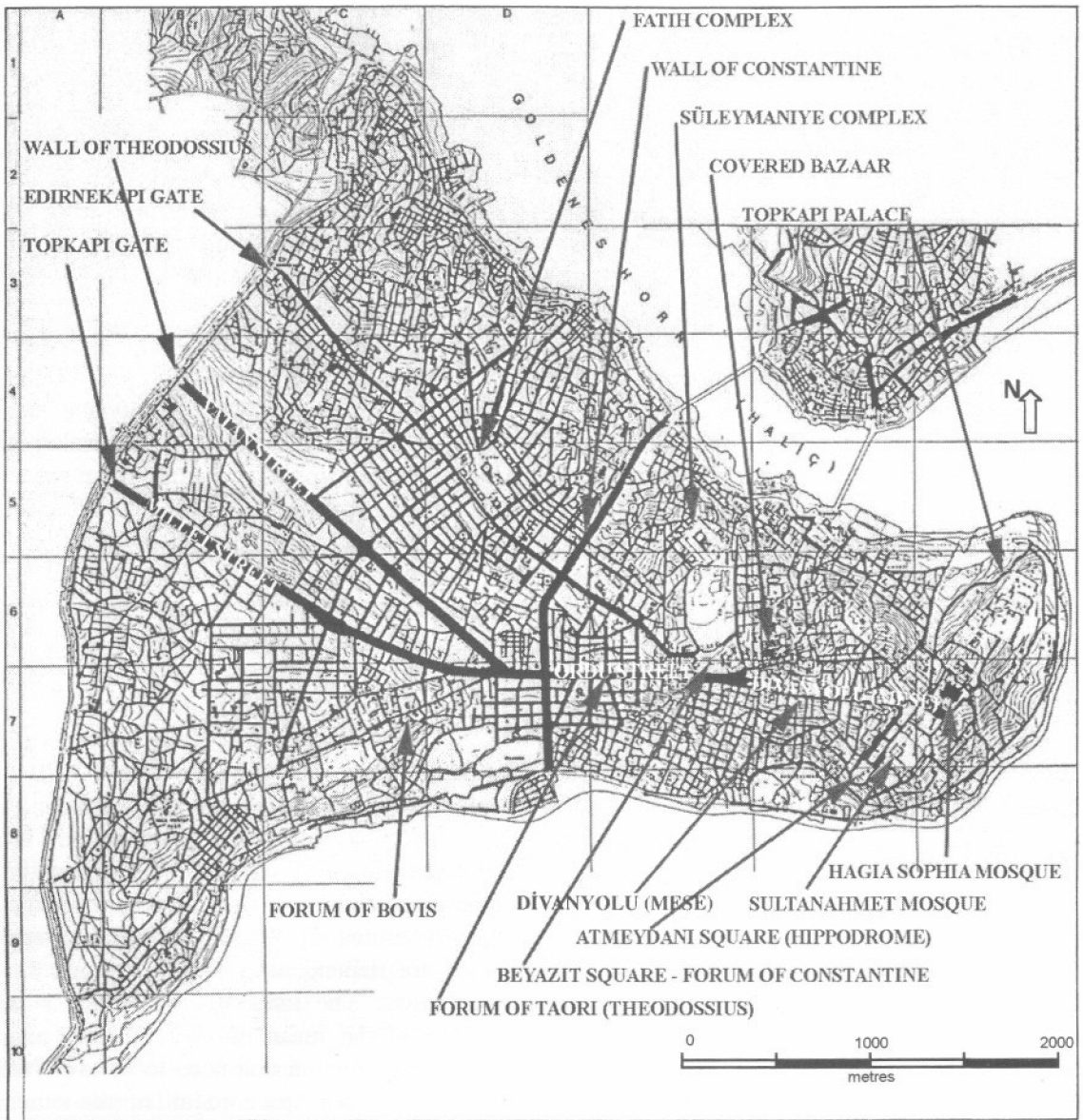


Figure 1. Open space map of Istanbul's historical peninsula in 1922.
(The street network is shown in black)

Another informative map can be produced by calculating integration to within three lines from each line in every direction: this is called *local integration*, or radius 3 integration, in contrast to 'global' or 'radius n' integration (Hillier, 1996). This kind of integration reveals local properties of space rather than overall characteristics.

The *integration core* of a settlement is 10-

25 per cent of the most integrated lines, numbered in order of integration. An integration core can be treated as a representation of syntactic centrality. This map is created to show where the most integrating lines are and what they relate to in the urban system; but what is more important is the type of pattern made by the strong integrating spaces. A useful device is



Figure 2. Axial map of the historical peninsula in 1922

to make a map of the 10, 25, and 50 per cent most integrated spaces or, if the system is large and complex, of a given number of spaces.

The set of the most integrated axial lines can be indicated on the map of axial lines. The percentage of spaces that are selected to define a core varies according to settlement size. The percentage of the most *integrated* axial lines clearly picks out the underlying

structure of the global integration. The set of most *segregated* spaces can be selected from the computer printout and its distribution across an urban area will indicate the position of the segregated, or most inaccessible, areas in the settlement (light dotted lines). With this knowledge, any adjustments or additions to the settlement can be evaluated. Evaluating integration will allow us not only to understand an area's existing structure by



Figure 3. Convex map of the historical peninsula in 1922

identifying its most integrated and segregated parts, but it will also permit a design proposal to be slotted into an existing site. In this way, it will also be possible to evaluate the effect of the new proposal on the total integration pattern.

Based on previous studies, the distribution of integration across an urban area is thought to correlate with the movement pattern of an area. Urban areas can be distinguished by,

and compared in terms of, different levels of integration, which is also used as a measure of their quality. Integration/segregation is the best index of the relative business or quietness of streets as they are actually used. Using the findings of Hillier *et al.* (1983), the *syntactic intelligibility* of an urban system is defined as the degree of correlation between connectivity and global integration values of each line in the system. The term 'intellig-

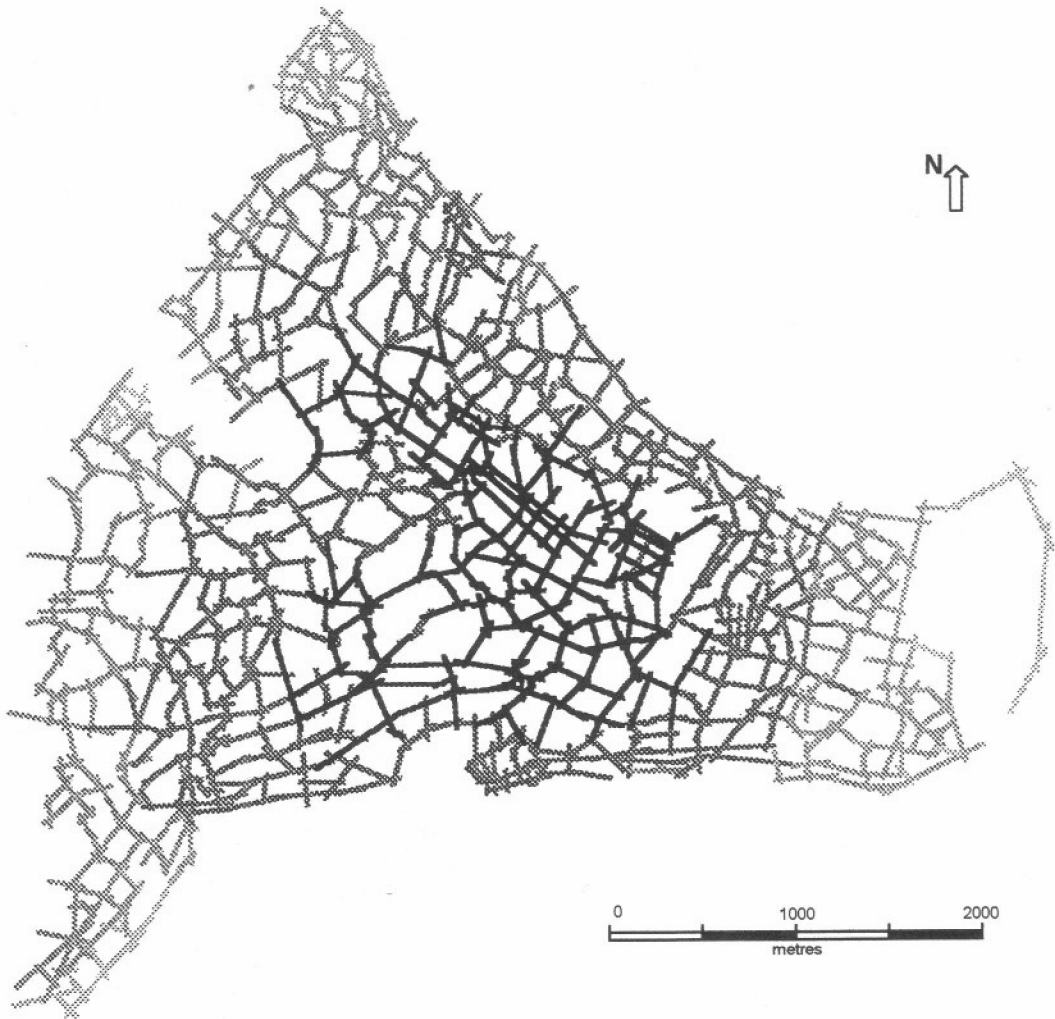


Figure 4. Axial map of the historical peninsula in 1840. The lines are shaded in a continuous scale corresponding to the numerical levels of integration (I). The most integrated spaces are shown in bold black lines, and the most segregated spaces are shown in light dotted lines.

ibility' is used because the stronger the correlation, the more we can infer the global position of a space from its directly observable local connections. The intelligibility value gives an idea of the extent to which people can learn about large patterns from their experience of small parts. By this measure, to be considered generally intelligible, a system should have a value of about 0.45.

From Roman-Byzantine city to Ottoman-Turkish city

The Islamic city of Istanbul was constructed on the heritage of Roman-Byzantine developments. With its emphasis on the Islamic way of life and privacy, it was markedly different from other major European cities at the time. Its dense, dendritic pattern seems at first very mysterious, until the underlying values are

understood.

The most historic parts of present-day Istanbul have an evocative landscape. The magnificent site is enhanced by monuments of great cultural value. The elements of the pre-Islamic past and the unique silhouette of a Muslim capital with its minarets and domes are surrounded by late Roman city walls, all of which are powerful manifestations of a most varied cultural history. While the old city core, the historical peninsula, which is analysed in this study, occupies only a small percentage of the contemporary metropolis, its role in the visual image of Istanbul, heavily conditioned by its well-preserved historical monuments, is paramount. Despite the modern developments, it reflects the historic and cultural duality of the East and the West, which gives Istanbul its personality.

There are four distinct historical periods, which have created the cultural diversity of the historical peninsula: the Roman Imperial era, the medieval Byzantine era, the Ottoman-Muslim era and the modern Turkish era.

Istanbul took the place of Constantinople, just as Constantinople had taken the place of Byzantium. From the period of Constantine the Great onwards, the main skeleton of the street network inside its fortifications has not changed greatly. In contrast, except for a few monuments, the physical structures of the different periods have not survived. Up to the Turkish era, the buildings often changed owing to frequent fires and lack of planning. Until the end of the nineteenth century, Istanbul showed an organic pattern that reflected the topography. In the twentieth century, development projects have ignored this historical identity. The organized, disciplined and rational society of the Western world, which influenced modern Turkish planners, clashed with the sentimental, irrational behaviour of the past. Nevertheless, the main axes were developed in accord with the topography and monuments remained as focal points. At the beginning of the twentieth century, gridiron street patterns and an organized traffic system began to replace the organic configuration

and the culs-de-sac of Islamic tradition.

In the Roman period, the Via Egnatia was the Mese, the main street of the city. Since that period, the peninsula has had a main road (the Mese) and a secondary road, which together formed a Y shape. This form of the main street, the general and unchanging structure of the basic elements of the city, the main forums, the sea shores, the walls, the harbours, the palace and the spatial distribution of vital functions, remained in place after the Turkish conquest. The Hippodamian-Roman plan could not be applied to Constantinople because of the topography of the site but the main 'spine' of the city has remained unchanged.

There are a number of differences between a Roman city and a Muslim city. In the Greek and Roman tradition, the forum was a focal point where political opinions were debated and where commercial activity was concentrated. Therefore, the roads leading to the forum were built in a straight line to provide a strong visual connection. Moreover, these main streets served as parade routes for imperial ceremonies. Muslim Istanbul, in contrast, did not have a forum, porticoes, memorial columns, triumphal arches, a theatre, or a hippodrome. Nor did it have streets paved with stones. Divanyolu, which was the extension of the Mese, became the principal artery of Ottoman Istanbul. It was lined with imperial buildings, which created their own enclosure, as well as with some ruined remnants of imperial Byzantium. Unlike the Mese, the streets of Ottoman Istanbul showed an organic pattern; their orientations and widths frequently changed and culs-de-sac were common. This organic pattern reflected a hidden, yet ever-present political concern for internal security.

Fatih Sultan Mehmet, the Turkish conqueror, restored and repaired the city, making it the economic, administrative, cultural and religious centre of his Empire. Islamic influence continued into the sixteenth century, reaching its peak during the reign of Süleyman the Magnificent (1520-1566). The monumental frame of the city was established during his rule after the construction of great

complexes, such as the Süleymaniye and Şehzade Mosques of the Ottoman period. Almost all of the open spaces of Roman construction were built upon. The function of social gathering was taken over by the interiors of the great mosques and associated buildings (*Külliyes*) (Kuban, 1996, p. 266).

Except for the great mosques or churches, and the cemeteries and the wastelands outside the city gates, public open space is reduced to the streets, and to the slight enlargements at their intersections. Non-residential uses, although to some degree concentrated along guild streets in the city centre, are strung out in narrow shops along the main ways, or occupy deep courtyards of their own which open to these ways (Lynch, 1984, p. 384).

Constantinople was the product of a municipal concept in which communication and open space were as important as the buildings themselves. Ottoman-Turkish Istanbul was a 'molecular' city, composed of functional elements, linked to each other by a web of irregular veins. The *mahalle* (the urban quarter) has been the urban molecule of the Ottoman city. Residential quarters surrounding other molecules, such as the palaces, the mosques and the *hans*, had their particular symbolic values.

The *Mahalle* was the key structural element of the new urban texture. In the *mahalles* there were a great number of culs-de-sac, which had much to do with the Islamic concepts of family privacy and private ownership. The cul-de-sac was not a street, it was an outlet from a house or a group of houses, so there were no planned squares, only an open space around the local *mescid*, or public fountains. The family was the vital cell and the essence of urban society. This emphasis on privacy makes medieval Islamic cities markedly different from European cities.

The Friday Mosque and its market characterize early Muslim cities. In the case of Istanbul, however, the city was so large

that there were many Friday mosques, and they were not necessarily connected to central markets. The commercial centre of Istanbul had been the port since the Byzantine era. Neither the Mosque of the Conqueror nor Saint Sophia lay within market areas until the Conqueror created his own market, which was turned into a covered bazaar in 1701, around the earlier foundations of the city.

In Istanbul, the mosque, with its *külliyeye*, replaced the planned city. The *külliyeye* became the core of social welfare and urban design. The mosque and its surroundings took the place of the Byzantine forums. However, there were also small complexes without mosques, expressing a more developed concept of social welfare and culture. 'Some *külliyes* were built on ancient forums. They were not deliberately built to adorn urban spaces. They were themselves urban spaces. They created their own centrality' (Kuban, 1996, p. 266). The major religious buildings are distinctive for their lack of right-angle relations to major axes. The most prominent of these, the magnificent Süleymaniye Mosque, which imposed its dominant form on the urban scene, was not located on a main thoroughfare.

The modern Turkish era

During the nineteenth century, the Empire was disintegrating and was being increasingly influenced by developments in Western Europe. By the end of that century, the political face of the Empire had changed. The Tanzimat reform movement acquired increasing powers.

The Tanzimat era introduced urban change. Streets were widened, the street façades of buildings were increased in height, and culs-de-sac were transformed into thoroughfares. The traditional street pattern was replaced by a more rigid, geometrical grid pattern, without a clear fit between functions and the arrangement of buildings and spaces. Increases in scale brought about a lack of unity in urban spaces. The institutional reforms set in motion by the declaration of the Tanzimat Charter had

parallels in the urban fabric. The classical Ottoman/Islamic urban image changed into a more cosmopolitan one, permeated by forms and elements adopted from Western models. One factor that played a major role in the transformation of the urban fabric was the frequent fires that destroyed the dense, wooden residential neighbourhoods of the historical peninsula. Large areas were rebuilt, applying urban planning concepts borrowed from the West. Furthermore, in 1836, geometrical rules were applied to the regularization of the street network. Wide streets were cut through the maze of narrow roads, facilitating fire control.

By the beginning of the twentieth century, communications within the commercial and administrative core of Istanbul had greatly improved. Eminönü quay was connected through the commercial areas to Beyazıt and the Divanyolu.

Beyazıt was also linked to the Marmara shore and the widened Divanyolu was given a new monumentality. In fact, with the open area around Constantine's Column, the punctuated entrance to the Hippodrome, and the newly opened Hagia Sophia Square, this artery now regained some of the glory that it had once possessed as the Mese of Byzantine Constantinople (Çelik, 1993, p. 80).

In 1908, modernization of the communication network and creation of an urban image based on European technology and cultural values were emphasized. Thus the main goals were to provide an uninterrupted communication network across the Istanbul peninsula by the creation of wide arteries connecting the heart of the city - the administrative and commercial regions - to the Byzantine gates.

In the first years of the Republic, during the 1950s, the city underwent a road widening and straightening programme. Divanyolu was destroyed by a modern city-planning concept. Beyazıt Square was reorganized, separating the thoroughfare from

Divanyolu and destroying the historical continuity of the axis. Consequently, the Aksaray axis leading to the city gates gained significance.

In recent times, the road network has been improved, new roads and new squares have been opened, culs-de-sac have almost been eliminated, much of the waterfront has been regularized, modern transportation has reached even the most isolated neighbourhoods, and much of the built fabric has been converted to concrete. However, many irregular streets still exist; the waterfront along the Golden Horn is crowded with factories, warehouses, and workshops (Çelik, 1993, p. 162). But the skyline of the peninsula, with its many domes and minarets, still presents a unique image.

Syntactical analyses

The plans of Istanbul that date from before 1840 are neither sufficiently accurate nor sufficiently detailed to justify syntactical analyses. Attention has therefore been confined to the plans of 1840, 1922 and 1964. Over the period covered by these plans, the peninsula area has become less integrated (Table 1), low values indicating shallow or integrated systems and high values indicating deep and segregated systems. The logic behind the old city is demonstrated by relating the spatial structure of the urban grid to the locations of the historical and traditional functions. This is done by superimposing the main elements of the city, such as the forums and main buildings, on the integration map of axial analyses.

The most integrated lines are the axes connecting the public squares, the Forum of Taori, the Forum of Constantine and the Forum of Bovis. These formed the integration core of the peninsula during the Byzantine period. The integration core forms a tree-like pattern and is concentrated in the heart of the commercial and ceremonial centre - it does not link the centre to the gates of the city - and leaves segregated areas near the walls of the city more or less inaccessible. These segregated areas are quiet residential areas, which are hierarchi-

Table 1. Syntactic measures for the historical peninsula of Istanbul at three different dates

Year	No. of Axial Lines	Integration (I)	Intelligibility	Local(I)/Global(I)
1840	983	0.5343	0.0419	0.0591
1922	1,217	0.8939	0.1869	0.3170
1964	1,242	1.2031	0.2346	0.4648

cally separated from the busy public spaces. In contrast, there is a lack of underlying geometry in the Muslim parts of the city.

In 1840 (Figure 4) there is no single dominant axis; clearly, the main streets lost their importance during the Ottoman period. However, the axis which connects Edirnekapi Gate to Hagia Sophia (Sultan Ahmet Square) and Beyazit Square remained an important ceremonial street. The axial lines between the Fatih, Süleymaniye and Beyazit mosques and the old palace indicated the integration core of the 1840s. The integrated lines are clustered at the centre, creating the integration core and an inward-looking integrated heart, inaccessible from the outside. The Grand Bazaar (Covered Bazaar) forms a bridge between two hills, which are marked by magnificent mosques and külliyes. This area is defined by high integration values as the Grand Bazaar is associated with large amounts of movement. The Topkapı Palace sits isolated in a large garden, with its courtyards, rectangular and cubical units of various sizes, at the tip of the peninsula, on the first of the seven hills of Istanbul. This is a segregated zone. Other segregated zones are residential areas in which privacy is dominant.

The maps of 1922 and 1964 (Figures 5 and 6) yield the most reliable results. The core that developed after the Byzantine period has become forked, with branches into Vatan and Millet Streets, and reaches the city walls. In addition to these main axes, the historical peninsula is fragmented by many shorter axes. The convex spaces have been

broken up. Further, mixture of organic and geometric styles has created a complex urban structure. The 1922 map shows a tree-like pattern which traverses the town, linking the centre to the outside (Figure 5). This spatial arrangement links the commercial central streets and squares to the outside, allowing easy access. The segregated areas, which are mainly residential, form continuous clusters of spaces on either side of the integrated core.

The first two integrated lines of the 1964 map pass along the major city routes, and run through Beyazit Square, which is a principal market district and one of the oldest and most striking quarters of Istanbul (Figure 6). Major integrated lines run through Ordu Street and make a connection to Divanyolu, which has lower integration values. Divanyolu opens to At-meydani Square (the Hippodrome of the Byzantine period), which is no longer a civic centre. The axial lines of this area also have low integration values.

The transportation layout is shaped by topography. The major axis, which is formed by the most integrated lines, runs to the city walls in two branches. Since the 1960s, the concentric routes that intersect these radial arteries have remained undeveloped. However, along the shores of the Marmara and the Golden Horn, there are streets parallel to the main arteries. In the 1960s, a coastal road running around the peninsula was constructed. This feeds and circumscribes the historical peninsula, but does not have high integration values. Despite the construction of the coastal road,



Figure 5. Axial map of the historical peninsula in 1922. The lines are shaded in a continuous scale corresponding to the numerical levels of integration (I). The most integrated spaces are shown in bold black lines, and the most segregated spaces are shown in light dotted lines.

Ordu Street, with its high movement patterns, is still the integration core of the historical peninsula in 1964. The integration core at this time (Figure 6) maintains the earlier tree-like pattern linking the central commercial area to the Topkapı and Edirnekapı gates, and leaving zones of segregated spaces on either side.

Syntactic measures over time

Comparison of the three axial maps from

1840 to 1964 suggests that three changes have taken place. First, the number of lines (streets) has increased as the city has become more dense. Secondly, the average line length has increased. Thirdly, several interlocking, more orthogonal grids of regular, longer through-streets have developed and grown alongside the more irregular parts of the grid. However, the major components of the layout have remained largely intact from the Byzantine



Figure 6. Axial map of the historical peninsula in 1964. The lines are shaded in a continuous scale corresponding to the numerical levels of integration (I). The most integrated spaces are shown in bold black lines, and the most segregated spaces are shown in light dotted lines.

period to the present. The main thoroughfares of modern Istanbul follow quite closely the course of the Roman roads built more than fifteen centuries ago.

When the historical peninsula is examined in terms of syntactic measures over time, the lowest integration values occur in 1840. Values increase toward the present. As the highest integration values indicate more depth and thus less integration, the results suggest that the number of segregated areas has increased, and the distribution of movement patterns has generally become less stable over time.

The increase in mean integration values over time (Table 1) indicates that the

geometrically regular alterations to the street system have not improved the overall integration of the city. The city has actually become more segregated. After the imposition of the new grid street system in some areas and the application of other innovations and modifications to the urban structure, the old city became less homogeneous, both as a whole and locally. While the modern changes have only slightly increased the average value of integration, they have dramatically increased the diversity of elements in the city.

Intelligibility was low, though rising, throughout the study period (Table 1). This suggests that changes applied to the urban