Urban form and culture: a comparative analysis of Anatolian and Italian towns

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Abstract. *The different town planning cultures that shaped old towns in Anatolia and the Italian Peninsula from antiquity to today are examined as a historical morphological study. The Roman Empire had a great influence on historical towns throughout the territories of Europe, the Middle East and North Africa. The underlying focus of this research is the urban fabric in Anatolian towns, built with similarities to settlements in the Italian Peninsula during the Roman Empire, which have changed with the arrival of different cultures from Anatolian Turks to Ottomans under Islamic influence. Eight fortified Roman origin towns from Anatolia and Italy are selected as samples. The comparison between these towns is based on the time at which they were established and specific elements such as their location and importance in their region and their status in the state to which they belonged. Morphological values and quantitative values are obtained through space syntax analysis. In addition to the comparative analyses, the connection of cultural and religious buildings to the whole town network is examined from a mathematical point of view to understand how cultural alteration influences urban form and structure. The urban tissues in both Anatolian and Italian peninsulas differ in block size and segment length. While the legacy of the Roman Empire still exists in Italy, the influence of Islamic tradition has completely changed the urban pattern in Anatolia. This is also confirmed by mathematical interpretations.*

Keywords: culture, Anatolia, Italy, urban morphology, space syntax

Introduction

Towns are formed by a combination of structures and elements that have been shaped by many acts and events through history. This is a continuous process with the exchange and readaptation of different parts which are spontaneously developed or consciously planned under different socio-economic, natural, religious and political conditions at different periods. Towns are shaped by the fact that cultural traditions and socio-economic values are influenced by varied civilizations and by the combination of these components (Moudon, 1997).

This paper explores how transformations in urban form occur as a result of the attempts of civilizations with different ways of conceptualizing space to reflect their own identities. Hillier (1989) defines this transformation as

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related to social relations and encounters of human beings and their representation. The focus of this research is the urban fabric in Anatolian towns, which were built with similarities with settlements in the Italian peninsula during the Roman Empire and which have changed with the arrival of different cultures from Anatolian Turks to Ottomans under Islamic influence (Figure 1). On the other hand, the transformations of selected towns in Italy have been shaped in the direction of their own cultures and important events throughout history. The point is that the old towns in both countries have basically the same structure for a certain period but, influenced by the arrival of different cultures in Anatolia, there have been changes in urban structures. Medieval defence and the priority given to trade were causes of changes in urban structures in Italy (Morris, 1994; Saalman, 1968).

Sample towns from Anatolia and Italy have been examined in order to understand the morphological identities that cultural changes have brought to the historical urban areas. The aim of this approach is to compare the historical core texture of the towns of these two countries using space syntax and through an objective perspective (Figure 2). The pairs of towns selected for comparison are Antalya and Genoa, Antakya and Verona, İznik and Lucca, and Bursa and Ravenna. The study areas are based on the area enclosed by fortification lines during the Roman Empire period. Although the Anatolian sample is selected from fortified towns, their counterparts in Italy are picked based on similar characteristics to those of Anatolia which are explained in detail later in the text. The scope of the study is to examine the urban form and its mathematical aspects in order to compare the towns of Anatolia and Italy and their roots dating back to antiquity.

The following sections introduce a mathematical framework that relates morphological and syntactic values to compare the case studies with the historical background of the eight towns. Their historical background is used for determining culturally-significant buildings and areas. The comparative analysis of the selected towns is based on studying the transformation in their forms and relating their aspects of spatial structures. This research aimed to explore the following research questions:

- Do towns in Anatolia formed under the influence of Turkish and Islamic cultures still reflect the spatial structure of the Roman period?

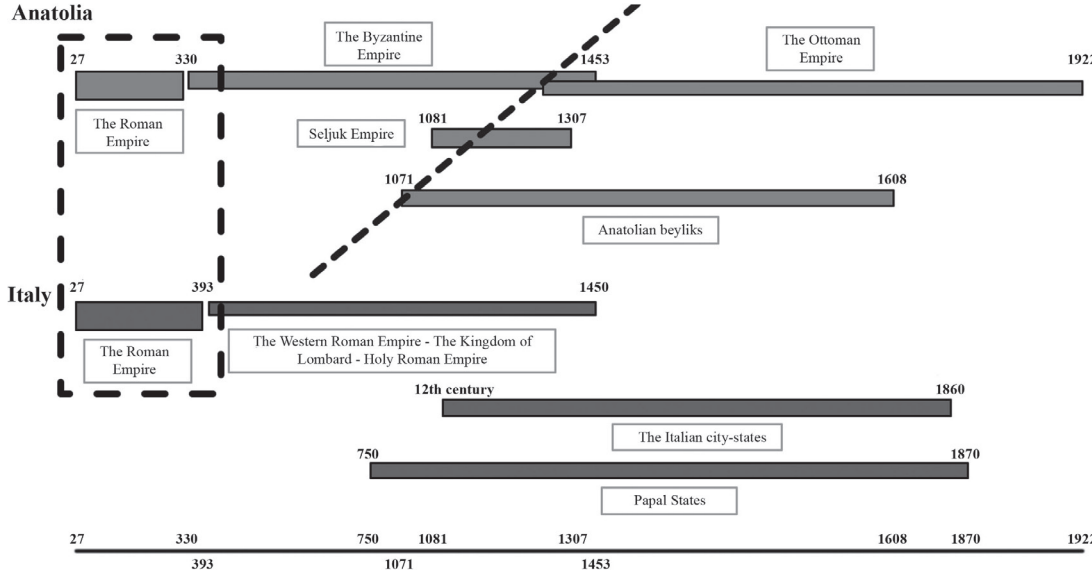

Figure 1. Time charts of events and urbanism in Antolia and Italy (McEvedy, 2004; Balchin, 2008; Turkey Historical Atlas – Eba, 2012).

Figure 2. Location of the case studies and borders of civilizations between B.C. 27 and A.D. 476 (McEvedy, 2004).

- In Italy, how do street patterns in historical sites affect spatial structure and open spaces, and does this spatial structure show traces from the towns' past?
- Could morphological differences shaped by different cultural and social structures in both countries be evaluated with mathematical interpretation?

Methodology

This paper is based on two methods: mathematical interpretations, and comparative analyses of these mathematical interpretations by space syntax and morphological values. In addition to the comparative analyses, the relationship of cultural and religious buildings to the whole town network is examined from a mathematical point of view to understand how cultural alteration influences the towns.

The historic cores of the selected towns are studied from the Roman period to the present day in terms of form, scale and time. In this context, contemporary maps are digitized with axial map drawings using AutoCAD software. The comparative case study has been carried out using both a review of historical literature and historical maps.

Space syntax theory and methodology are tools to describe and quantitatively measure the spatial configuration of urban space. Space syntax can analyse spatial configurations at all scales using computer technology. As an example, a spatial configuration can be defined to include urban components such as buildings, roads and borders that are social and cultural parts of society. The method establishes a special bond between space use and social meaning. One of the most important features of the method is to treat the environment as an independent variable. The space syntax method aims to demonstrate a relationship between components that constitute the spatial networks, from parts to whole. The method aims to explain these spatial networks with mathematical and evidence-based approaches focused on identifying social and economic patterns (Charalambous and Mavridou, 2012). Space syntax theory analyses spatial layout with defined parameters such as integration, choice, connectivity, and intelligibility as defined in Figure 3.

Space syntax uses a spatial layout defined on an axial map to obtain an axial analysis (Hillier and Hanson, 1984). Axial lines or axial maps are insufficient due to the linear basis of their calculations (Ratti, 2004; Turner, 2007). Turner (2007) introduced a new model for space syntax analysis of transportation networks and route selection, using road centre line data, known as segment analysis. This is used in this study as it is better able to express space as parts than axial analysis. The advantage of segment analysis is that it draws lines between each turning point instead of forming the longest and the least number of lines such as axial lines, which gives greater accuracy in expressing organic urban patterns. Segment analysis includes topological, angular and metric values on a segment map (Turner,

2004). The negative side of segment analysis is that if road centre line data are unavailable, an analysis needs to be hand drawn in a digital environment and converted into a segment map with the help of the Depthmap program (Turner, 2004).

The space syntax method represents the syntactic values of case studies and the determinants of the changes in the morphological structures of the case studies. Where these values are related together with syntactic values constitutes the methodology of this study. Urban block and axial maps created by ArcGIS were examined with the historical maps and historical buildings that reflect the identity of civilization in terms of urban form. Axial maps were converted into segment lines with DepthmapX, and quantitative values explaining integration, choice, intelligibility and synergy values were obtained (Figure 3). In addition, new parameters are continually emerging through ongoing space syntax studies and this study can make an important contribution to the field.

This has become an effective method for studies of urban form in terms of both history and in revealing relationships between social phenomena and space. In order to make a quantitative comparison of the case studies according to evidence and numerical data, the space syntax method was the main element of the study (Table 1). In a related study, Griffiths (2012) examined the effect of the industrial revolution on Sheffield through street integration values. He agrees that space syntax creates an opportunity to integrate history, social phenomena and space. The present paper also aims to combine history, in terms of the location of important sites, with social differentiation on space, in terms of the space syntax analysis parameters.

Integration, choice, intelligibility and especially synergy are the parameters used in this comparative analysis of the selected historic towns. The integration parameter describes the relationship between a particular space and other spaces in a system. It introduces numerical approaches and provides data which give an idea of how urban tissue is shaped. The integration value helps to determine how the spatial structure in the selected cases has changed; that is, integrated or separated in both general and local scale. The integration value, which emphasizes a 'constant' (Hillier, 1996) measurement, also provides data through its correlation with other space syntax parameters. The choice parameter measures how a line or segment component passes through from all spaces to all other spaces in an entire system. Contrary to the constant structure of the integration value, the choice parameter, which emphasizes dynamic data, is evaluated by the fact that the city structure has multiple spatial layers. The intelligibility

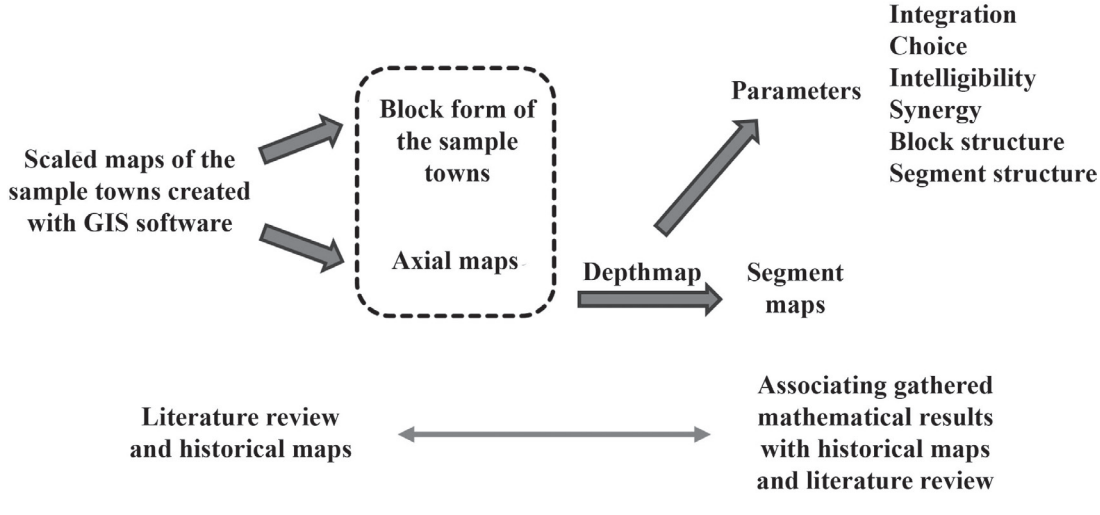

Figure 3. Details of methodological basis of the research.

Table 1. Selected space syntax parameters, definitions and reasons for selection (based on Choudhary and Adane, 2012; Feng *et al*., 2012; Kubat, 1997; Mohareb, and Kronenburg, 2012)

Selected space syntax Parameters	Definitions	Reasons for selection
Integration	Integration is a normalized measure of distance from any space of origin to all others in a system.	Integration seeks to determine how the spatial structure in the selected sample towns has a structure that is integrated or separated in both general scale and local scale.
Choice	Choice measures how likely an axial line or a street segment is to be passed through on all shortest routes.	Data for the location and importance of the important spatial structure and street texture in the entire historical spatial network of case study towns are generated.
Intelligibility	Axial intelligibility indexes the degree to which the number of immediate connections a line has is a reliable guide to the importance of that line in the system as a whole.	A strong correlation implies that the whole can be read from the parts. It is aimed to define the urban network in the sample towns for the user and urban elements.
Synergy	This measures the degree to which the internal structure of an area relates to the larger-scale system in which it is embedded.	Through the synergy parameter, the relation between the network of sample towns and the result of the diagrams of the important axes within the sample cities will be examined.

parameter provides evaluations based on the obtained integration and connectivity parameter values. A high value of intelligibility is related to the high value of the integration parameter. Also interpreted as space in a system, it can easily define the system on a global scale, which also provides a clear urban system for the user. Lastly, the synergy parameter is based on the correlation of global and local integration values. This parameter is the main focus of this study to describe how cultural alterations influence towns. Diagrams are generated through DepthmapX and interpreted to explain the relationship. The last two parameters, intelligibility and synergy, can be compared by correlation diagrams. If the obtained result is between 1 and 0.45, the local scale is effective in the system; if it is between 0.45 and 0.2, the system has an average value and if lower than 0.2 the local scale is disconnected from the system (Choudhary and Adane, 2012; Kubat, 1997; Mohareb and Kronenburg, 2012).

According to Hillier and Hanson (1984), space syntax theory is based on urban structure and spatial culture. Kubat (1997) used space syntax to analyze the morphological structures of Anatolian towns and determined mathematical interpretations. As a result of the comparisons, as the integration values of Anatolian towns reflect a deeper and unified structure, the complexity of the Anatolian towns provided a low comprehensibility compared to the examples from other countries (average value: 0.3503). Banerjee and Thilagam (2015) determined that, in the spatial structure of cities dominated by the Indian city genotype, symbolic structuring had as much impact on urban elements as functional configuration.

The relation between urban tissue and urban components is a relationship between the part and the whole, which makes space syntax methodology ideal for this study. The space syntax analysis provides numerical and consistent results for defining the complex

city structure. While the method defines the city structure, it concentrates on the space and forms a spatial network based on street connections. With this network, the interaction of many places within the city with their immediate surroundings or throughout the city is achieved and its structure is revealed.

History and culture in the eight Anatolian and Italian towns

The basic necessities of the settlements have been factors that ensure the continuity of the established settlement, meet the needs of the living society within it, and ensure the security and, most importantly, the survival of the inhabitants. The proximity to water, food and a relationship between topography and defensibility establish these basic necessities shaping settlement structures. These are generally sought-after factors due to the geographical characteristics of the settlement's location. Historically, the changing needs of daily life have played a key role in every town and civilization in the shaping and development of towns. The desire to demonstrate the power of the societies, the religion that defined the way of life of societies, which played a major role in the identification of a historical period, continued to be responsible for the change and development of the structure of towns. Lilley (2002), for example, explains that new towns were established to enhance the power and income of families in England, Ireland and Wales in the late eleventh century.

The first interaction between Anatolia and the Italian peninsula was the result of Greeks settling in the coastal regions of both regions. The subsequent interaction was made by the Roman Empire in the form of a strong and expanding state structure throughout Anatolia. Later, as the Roman Empire transformed into the Byzantine Empire and became the administrative and cultural focus for Anatolia, traces relating to western civilizations became more significant. In the Italian peninsula, focusing on defence due to unrest after the fall of the Roman Empire and changing patterns of political and commercial activities in the Middle Ages, towns developed with organic forms. The old towns in Italy, which bear the traces of Roman grid plans, have changed in ways that reflect the historic structure again with the approach adopted in the Renaissance period.

The Greek and Etruscan civilizations inspired the Roman Empire on the Italian peninsula, which means that they also influenced a great deal of the Roman Empire's basis of urban planning (MacKendrick, 1956). The general grid plan streets and details of the buildings as a Greek reflection can be seen in Roman towns in general. In Roman towns, the intersection of two main axes of the grid street system, the *Cardo Maximus* and the *Decumanus Maximus*, was a focal point, and forums were placed in the centre of these intersections. In the period of Greek civilization, *agoras* were open spaces where the political, religious and economic activities of the society took place, while similar functions in the Roman Empire turned an *agora* into a forum. The forums continued to form the town centres as shapers of identities, and served the towns as multifunctional sites.

The Middle Ages, which began with the collapse of the Western Roman Empire (A. D. 476), were a period of restraint and shaping of urbanization together with political and religious structure. One of the major components of many medieval towns is the town walls; these played a crucial role in defence, settlement definitions, and for tax purposes. Thereafter, the main urban function became trade, and streets were turned into market areas. Undoubtedly, the trade function, which largely defined the era, had the most important role in the formation of space in cities. Towns that have a linear street structure from the entry points to the market area are narrower and more irregularly structured in their interiors (Saalman, 1968).

Religion has brought structural changes to many towns. The first reflection of this is that one can obtain an idea about the socio-economic levels of the societies from the external aspects of the buildings such as building type, size or style during the Roman Empire period, whereas in the Islamic towns, religious ideas were reflected in their external façades

as uniformity and simplicity. The privacy and introversion of Islam in itself is reflected in the urban system and the structures within the town. The most important characteristic of Islamic towns was not the exterior, but that all buildings, from houses to bazaars, had inhabited courtyards. The courtyard was dominated by geometrical design, which emphasized privacy, secrecy and the independence of the spaces. The street structure of the Islamic town has developed in such a way that the pavements and street furniture are insignificant, as so much importance is instead attached to the interior of the courtyard buildings. Open and green areas were limited in the courtyards of the buildings and in the historic gardens. The bazaar, where social and political considerations were shared, was used as a platform where the news and thoughts were exchanged, as in the Roman forum. With the Turks who embraced the Islamic religion and survived their migration from the Middle East, Anatolian Byzantine cities gained new identities influenced by their culture and understanding. As a result, due to the perceived importance of privacy, dead-end streets (culs-de-sac) that do not directly link buildings with the streets have been formed and a street system with narrow roads has been formed (Kubat *et al*., 2001). Squares in cities seized by Turks were separated from bazaars, or structures were built reflecting the important Islamic building types such as mosques. Mosques were constructed to give identity to an area of a city, and this identification process continued in new areas as the city developed and expanded.

Morphological analysis of the eight Anatolian and Italian towns

Throughout history, there have been significant entry points through the Mediterranean in countries where both Antalya and Genoa are located. Both towns were important entry points into their regions from the Roman Empire period onwards, and the changing of social structures in the Middle Ages are the point at which the towns began to diverge structurally. Geographically similar, with mountains to the north and the Mediterranean to the south, both are surrounded by walls for protection from external factors that continued to be significant until the twelfth century.

Antalya and Genoa both have a grid plan and the typical urban components built during the Roman Empire. During the Seljuk period, a Turkish population started to settle in Antalya and the Roman theatre and the palace area were the first parts of the old town to be reshaped. On the other hand, in Genoa during the same period, the old town grew beyond the first walls and the town structure began to deteriorate, even though some traces remained. Antalya also expanded beyond its walls during the Ottoman Empire and took an organic form. The old town faced some changes during this period, for example the northern part of the town was reshaped in Islamic form, losing its Byzantine palace and open spaces, while the grid plan of the Roman area was retained. When the components that shape urban space are compared, while there were efforts to provide a continuity and inter-town connection in Genoa, Turks and Christians lived separately from the Seljuk period in Kaleiçi, Antalya, and two different morphological structures emerged giving a lack of continuity in the town (Figure 4).

The long history of the morphological structure of towns such as these has caused the layers of different periods and a mutual interaction between the host communities to occur in both towns. Antakya and Verona are the most prominent examples of those considered by this paper where this interaction is observed. While the basis of the comparison between the two towns was based on this approach, the fact that both were located on the lowland and mountain slopes and, most importantly, were located along rivers and were therefore excellent locations for trade became another factor of comparison.

Antakya and Verona are similar to the previous example in that they each had a Roman-period grid pattern (Figure 5). Antakya was one of the largest towns during the Hellenistic period and Verona still reflects the urban tissue it gained during the Middle Ages. Only the main axes in Antakya maintained their early

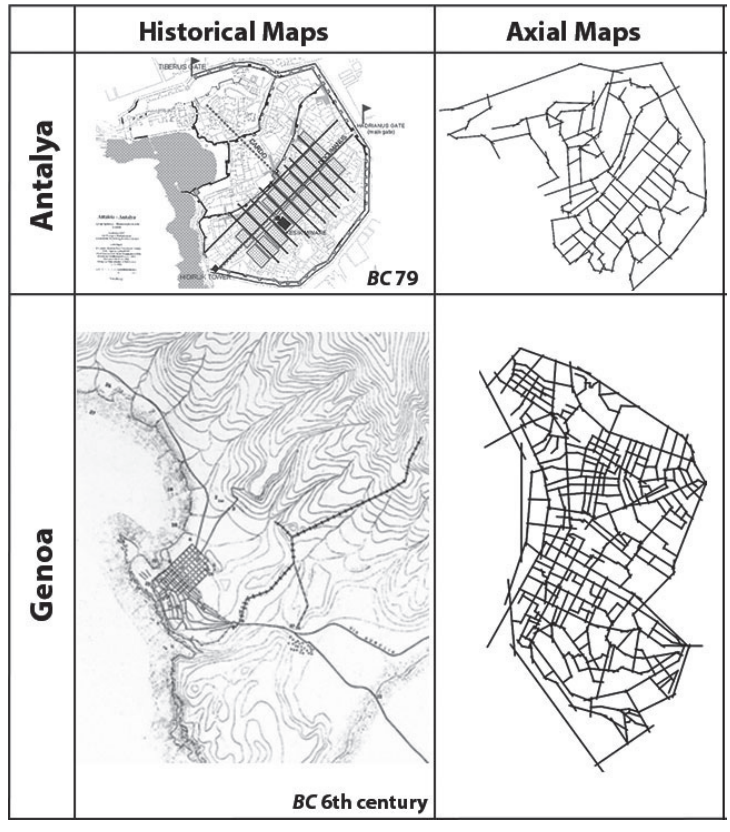

Figure 4. Historical and generated axial maps of Antalya and Genoa (source for historic maps: Süer, 2006; Giunta, 2015).

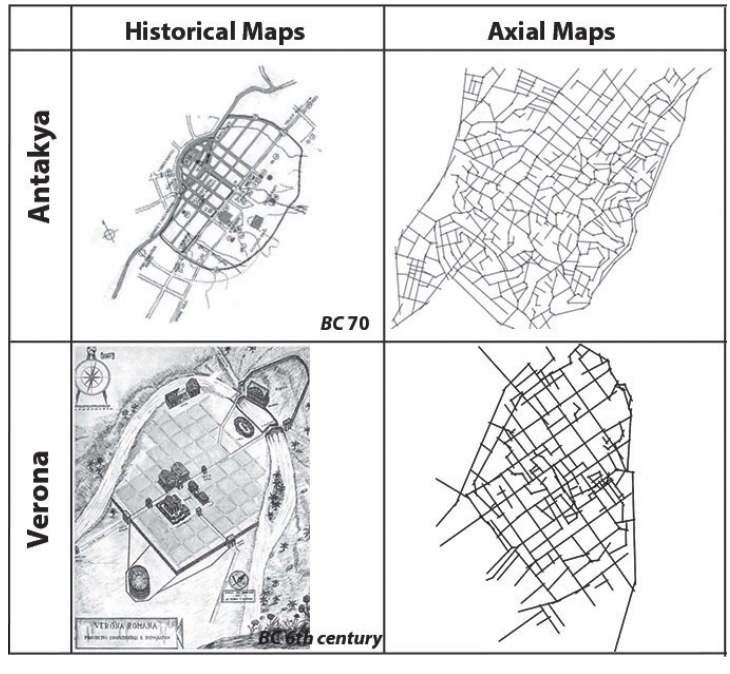

Figure 5. Historical and generated axial maps of Antakya and Verona (source for historic maps: Topçu, 2003; Labunski, 2010).

alignment and the rest of the urban pattern developed into organic forms after the settlement of different civilizations in the town and redevelopment following severe earthquakes. In Verona, the grid pattern formed during the Roman Empire still shapes the contemporary urban tissue, but the town has changed in detail, with new streets and culs-de-sac as interior features of the grid form. This can be observed in the Piazza delle Erbe, one of the main components of the city during the Middle Ages, which was also a Roman forum.

Towns underwent various developments and had more monumental structures that reflect the values of society if they were located in an important central point in a region. Iznik, the capital of the Anatolian Seljuk Empire and Lucca, the capital of the Tuscan region of the Holy Roman Empire between the tenth and eleventh centuries, have undergone significant changes in terms of both urban texture and function due to their proximity to the important towns in their regions. Following its conquest by Sultan Orhan in 1331, İznik started to develop as a Turkish town and became the place where Turkish art began to use tile. With the settlement of a new society in the town, the existing grid form and the structures belonging to the Christian town were transformed to reflect the Turkish and Islamic town. The Hagia Sophia church was converted into a mosque and *madrasah* during the reign of Sultan Orhan, and many other mosques, *madrasahs* and baths were built. On the other hand Lucca, which declared its independence during the medieval period, increased its wealth through its silk production and trade and began to attract immigration. Throughout the ages, Lucca's walls have influenced the growth and development of the town, even when they were demolished: the locations of some Roman and medieval walls are now occupied by modern roads, for example (Figure 6).

Bursa, the first capital of the Ottoman Empire and Ravenna, the last capital of the Eastern Roman Empire after the split of the Roman Empire, gained high status and underwent changes in their urban structures as a result of their functions as capitals of these two important empires. After Bursa had become the capital, the town grew beyond the Roman walls and the old town was not greatly affected until the severe earthquakes of 1855

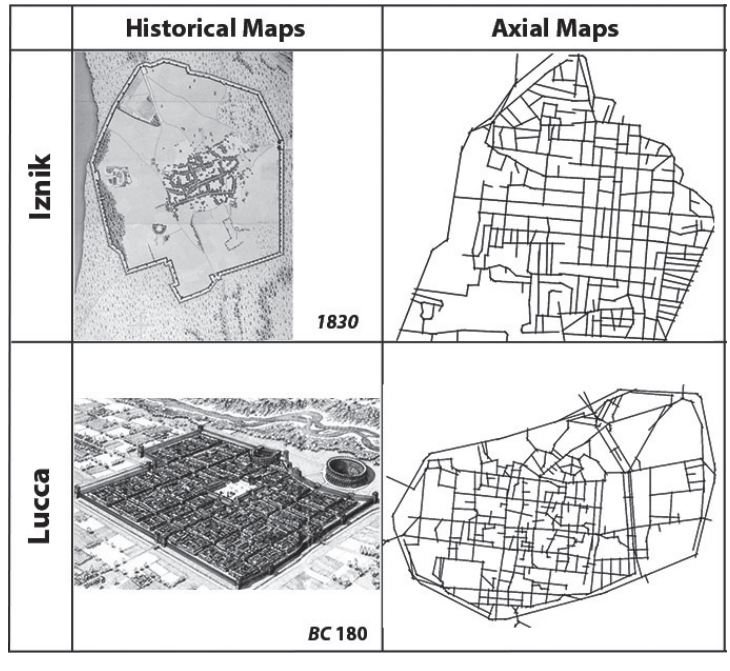

Figure 6. Historical and generated axial maps of Iznik and Lucca (source for historical maps: Rabbel *et al*., 2015; Art of the Roman Provinces, 2014).

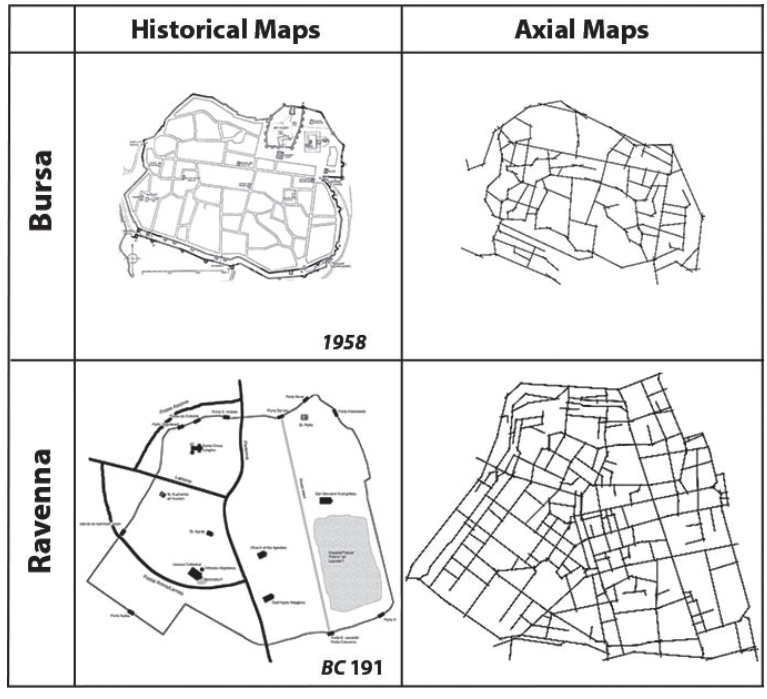

Figure 7. Historical and generated axial maps of Bursa and Ravenna (source for historical maps: Kuran, 1996; Deliyannis, 2014).

(Kuran, 1996). Then organic and irregular development patterns replaced the original forms and today the average block size in Bursa is 1564 sq. m. Ravenna also expanded and still reflects the traces of the main axes built during the Roman Empire (Figure 7).

As a result, both towns had basically the same urban fabric structure during the Roman Empire period, and then the structure and elements of Bursa changed with the influence of a new culture and religion in Anatolia (Table 2). Examination of the texture of the towns shows that the strongest structure was the axes that formed the skeleton of the settlement from the ancient period, similar in both countries. The Italian urban fabrics are in a form that preserves continuity and linear structure. This continuity is supported by the squares in the towns' centres, which have been one of the most important elements of the spatial structure from antiquity. In the Anatolian settlements examined, although there are axes that constitute the main skeleton of the towns and reflect the traces of the ancient period, the texture around this structure is irregular.

Quantitative analysis of the eight old Anatolian and Italian towns

In this section, quantitative values obtained through space syntax analysis are compared and discussed. While the previously-described parameters and spatial mapping are used within this theoretical approach, morphological values that were discussed in the previous section are also associated with space syntax values and the effect of culture on urban morphology is compared.

Antalya and Genoa

The two important streets forming the grid pattern that reflect the spatial structure in old Roman towns, *Cardo* and *Decumanus*, lost their importance in Antalya and Genoa. The Roman street-pattern traces have the highest integration value in both Antalya and Genoa today. Segments identifying urban space that was built on the traces of the Roman walls during the medieval period have been found to have the highest integration value in the

Table 2. Quantifying aspects of the case study towns

Town	Origins	Segment count	Average segment length (m)	Block count	Average block area (sq. m)
Antalya	B.C. 79 Founded by the King of Bergama.	143	10.48	51	1460
Genoa	B.C. 6th century Etruscan period foundation.	370	8.65	238	356
Antakya	B.C. 300 Founded by Seleucus Nicator, one of Alexander the Great's commanders.	512	11.11	156	1153
Verona	B.C. 100 Neolithic origins, though urbanization began with the Roman Empire.	175	13.95	137	834
Iznik	B.C. 316 Founded by Antiochus, one of the generals who shared the empire after the death of Alexander the Great.	274	16.80	177	1528
Lucca	B.C. 180 The Etruscan city was rebuilt as military camp during the Roman Empire.	335	13.47	197	1211
Bursa	B.C. 700 Founded by the Prince of Bithynia.	135	12.10	54	1564
Ravenna	B.C. 191 The Etruscan city was rebuilt as military camp during the Roman Empire.	256	18.10	146	2260

Genoan system. The town form was divided into two because Turks and Christians lived separately, resulting in a lack of continuity and two different morphological structures: a Turkish town with narrow streets and organic texture, and a Christian grid plan.

As the Antalya study area is smaller than Genoa, it has a lower number of segments (143 / 370), while the average segment length is higher than that of Genoa (10.48 m / 8.65 m). In Antalya, where the block size is larger and the average segment length is longer, the integration value is lower (86.3143 / 319.835). However, the intelligibility of Antalya, where the size of the blocks and the average segment length are high, is higher than that of Genoa (0.6428 / 0.6043). The synergy analysis shows that the segments where the mosques are located in Antalya have an integration value below the system average (82.8945). These values mean that the mosques are segregated from the whole spatial layout. In both cases, the segments where the squares and the churches are located have integration values above the system average (Figure 8). These places are integrated with the whole system in both examples.

Antakya and Verona

Today the *Cardo* and *Decumanus*, which still form important elements in the urban tissue in both towns, are partly retained in Antakya and fully preserved in Verona. For the rest of the towns in Antakya, this linear structure

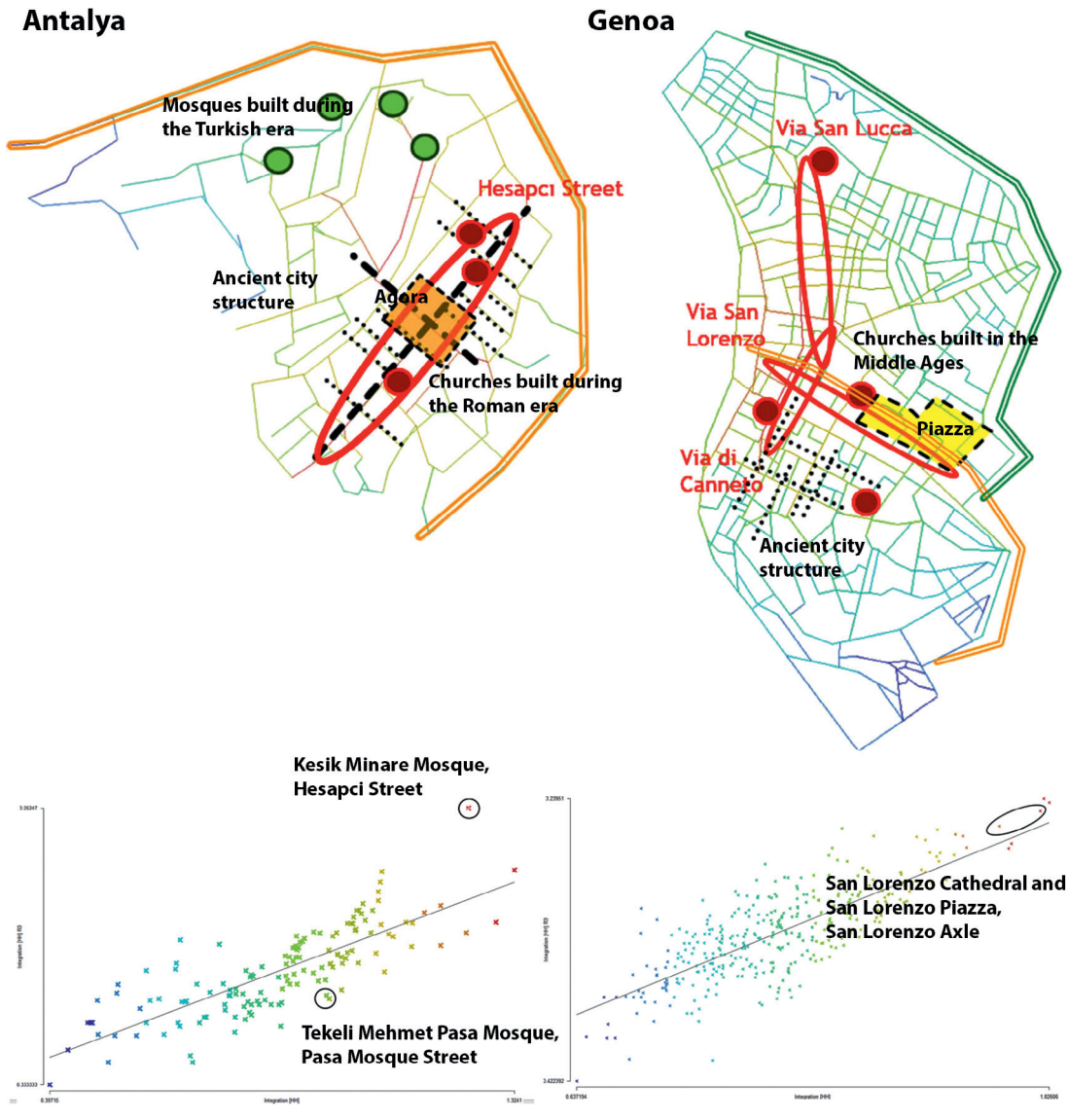

Figure 8. Spatial structure analysis and synergy diagram of Antalya and Genoa.

has been lost. In Antakya, Kurtuluş Avenue (*Decumanus*, R400 = 276.368) and Kemal Pasha Street (*Cardo*, R400 = 235.967) are the most important segments of the town. In Verona, the traces of the two main axes of the Roman period, the Cors Sant'Anastasia (*Decumanus*, R400 = 260.845) and Via Cappelo (*Cardo*, R400 = 254.281) and the square that was transformed into the Erbe Square in the Middle Ages (R400 = 236.13) at the intersection of the *Cardo* and *Decumanus* is now the most integrated part of the old town. This interpretation is also supported by quantitative results, while the integration value of the 'town edge' (boundary of the study area) is 99.8725 and the average integration value is 166.121. The urban structure in Verona reflects the Roman grid pattern in the town centre but loses its linear structure on the riverside.

Antakya has more segments than Verona (512 / 175) due to the size of its study area, but the average segment length is less than that of Verona (11.11 m / 13.95 m). In Antakya, where the larger blocks are located, the integration value is lower (166.121 / 176.882). However, in Verona where the size of the blocks is lower, and the average segment

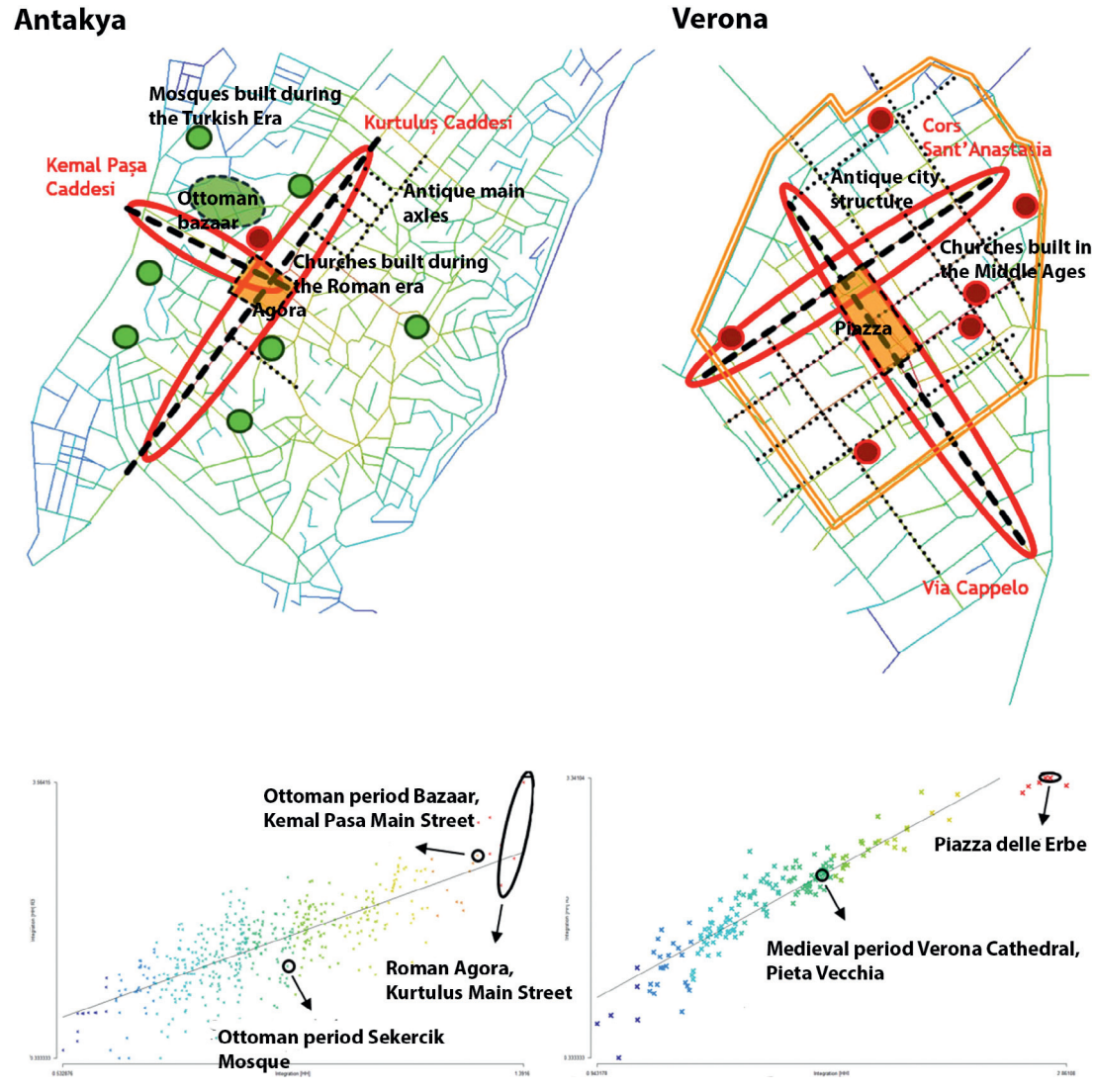

Figure 9. Spatial structure analysis and synergy diagram of Antakya and Verona.

length is longer, the intelligibility value is higher than that of Antakya (0.1862 / 0.5480). While mosques are located on lower integration value segments in Antakya, squares and churches are found on high integration value segments in Verona (Figure 9).

Iznik and Lucca

Unlike the previous two pairs of examples, ancient traces were preserved in the Anatolian town of Iznik. In Lucca, the grid pattern from the Roman period persists, although with new irregular and cul-de-sac streets in interior segments. There are also two different morphological patterns in Lucca, as in Antalya. While the traces of the Roman period still exist in the centre of the old town, the spatial structure outside the Roman walls reflects a medieval organic structure. The integration values of the two old towns are 123 in Iznik and 203.341 in Lucca. This demonstrates that the old town of Lucca has a more accessible urban system than that of Iznik.

The study area size of Iznik and Lucca is approximately the same, the number of segments in Iznik is 274 and 335 in Lucca. Due to the ratio between the study area and the number of segments, the average segment length

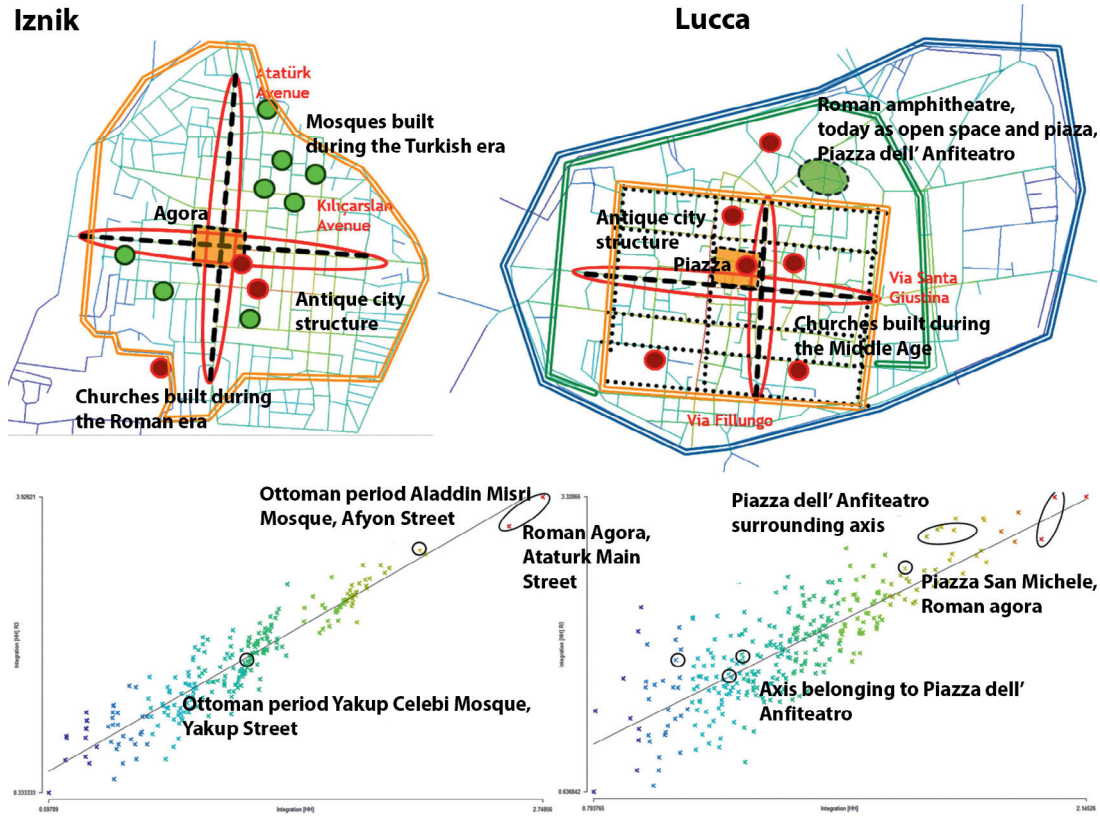

Figure 10. Spatial structure analysis and synergy diagram of Iznik and Lucca.

of Iznik is higher than that of Lucca (16.80 m / 13.47 m). The intelligibility of Iznik, where the average segment length is high, is stronger than that of Lucca (0.3832 / 0.2694).

In contrast to other Anatolian examples, the segments where mosques are located have average or above average integration values in Iznik. However, there are also similarities such as the location of mosques in the inner parts of the town. The persistence of traces of the Roman period is the reason why Iznik has a high integration value. The synergy parameter shows that Lucca has the same urban structure as the other Italian old towns, where squares and churches are located on high integration value segments (Figure 10).

Bursa and Ravenna

An irregular morphological structure and many turning points are the reasons why Bursa has the lowest integration value of the towns studied here (R400 = 89.3895). Ravenna is similar to Bursa in that it has many turning and breaking points, although it also maintains linear and continuous Roman streets and has the lowest integration value among all of the Italian examples (R400 = 125.088). The synergy parameter shows that in the Anatolian example, mosques were placed on average or below average integration value segments (Figure 13). In Ravenna, churches that were built both during the Byzantine period and more recently were located on above-average integration value segments (Figure 11). Due to the fact that the study area of Bursa is smaller than that of Ravenna, the number of segments in Bursa is lower (135 / 256). As a result of the linear structure of the streets in Ravenna, the average segment length is more than Bursa (12.10 m / 18.10 m). Bursa's integration value is lower than Ravenna (89.3895 / 125.088). The intelligibility of the city of Ravenna, where the average segment length is higher, is stronger than that of Bursa (0.3366 / 0.4132).

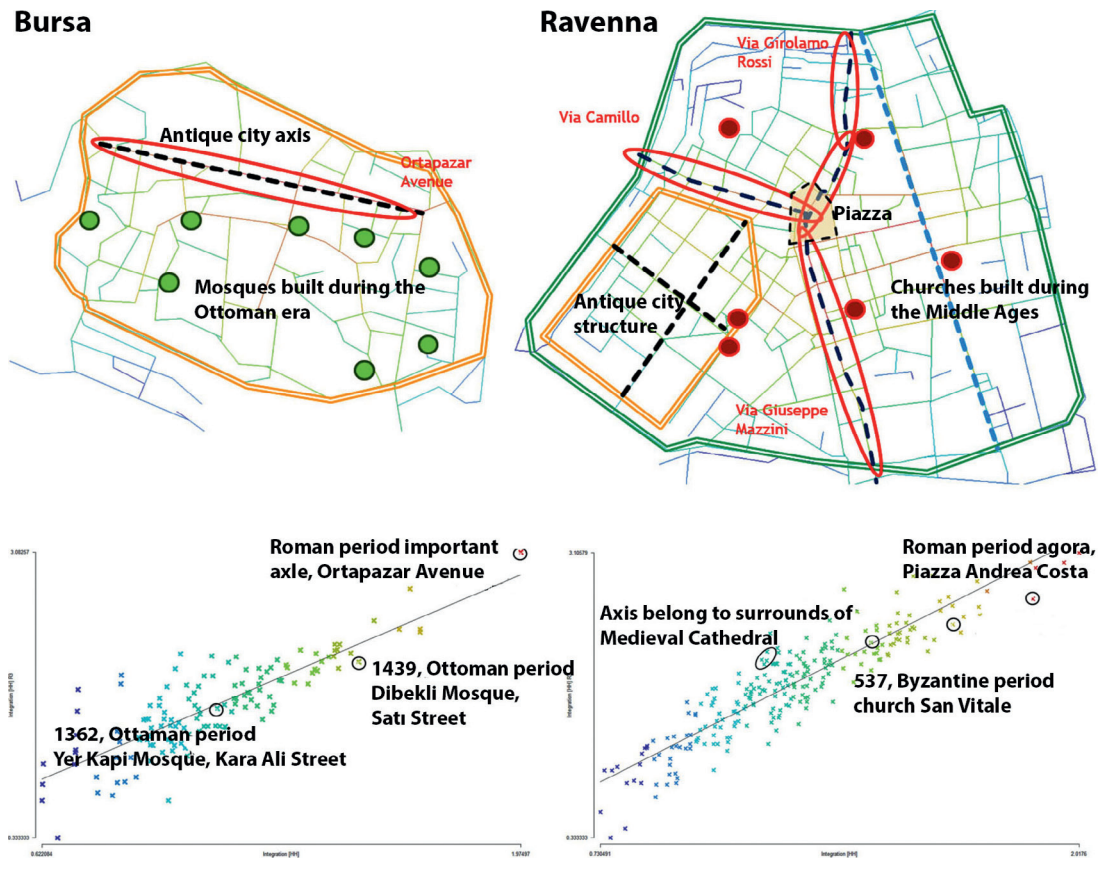

Figure 11. Spatial structure analysis and synergy diagram of Bursa and Ravenna.

Conclusion

The effect of Roman urban patterns can be clearly seen on average segment lengths, which are longer and more linear than those in organic tissues. The longer the segment length, the more linear and continuous the street pattern. This situation reflects the linear structure and continuity of the streets that demonstrate Roman influence. The average block size is significantly larger in Anatolian towns (Table 2). This can be explained because here, the grid patterns have been changed into more organic forms and large block patterns under the influence of Turkic and Islamic cultures. On the other hand, in Italian old towns, changes of street forms in the medieval period took place without significantly deforming the main grid pattern. The analysis shows that the Roman grid pattern is deformed in Ottoman towns, which affects block size and block shape (Table 2). On the other hand, urban extensions outside the first city walls during the Middle Ages in Italian towns also show different block sizes, but the formal rectilinear shape is retained.

It is clear that morphological values partially affect the values obtained through space syntax analysis as integration and choice values are higher in Italian old towns (Table 3). Higher integration and choice values emphasize that Italian old towns are more accessible in terms of orientation to space. In addition, systems with longer average segment length are more intelligible. This finding leads us to the conclusion that linear and continuous urban forms have a relation with intelligibility.

Similarly, in both countries, the highest integration value axes are those remaining from ancient times and which also constitute the skeleton of today's settlement. In Italy, these streets which are integrated with the rest of the city interact with the square in the

Table 3. Space syntax values of case study towns.

Towns	Integration value (Rn)	Integration value (R400)	Choice value (R400)	Intelligibility	Synergy
Antalya	86.3641	82.8945	2 407.68	0.2896	0.6428
Genoa	319.815	257.286	10 295.2	0.2571	0.6043
Antakya	285.369	166.121	6 905.02	0.1862	0.5994
Verona	208.07	176.882	3 735.12	0.5480	0.8754
Iznık	259.611	123	2 210.18	0.3832	0.8702
Lucca	333.631	203.341	5 687.82	0.2694	0.6595
Bursa	100.517	89.3895	2 676.51	0.3366	0.6932
Ravenna	240.428	125.088	2 268.24	0.4132	0.8265

centre. In this way, streets provide an accessible system. In Anatolia, while these streets are sufficiently important to form the structure of the towns, they are separated from the residential areas and functions elsewhere in the town. As a result, accessibility in the whole town is limited (Table 3).

The intelligibility value was highest in Verona, where the Roman grid plan was most prominent (0.5480). The fact that the value is greater than 0.45 indicates that the town's comprehensibility value is very high. Antakya, where organic tissue is dominant, had the lowest comprehensibility value (0.1862). The fact that the value is less than 0.2 indicates that the urban system is incomprehensible. In addition, when the comparative analyses were made, it was found that the town with the average segment length was more comprehensible than its pair. This situation can be related to the linear structure of the streets and the Roman urban structure. While the general urban layout with linear and continuous axes ensures that the town is accessible, high integration and preference values have confirmed this situation. Since the intelligibility parameter is also associated with the connectivity parameter, it has been found that it is related to the lengths of the linear axes independent of the relationship between town centre and wall.

As a result, it has been found that the Roman urban structure has been preserved and influences the structure in the historic centres of today's Italian towns. While this linear and continuous structure directs the user towards a point in the centre, the high integration and preference values confirmed that urban systems are accessible.

Future research using this approach might usefully examine the new towns established in the Ottoman period. Diversification of such studies will contribute to a better explanation of the relationships between morphological processes and urban structures.

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