

# Heraklion and Chania:

## A study of the evolution of their spatial and functional patterns

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### Abstract

This paper takes a comparative approach to the evolution of spatial and functional patterns of two Cretan cities: Heraklion and Chania. It originates from a puzzle, related to the function of these two settlements as they are today. The paper aims at exploring the reasons for this difference. In this framework, it reveals a problem as to whether these different contemporary functional patterns are the product of pure chance, historical accident or of spatial factors such as the location of particular facilities or attractions. The study is based on the conjecture that the morphology of their grid differs, and this is reflected in their different functional patterns. This paper therefore explores the interrelation between space and function in the two cases. The spatio-analytical method employed is “space syntax”. The spatial analysis suggested syntactic differences during their evolution process may account for their different functional patterns. In the light of its research question, considering the limited data, the paper shows that syntactic analysis especially the radius-radius analysis related to the land use pattern, is a promising line for further research with more complete data.

The paper begins by establishing the puzzle. Concepts like “centrality” and ultimately “live centrality” are developed, both strongly influenced by movement according to the theories of “natural movement” and “movement economy” (Hillier, 1993, 1996). Next, the paper describes the methodology and the data used. Then the two cases are reviewed and the paper ends with a discussion in the light of research findings related to the initial question and to concepts developed in the theoretical framework.

### 1. Introduction: the puzzle and its approach

Heraklion and Chania are historical cities, both located on the north coast of Crete, on its east-west main axis, which relates all the large settlements of the island. Therefore, they both seem to have undergone similar historical processes. However, today these two urban systems appear to function differently. Both cities comprise an historical centre, encircled by the rest of the urban system. Heraklion’s historical core functions as the core of its urban tissue, housing all its central activities despite

### Keywords

Evolution process,  
urban grid, spatial and  
functional pattern

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the fact that the core appears to be almost separated from the surrounding new city. In Chania, the old historical core, although is better connected with the rest of the settlement, functions as a tourist attraction, and thus its “urban buzz” seems to have been displaced outside of the historic centre. It is suggested that configurational factors may account for this difference between the two cases

In the light of its main conjecture, the methodology of this study is based on an analysis of the evolution process in both cities. This requires the analysis of their historical records and maps. However, the limited historical sources make this research akin to detective work on the basis of imperfect data. Considering these difficulties in terms of the research question the study has reviewed the historical development and growth of each city in an attempt to find out if there are any specific historical clues that can account for the difference between the two contemporary urban systems. This historical review has also included socio-economical details of each settlement throughout their evolution process. The analysis of the historic spatial evolution of the two cities (emerges, as powerful methodological implement). The spatial analysis, which expresses the urban grid<sup>1</sup> as an axial map<sup>2</sup> and analyses it configurationally, is based on old historical maps and others, provided by the local authorities. For Heraklion the axial maps refer to the following years: 1668-69, 1936, 1960 and 1990, while for Chania the axial maps refer to the years: 1660, 1905, 1947, 1963, 1990. As far as Heraklion in 1668-69 is concerned, the axial map is based on an original plan designed by Hans Rudolf Werdmuller<sup>3</sup>. Similarly, for Chania in 1660 and 1905, the axial maps are based on a map designed by Fr. Collignon and a map surveyed by W. Chapman<sup>4</sup>. The study has considered the comparative scale of all the maps for both cities. The findings of the spatial analysis have been correlated with Heraklion’s and Chania’s functional patterns throughout their evolution process, whenever the appropriate data have been available. Hence, for Heraklion the study has plotted the distribution of land uses during the years 1666-68, 1960 and 1990. As for Chania, the distribution of land uses has been mapped during 1905 and 1990.

## **2. “Live centrality”: a spatio-functional process**

The analysis of every urban settlement is usually concentrated on its centre, which expresses the essence of its function as a system. In the light of “space syntax”, the term “centre” comprises both functional and spatial elements. Thus, *functionally* entails a concentration and mix of activities in a particular area, while *spatially* refers to accessibility considered relative as the settlement as a whole. However, what seems to remain ambiguous is whether this centre remains stable or if there is a dynamic process which leads to its gradually displacement. Considering the “centre” as having its own dynamic, the problematic is further developed around whether

this is related only with economic or planning decisions or whether there are some spatial aspects which tend to push the centre one way or another (Hillier, 2000).

Therefore, the search for a spatial model of the key component of the urban concept of the “centre”, that is “live centrality” is justified. The term “live centrality” describes this aspect of “centre” which is led by functions such as retail, market, entertainment and all other activities that benefit from movement. The “live centrality”, in terms of its functional elements, is distinguished from central functions such as administration, religion or office employment. The former requires a distinctive spatial component, which is described by the multiplier effects of movement on the urban grid, and the distribution of land uses. The latter is linked generatively to the configuration of grid through the by-product effect of “natural movement” according to the principle of “movement economy”.

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The principle of “natural movement” suggests that it is the configuration of the urban grid that generates the fundamental pattern of movement, not the presence of specific attractors (Hillier B et al., 1993). The by-product effect of urban movement appears in the forms of sequences of spaces that are passed through on the way from origin to destination between the functions in the network, suggested by the theory of “movement economy”. Thus, the latter describes the complexity of cities as a mixture of busy and dense mixed-use areas and quieter and more homogeneous residential areas. Thus, spatial configuration through its effect on movement, shapes and ultimately, is shaped by land use pattern and densities.

A “live centre’s” spatiality is described by both the overall configuration of the grid and by the local grid conditions, since it is strongly related with the urban movement and this occurs at different scales: the globalised and the localised. Globally, the “live centrality” selects locations that have the appropriate degree of integration regarding the settlement as a whole. Locally, it selects locations where there is an intensified local grid. The latter is produced and reinforced by the “movement economy” process. Both ultimately lead to a network of higher and lower intensity areas. Since “movement economy” is a constant procedure in every urban system, the “live centre” attracts greater movement and thus its blocks become smaller in order to enable movement; its urban grid is more intensified (Hillier, 2000).

However, the growth of settlements changes the pattern of integration and this finally can lead to the displacement of the “live centre”. Usually, but not always one can notice an outward shift of it. Locally, the growth of settlements bringing about smaller block size or “islands” such as to allow greater and easier movement within the centre that is the local intensification of the grid. The greater the scale of

the centre, the stronger this process is. In terms of historical cities such as the case studies of the present research, the growth of cities displaces the centre of the historical core towards what was once the edge. However, what seems to enrich furthermore the understanding of the complex process of urban growth is the fact that there is a simultaneous local process of creating sub-centres. Therefore, according to this argument, in historic cities the functional specialisation of sub-areas that one finds in the historic centre will be transformed as the urban grid grows, into distinct sub-centres with different functions. And thus, the problem of centrality takes the form of including the “hierarchy of centres and sub-centres” (Hillier, 2000).

### 3. Data and Methodology

For Heraklion, the main sources of data were research conducted in 1966 by A. Proveleggios and a complete report for the city, conducted in 1998 by the Ministry of Environment of Greece, both provided by the local authorities.<sup>5</sup> As for Chania, the main source of data was a research conducted in 1977 by A. S. Kalligas - A. G. Romanos for the medieval town of Chania, provided also by the local authorities.<sup>6</sup> However, these data have also been completed by other documents and by the researcher’s observations.

In an attempt to investigate the reasons for their different functional patterns the study attempts a historical review of the two settlements. However, in the light of study’s conjecture, the research focuses on the analysis of their spatial evolution through the comparative axial analysis during the historical process of each city. The structure of the historical core and its evolution has emerged clearly from the axial analysis of the core itself separated from the surrounding urban structure. The spatial analysis has included the integration analysis radius  $r_n$  (global integration) and radius  $r_3$  (local integration) for all the axial maps. However, because of the powerful effect that “natural movement” has on the evolution of urban pattern and on the distribution of land uses, the true to life picture of the contemporary cities is given by the radius-radius analysis. This is set at the mean depth of the whole system from its main integrator. This analysis suggests that each axial line is analysed at the same radius, and thus the globality of the analysis is maximised while the tendency that the edges of the system have towards segregation (edge-effect) is minimised. (Hillier, 1996: 163).

Having analysed the historic spatial evolution of both cities, the study focuses on mapping what is known of the functional pattern of both cities. As far as the land uses is concerned, the retail and the market are identified as the functions, which are strongly related to the concept of a “live centre”. Thus, both functions are strongly bound up with “natural movement”, in contrast to movement which occurs

because of the presence of certain attractors Both of them are distinguished from other central functions such as administration or banks, in terms of the specific spatial conditions that are required or that they generate. Hence, for this study all the emergent functional patterns comprise activities like the retail, the food market, the administration and the bank employment.

The difference between the two cities is expressed through the interface between the movement of the inhabitants and that of strangers who are entering and leaving the city. Therefore, in this study land uses have been mapped based on the elementary distinction between those that are related with the inhabitants and those that are related with the strangers. In this framework, the study introduces a further distinction regarding retail; between boutiques and tourist shops. In some cases like the functional pattern of Chania in 1990, or of Heraklion in 1960, the study includes some special shops, selling handicrafts clustered in a particular location. Hence, land uses for both cities have been divided into the following categories: food shops, boutiques, tourist shops, administrative buildings and banks.

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#### **4. Historical review: findings**

The historical review of the two settlements aimed at dealing with these factors which possibly affected the contemporary functional patterns of both cities. Hence, what appears to be significant for the evolution of Heraklion is that the city appears to have retained the same location since the first Byzantine period of Crete (330 - 823a. C.). During the ensuing centuries there were a lot of physical disasters and wars. However, the city was always rebuilt in the same location. What seems to be more significant is the plan of 1936, which focused on increasing the density of the old core in which all the central functions would be located, when the city had already started to expand outside its walls (Tzobanaki, C., 1996, p.91). By contrast, Chania's evolution seems to have been led by its proposed plan in 1947 that proposed a complete transformation of the old core along with the concept of revitalising it by transforming it into a tourist attraction, expressed around 1967. These constitute possible historical factors which could have led to the different functional patterns of the contemporary settlements.

The walls as the dominant spatial element of Heraklion, for more than seven centuries (9<sup>th</sup>-16<sup>th</sup>centuries) provided "...psychological reassurance for the city dwellers by dividing, enclosing, and rendering space exclusive." (Georgopoulou M., 2001, p.48). Therefore, all the functions that constitute a city such as administrative buildings, churches and the marketplace were located inside the walls. During the 13<sup>th</sup> century, the Venetians reorganised Heraklion (Candia) and restored its existing fortifications. Gradually, the city began to expand outside the walls

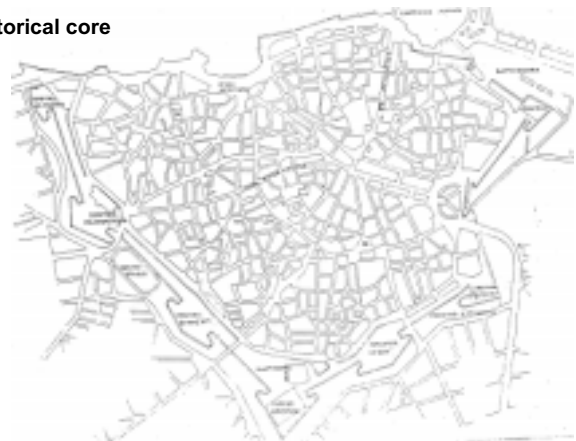
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Therefore, the Venetians decided to rebuild and reinforce the fortifications in order to embrace the whole settlement, with all the newly formed suburbs (burgi), is an attempt to protect the settlement from Ottomans, who had already threatened Venetian sovereignty. Thus, Candia became the most well-known fortress of the Venetian Empire in the eastern Mediterranean. The backbone of the settlement remained the same street as that of the Byzantine settlement, known as Ruga Maistra. This street led to the central square of the settlement, St Markos, a place of commercial and economic transaction, under the control of the authorities (Georgopoulou, 2001: 48.)

Heraklion, at the end of 19<sup>th</sup> century, was the most important urban and commercial centre in Crete. Thus, at the beginning of 20<sup>th</sup> century, there was a lot of discussion about planning the new city. The first plan of the city took place in 1901. Since 1930 the city had expanded outside the 4 entrances of the Venetian walls along the streets that originated from the old city and headed towards neighbouring settlements. Subsequent plans after 1936 had not changed the urban fabric. Hence, what seems to emerge from this brief description of Heraklion in the 20<sup>th</sup> century is that the old core of the city remains its “live centre”; that is, where the urban buzz is located

Today, Heraklion maintains the same structure as that of the early 20<sup>th</sup> century, mainly when the southern and the western parts of the contemporary settlement are concerned. The old core is still surrounded by the Venetian walls (Figure 1) The same road, 25<sup>th</sup> Avgoustou, its backbone for more than ten centuries (9<sup>th</sup> –20<sup>th</sup> centuries), functions as the main road which leads from the “centre” towards the sea and thus it is related with the movement of strangers who are leaving or entering the city. However, small circular roads between the central radial streets and the main ring road, which practically embraces the whole city, have enriched the structure. The ring road is part of the main axis of Crete. However, what seems to be interesting regarding the contemporary settlement is that the “live centre” of the urban settlement remains within the Venetian walls, in the historic core of the city.

**Figure 1: Heraklion, during the late 20<sup>th</sup> century. Plan of the old historical core**



As for the economic aspects of Heraklion , it emerges that trade activities were the dominant economic resources of its population. Therefore, from the 15<sup>th</sup> to the 17<sup>th</sup> century, there were a variety of people engaged with the trade. According to the census of 1961, 59.2% of the active population in Heraklion is employed in this sector of the economy, which includes both trade activities and administration.<sup>7</sup> During 20<sup>th</sup> century its population has increased significantly compared to all the other major cities of Crete.<sup>8</sup> Today, retail shops and administrative buildings are within the old core of the city, which appears to remain its “live centre”.

If we now turn to the second case study, Chania. Today, Chania is the main economic and administrative centre in the larger area of western Crete. However according to research conducted in 1977, the society of Chania and its larger area was identified by its stability.<sup>9</sup> The limited retail activities reinforced the image of the city as the transitional point between the surrounding countryside and larger settlements.

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The historical evolution of Chania originates from the first Byzantine Period (330-823a.C.). However, until 1211, despite the fact that Chania was an existing settlement it was of minor importance, and thus there are not enough historical records about the settlement. In 1252 the Venetians rebuilt and fortified the settlement by reinforcing the existing fortress of Kasteli, the first core of the settlement. During the 16<sup>th</sup> century new walls were built along the coast and the southern part of the settlement, being identified as settlement’s main spatial components. They encircled three identifiable areas; the central area of the ancient acropolis (Kasteli) embraced by the old walls, the Venetian harbour and the dense residential areas to the south-west and south-east. Therefore, the spatial pattern of the settlement emerges as a bunch of main streets orientated towards the harbour and a small number of disproportional squares (the squares that do not have a clear geometrical shape). The main road (Ruga Maistra) originated from the harbour and led to the south outside the walled city. A major square formed around a public fountain south of the Venetian harbour. In Chania, the administrative buildings were clearly separated from what were the main activities of the city, that is, the marketplace, the squares and the public fountain (Georgopoulou, 2001).

In 1898, the authorities decided to destroy the northwestern part of the Venetians walls. In 1901 the new plan of the city decided the expansion of the city outside the walls, and thus the demolition of the southern walls. The new plan led to the development of new streets which connected the “inside” settlement with the developing “outside” one. The municipal food market was built on the south edge of the old walled city, leading to the demolition of another part of the wall. Apparently, when there was need for defending the sovereignty of Venetian rule, the settlement

followed the rules of growth and expanded outside the walls.

Today, Chania's historical core retains only part of the original structure due to the bombing of the city in 1941 and the partially applied plan of 1947, which suggested the complete transformation of the existing urban structure. (Figure 2) The historical core is not an identifiable walled city. Its function as tourist attraction can be traced back to 1967, when another research suggested the maintenance of the old urban structure and the restoration of all its monuments in an attempt to develop it as a tourist attraction.<sup>10</sup> Thus, at that time the answer to the socio-economic stability, which the research conducted in 1977 pinpointed, was the development of the old core of the settlement as a tourist attraction. Hence, Chania has followed the rules under which other historical cities have grown, having its "live centre", completely separated from the old historical core. The latter has become a "live museum" entailing all the functions and cultural events bound to this concept.

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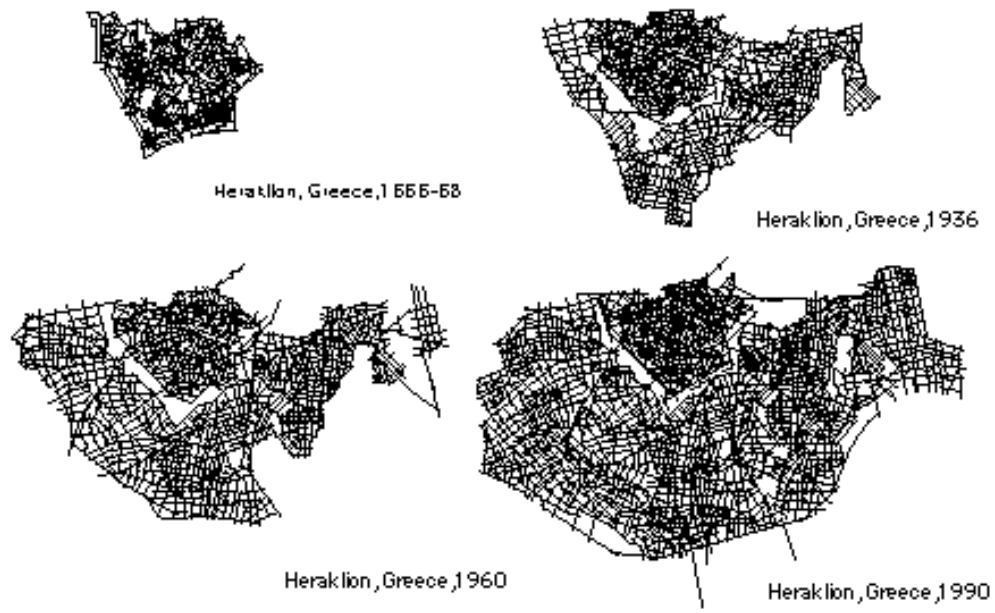
**Figure 2: Chania in 1990. The street pattern of the old historical city**

However, the study's initial hypothesis suggests that Heraklion and Chania differ in terms of their spatial structure, that is the morphology of the grid. This difference is related to what is known about the distribution of land uses and appears to be a more powerful reason for their different functional patterns today. For this study the morphology of the grid is analysed configurationally through the axial analysis. Hence, the latter will reveal each city's spatial pattern.

### **5. Spatial Analysis**

Comparing the axial maps of Heraklion and Chania throughout their evolution process, it emerges immediately that these differ geometrically, especially regarding the maps of 20<sup>th</sup> century, that is 1936 and 1947, or 1960 and 1963 and lastly 1990. Heraklion's axial models appear to be more "radial" than Chania's models which appear to be "griddy".<sup>11</sup> (Figures 3 and 4)





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Figure 3: The growth of HERAKLION

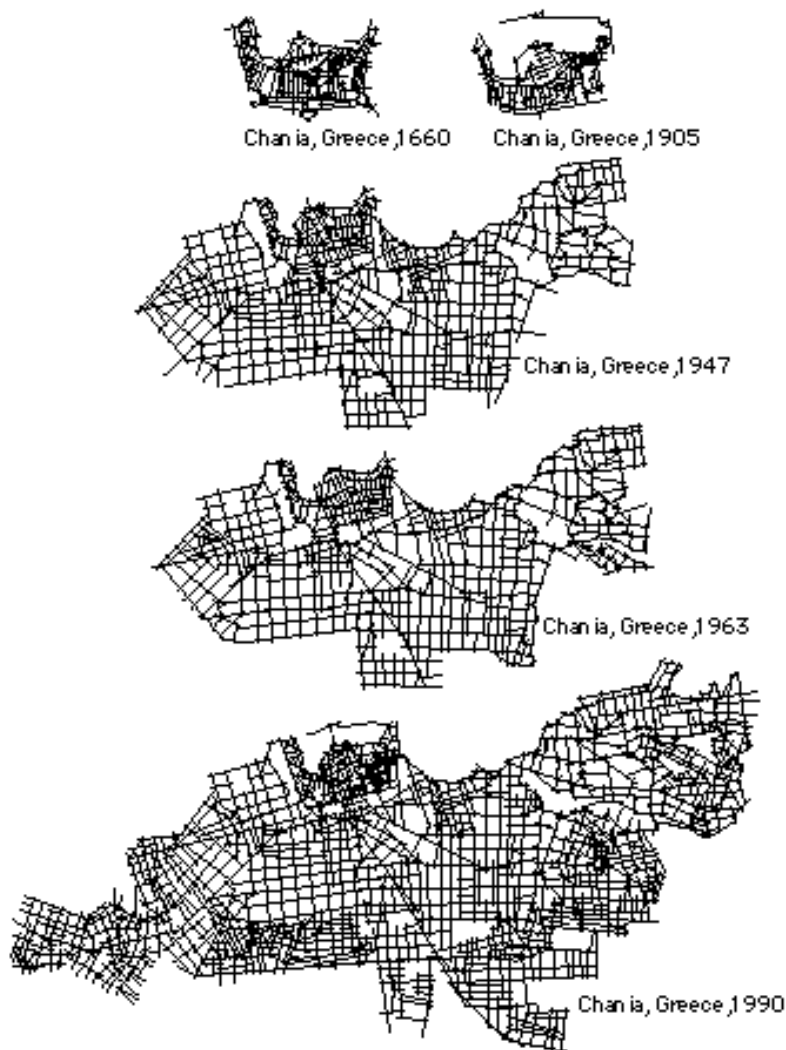


Figure 4: The growth of CHANIA

All the axial maps of Heraklion comprise short lines, which end on other lines, and this is found both locally and globally. The longest lines begin from the historic core and head outwards. The contemporary settlement seems to have grown under the same rules as those which formed the old city. Thus, the axial lines outside the old core have similar geometrical features to those of the old core. However, the latter has a weak connection with the surrounding grid. Thus, the “old” and the “new” grid are mainly connected through three different lines. Comparing the axial maps of Heraklion, one can notice that between 1960 and 1990 the grid is intensified in almost all areas.

The axial maps of Chania consist of a number of parallel long lines, passing through each other. These lines form the grid mainly just outside the historical core. This area of the grid has a strict right angle of intersection. The historical core of Chania maintains some of its structural elements throughout the historical process of evolution. It comprises shorter lines than the grid just outside of it, with less of a right angle of intersection. However the grid of this old core appears to be well connected with the grid of the new city, through two strong lines that practically cross the structure of the old core, having a north-south orientation. The geometric difference between the axial maps of Heraklion and Chania reflects the syntactic differences as they emerge to the syntactic analysis of this study.

### 5.1 Syntactic Analysis: methodology and findings

For this study the analysis has included the integration  $rad_n$  and  $rad_3$  analysis of all the axial maps. The latter has been also applied in an attempt to find the local grid conditions, which can be indicative for the “live centre” of a settlement. Since the study has drawn upon the different functional patterns of the two historical centres, these two cores were analysed as closed systems, clearly separated from their surroundings. The syntactic analysis of both cities has shown that there are syntactic differences between these cities, which are better described by the radius-radius analysis of the contemporary settlements and the measure of synergy.<sup>12</sup> Tables 1,2,3,4,and 5 show the syntactic parameters of both cities throughout their evolution process, as this study has monitored it.

**Table 1: Syntactic parameters of HERAKLION**

Heraklion	Mean global Integration	Mean local Integration	Mean Depth	Mean Conn	R <sup>2</sup> local/global	R <sup>2</sup> conn/global
1666-68	0.853	2.202	9.831	3.959	0.363	0.265
1936	1.208	2.792	7.080	5.251	0.258	0.166
1960	1.032	2.855	10.322	5.457	0.262	0.148
1990	1.020	2.856	8.349	5.413	0.192	0.126

**Table 2: Syntactic parameters of CHANIA**

Chania	Mean global Integration	Mean local Integration	Mean Depth	Mean Conn	R <sup>2</sup> local/global	R <sup>2</sup> conn/global
1660	1.188	2.135	5.629	3.604	0.558	0.334
1905	0.892	1.843	16.101	3.143	0.449	0.288
1947	1.226	2.828	10.567	5.539	0.478	0.336
1963	1.090	2.695	10.594	5.136	0.477	0.279
1990	1.203	2.747	9.045	5.192	0.376	0.249

**Table 3: Syntactic parameters of the old core of HERAKLION**

Heraklion/old core	Mean global Integration	Mean local Integration	Mean Depth	Mean Conn	R <sup>2</sup> local/global	R <sup>2</sup> conn/global
1666-68	0.853	2.202	9.831	3.959	0.363	0.265
1936	1.356	2.674	6.892	4.987	0.463	0.328
1960	1.329	2.715	1.917	2.636	0.533	0.363
1990	1.608	2.953	10.178	5.910	0.724	0.537

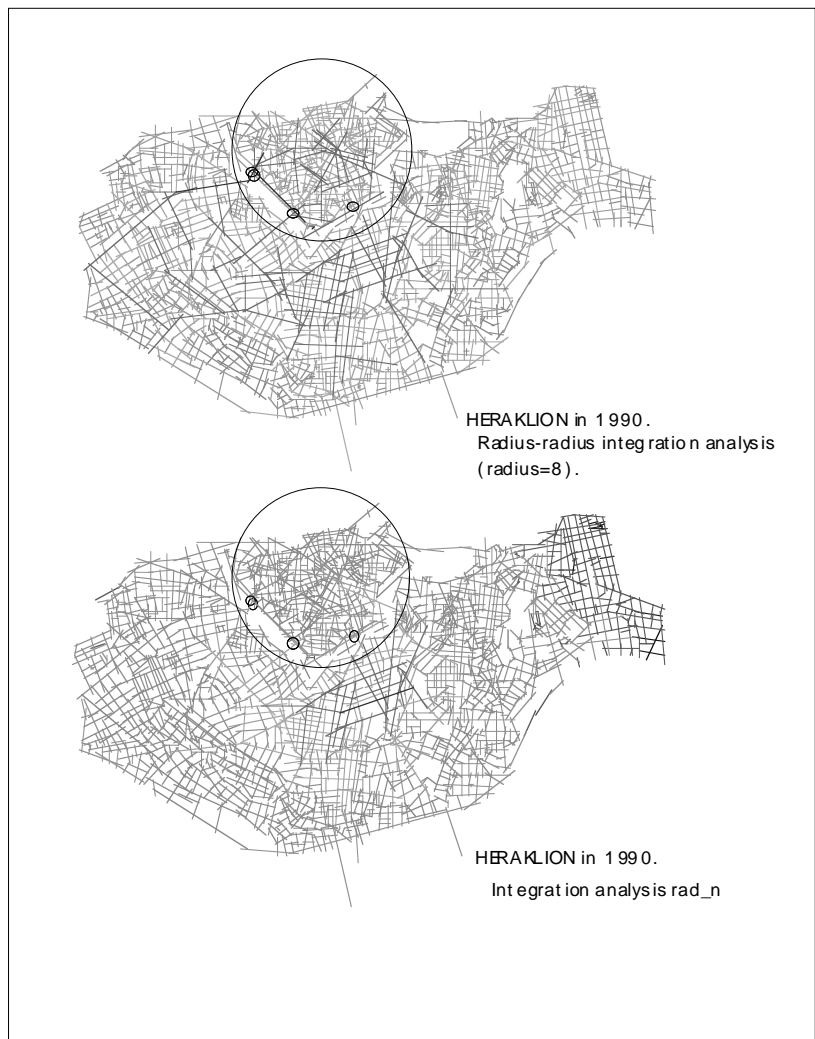
**Table 4: Syntactic parameters of the old core of CHANIA**

Chania/old core	Mean global Integration	Mean local Integration	Mean Depth	Mean Conn	R <sup>2</sup> local/global	R <sup>2</sup> conn/global
1660	1.188	2.135	5.629	3.604	0.558	0.334
1905	0.892	1.843	16.101	3.143	0.449	0.288
1947	1.501	2.526	7.533	4.803	0.759	0.625
1963	1.222	2.423	4.228	4.474	0.658	0.467
1990	1.131	2.172	12.175	3.837	0.455	0.322

**Table 5: Syntactic parameters of the radius-radius analysis**

Settlement	Mean global Integration	Mean local Integration	Mean Depth	Mean Conn	R <sup>2</sup> local/global	R <sup>2</sup> conn/global
Heraklion (1990)	1.020	1.515 (rad_8)	8.349	5.416	0.534(rad_8/rad_n)	0.126
Chania (1990)	1.203	1.422 (rad_9)	9.045	5.210	0.877(rad_9/rad_n)	0.249

The radius-radius analysis, of Heraklion in 1990, set at rad\_8<sup>XI</sup> shown in Figure 5 has suggested that its old historical centre is part of the expanded rad\_8 integration core. It has highlighted as the rad\_8 integrators the same axial lines which used to be the dominant integrators 54 years ago.



**Figure 5: HERAKLION: Integration analysis rad\_8 and rad\_n**

Analysed on its own, the old core has given a good correlation between the local and the global integration ( $R^2: .724$ ), a fact which means that the distribution of local integration within it is a good indicator of global integration. In Figure 7 the old core, represented by the lighter dots, forms a regression line which cross the line of the whole city at a steep angle. The slope across the line implies that the most integrated lines within the old core are more locally than globally integrated. This correlation, representing the synergy of the whole system, gives a  $R^2: .192$ . However, in the case of the old city, that is the city inside the walls the correlation has a value of .314. This number is very close to .363, which is the correlation between the local and global integration of Heraklion in 1666-68, the scattergram of which is shown in Figure 6. Despite the poor correlation, the points form a tight shape around the regression line. The latter justifies what has already been mentioned about the maintenance of structure of the old core, and thus the almost unchanged syntactic parameters of the city during its evolution process.

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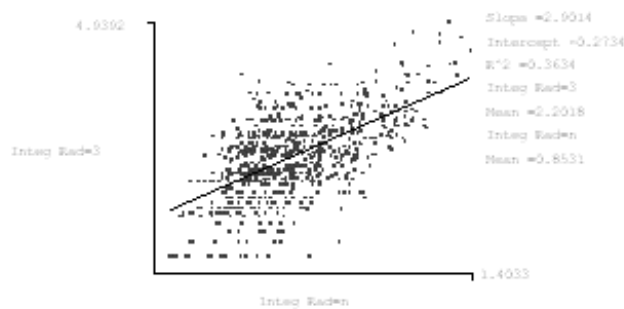


Figure 6: Scattergram showing the synergy for the axial map of Heraklion in 1666-68

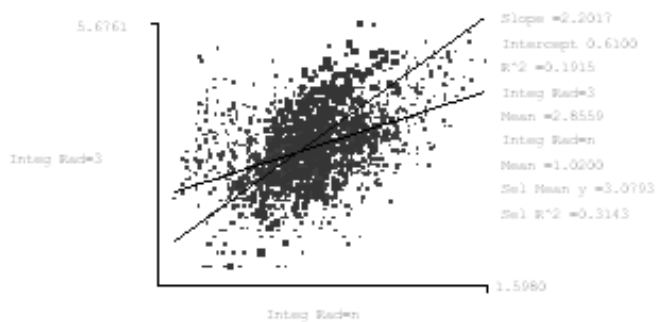


Figure 7: Scattergram showing the synergy for the axial map of Heraklion in 1990

The urban structure of the old core consists of streets which for more than 300 years have been the dominant integrators both of the global and local structure (1666—1936). As the settlement has grown, the significance of the structure of the old core has lost its global effects. However, the dominant integrators for more than 300 years have been transformed into local centres. (Figure 8) Thus, the study confirms what Hillier has suggested, that about the distribution of integration in an urban system does not yield a static picture of the current state of the system so much as a structural record of the historical evolution of the system (Hillier, 1996: 344). Therefore, through its evolution process, as Heraklion has grown maintained the main structure of the old core, along with the expected intensification of the grid within this old core (Hillier, 2000). This structure is consisted of lines which function through the evolution process either as the dominant integrators, both global and local, or only as local integrators



Figure 8: HERAKLION comparative integration analysis rad\_3 of the historical core

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By contrast, the radius -radius analysis of Chania in 1990, set at rad\_9, shown in Figure 9, suggests that the old core is a more segregated area despite the strong lines, like Halidon Str or Daskalogianni Str. which connects the old and the new city and some other streets 1-step away from them. The old core has ceased to function as a local centre, and the integration core of Chania in 1990 is fully developed outside the old city.

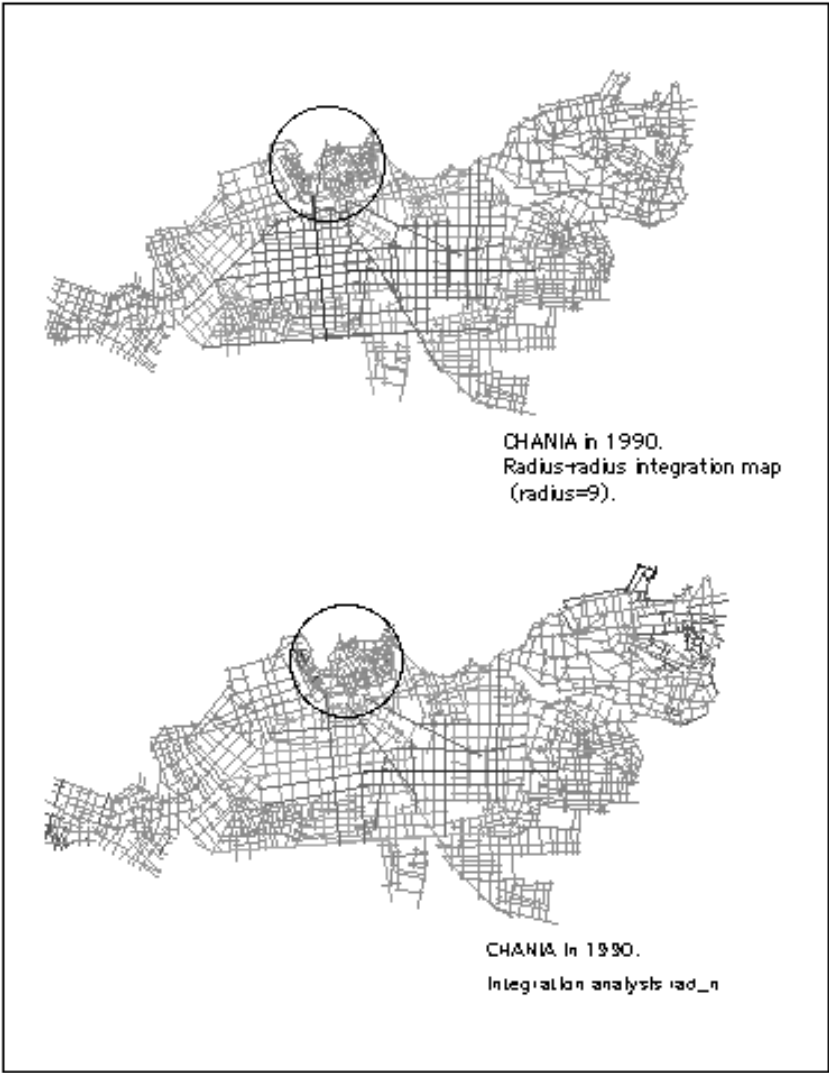


Figure 9: CHANIA integration analysis rad\_9 and rad\_n

The same old core analysed on its own has given a poor correlation between the local and the global integration ( $R^2: .455$ ), compared with the  $R^2: .724$ , of Heraklion's old core. The same old core embedded in the whole city, represented by the lighter dots, shown in Figure 11 forms a series of layers, with a poor correlation between the local and global integration ( $R^2: .342$ ), suggesting an area which "freezes" the natural movement. (Hillier, 1996: 135). This value is far away from the .556 of the first settlement in 1660 (Figure 10) but very close to the figure for the whole city. The measure of synergy for the whole city in 1990 gives a value of  $R^2: .376$ , better than that of Heraklion in 1990 ( $R^2: 0.126$ ). However, its low value shows that in this system the local integrators are not the same as the global integrators.

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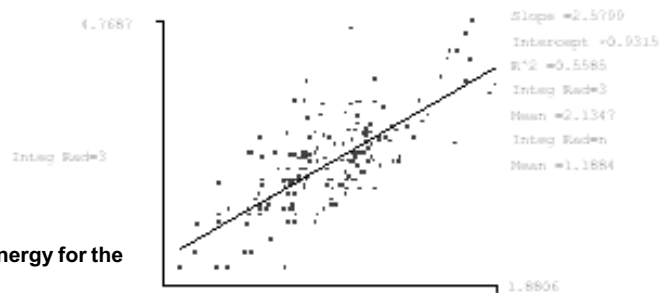


Figure 10: Scattergram showing the synergy for the axial map of Chania in 1660

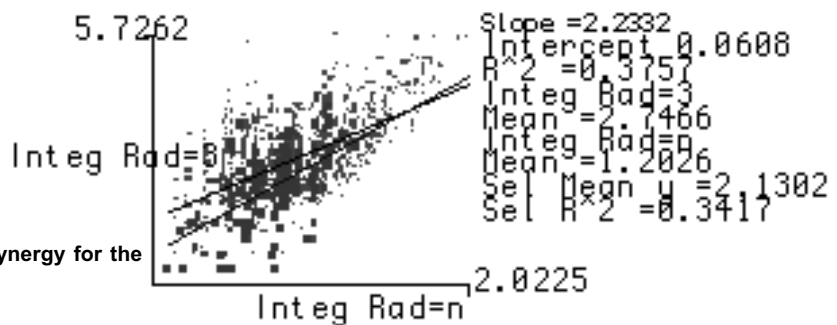


Figure 11: Scattergram showing the synergy for the axial map of Chania in 1990

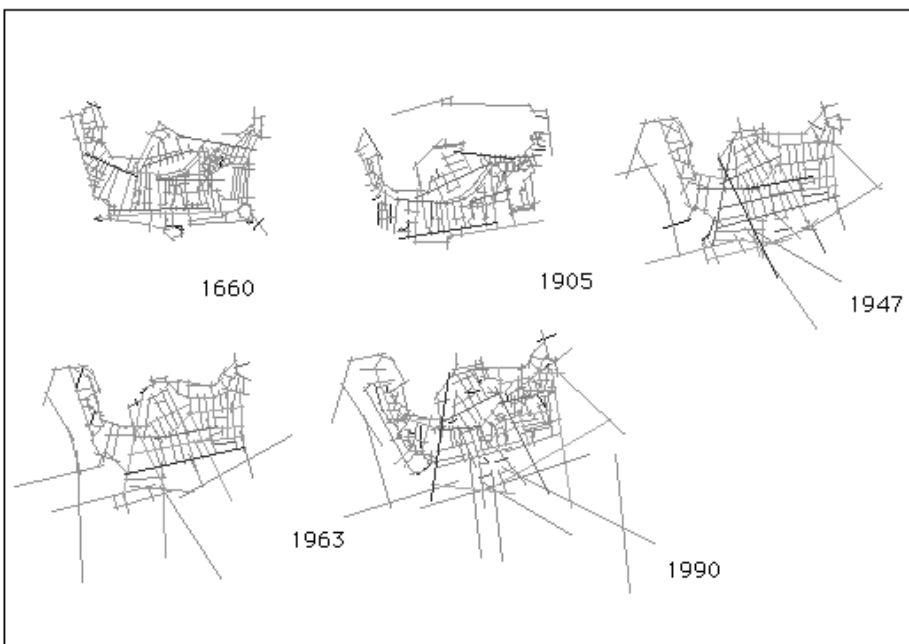


Figure 12: CHANIA comparative integration analysis rad\_3 of the historical core

Thus, regarding the research question the syntactic analysis of both cities revealed syntactic differences, which are mostly related with how the new settlements are connected to the old historical centres.

## **6. Functional Analysis: methodology and findings**

Having analysed the spatial structure of both cities during their evolution process, the study focuses on their functional patterns and how these were transformed or remained almost unchanged over time. In view of the limited historical data, in an attempt to trace the functional aspects of “live centrality” the study mapped the location of retail, food and tourist shops. These were distinguished from where buildings like banks or administrative ones are located. For Heraklion the study mapped only the land uses distributed in the city during 1666-68, 1960 and 1990, since there was no clear evidence of the functional pattern during 1936. For Chania the study mapped the functional pattern of the city during 1905 and 1990 since there is no evidence of land uses in Chania during 1660, 1947 and 1963.

19.15

The functional analysis of Heraklion has shown that the old city retains its significance in terms of its urban life. The old core appears to be the main location of the urban buzz for three centuries (17<sup>th</sup> -20<sup>th</sup> century). According to historical records in 17<sup>th</sup> century the “live centre” of the city co-existed with the administrative centre and both were developed along the same lines. The former appears to be located in city’s geometrical centre, today’s El. Venizelou Square, while all the administrative buildings were located along a strong line, Ruga Maistra, originating from the main square (Tzobanaki, 1996). The “live centre” of Heraklion in 1960, remains inside the old core. It is developed around the focal point of 17<sup>th</sup> century, and the distribution of land uses is similar to those of the 17<sup>th</sup> century<sup>14</sup>. The banks were mainly located on 25<sup>th</sup> Avgoustou Str., where in 17<sup>th</sup> century the administrative buildings were located (Figure 13). In 1990 the functional pattern of Heraklion is intensified. Its “live centre” is still located in the old core of the city (Figure 14). Banks are still located on 25<sup>th</sup> Avgoustou Str. along with some tourist shops, due to its feature as the main axis that connects the “live centre” of the city and its “entrance” from the sea. However, what is significant to the functional pattern of Heraklion in 1990 is the fact that despite the tendency to become more convex in shape, due to the intensification of the grid that occurs in its centre during its evolution process, there are still streets, that is lines along which the functions related with the centre are developed. This contrasts with previous research findings on the functional patterns of other cities. For example, in the case of Birmingham in 1997, the pattern of shops had changed from a linear structure to a compact and convex structure and thus most of linear shopping streets leading towards the city centre had disappeared (van Nes, 2002: 181). However, in Heraklion in 1990 the linear

pattern of shopping streets retain their significance, and convex areas of shopping streets described by the local grid conditions have developed around them. Thus, the overall functional pattern comprises a convex shape with spikes. Hence, the dominant functional pattern of Heraklion's "live centre" between 1960-1990 is formed by strong lines around which convex shopping areas are formed particularly marked in the functional pattern in 1990.

19.16

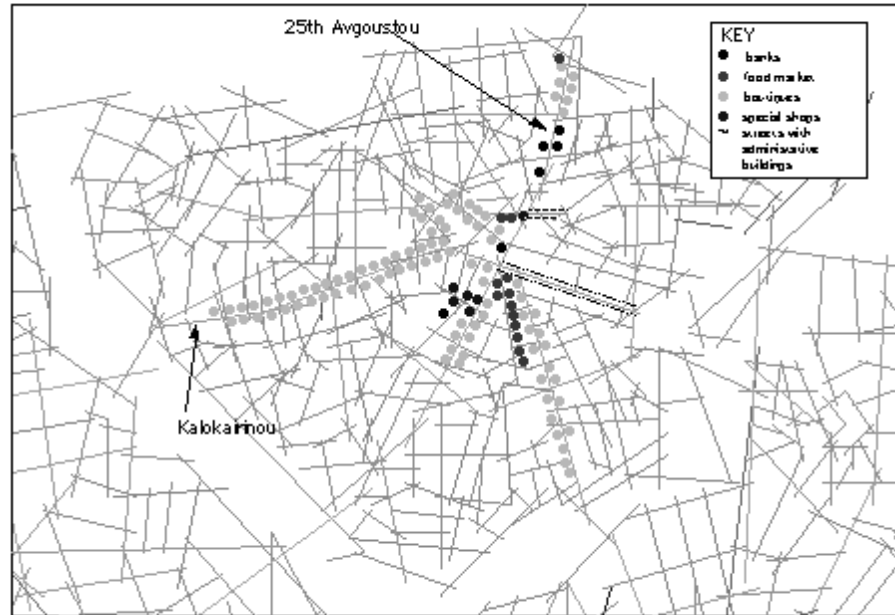


Figure 13: KERAKLION 1960 land uses imposed on the integration rad\_3 map

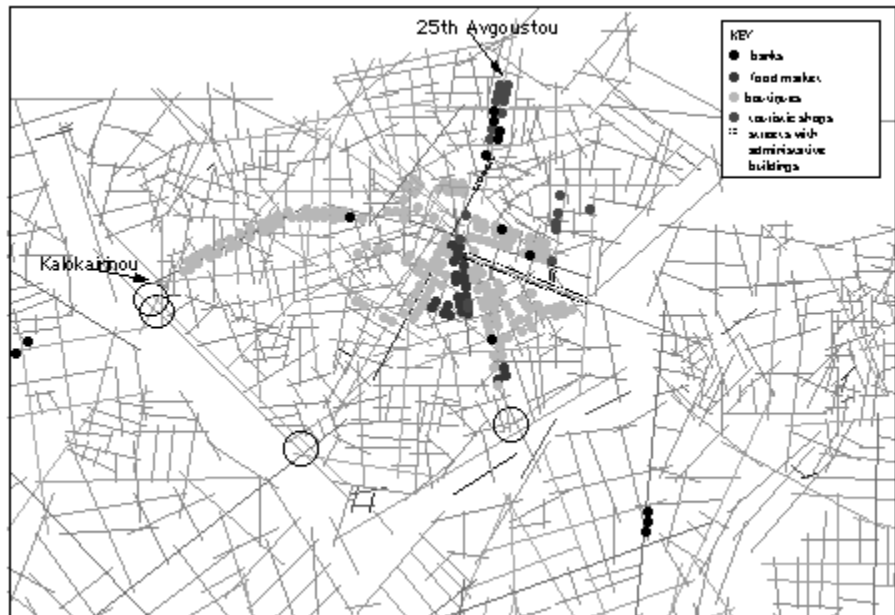
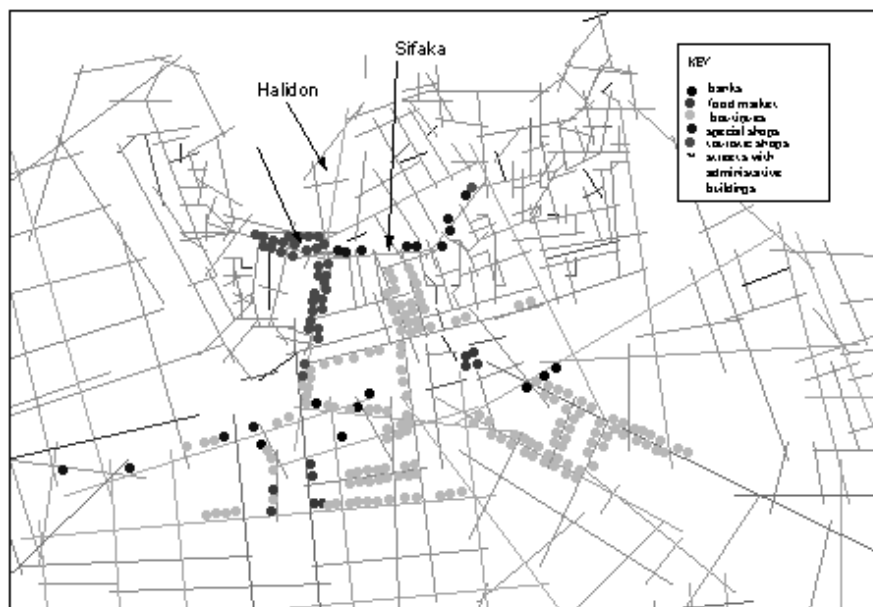


Figure 14: KERAKLION 1990 land uses imposed on the integration rad\_3 map

Regarding Chania the plotting of land uses in 1990, featuring in Figure 15, clearly shows that its compact and convex "live centre" lies on the edge of the old core<sup>15</sup>. Thus, the functional pattern of Chania in 1990 manifests what has been already mentioned about the functional separation of the old core from the "urban buzz". The old core is the spatial framework for the tourist functions, which are linear. Within the old core the shops, which dominate the retail uses are the tourist shops. These tourist shops are distributed along Halidon Str, a dominant integrator,



and Zambeliou Str., 1-step away from Halidon Str. Even some handicraft shops, developed along Sifaka Str. ,1-step away from Halidon Str, seems today to target tourists. The pattern that emerges is a convex shape with a strong line, Halidon Str. along which the tourist shops are located. However, due to lack of data the study has not traced the possible transformation of Chania's functional pattern throughout its evolution process, especially during recent years.



19.17

Figure 15: CHANIA 1990 land uses imposed on the integration rad\_3 map

## 7. Discussion

The study has already pinpointed differences in Heraklion's and Chania's evolution process in terms of both their functional and their spatial patterns. The spatial analysis has revealed that Heraklion and Chania followed different rules of growth, which was reflected in the morphology of their grid, manifested by the radius-radius analysis of both contemporary settlements. The radius-radius analysis of Heraklion in 1990 showed that its old city has retained its significance as a focal point of the city. The grid inside the walls is part of the extensive integration core of the whole city. The geometrical focus and the integration core of the city in the 17<sup>th</sup> century, still functions as local integrators today (Figure 8). On the other hand, Chania followed the rules of growth according to which other historical cities have evolved. Thus, as the settlement had grown its integration core had been displaced from the historical core towards the edge and finally outside of it. The radius-radius analysis of the city in 1990 showed the segregation of the old core. The historic core retains its significance partly as having local centres. The old city as a local area is easily accessible to strangers by strong lines from the edge of the area, like other European historic cities. (Hillier, 2001). In this particular city, these strong lines, Halidon and Daskalogianni streets are the connections between the old historical part of the city and the new settlement and both cross the whole old core on a north-south axis.

Both spatial patterns have been suggestive for the different functional patterns, mapped in Figure 13, 14 and 15. The functional pattern of Heraklion during the decades from the 1960s to the 1990s describes the old core as the place where the urban buzz is located. Hence, in 1990 the main shopping streets are found inside the walled city, forming a convex shape attached to which other shopping areas are developed along lines. Unlike other historical cities, Heraklion retains its historical core as its main functional core, that is, its “live centre”. The functional core that is strongly associated with natural movement was described by the rad\_8 analysis of Heraklion in 1990, which showed the main grid of the old city as comprising dominant integrators. Unlike Heraklion, Chania’s functional pattern showed that its “live centre” is located on the edge of the old core. The old core, having an historical significance, functions as an attraction for visitors. The rad\_9 analysis of the city showed that the old core is clearly separated from the integration core. This true-to life spatial pattern seems to have been very suggestive for the functional and current movement patterns of the city.

### **8. Conclusions**

Despite the similar historical process by which these two cities were formed, their evolution appears to have led to different spatial and functional patterns. Heraklion and Chania differ in terms of the size of their historic core. Heraklion’s old core comprises a substantial part of the settlement as a whole. Its significance in terms of the function of the whole city can be traced to the intensification and density of its grid, which have taken place during the last decades. However, despite its size and density, the historic core is not well connected with the settlement as a whole. The latter reaches the old city through four lines, which are not very strong. By contrast Chania’s historical city is a small part of the contemporary settlement, which has been expanded significantly during the 20<sup>th</sup> century. The morphology of the grid of the old core is clearly different from that of the new part of the city. The historical city is connected to the new city through two strong lines, which practically cross the old core on the north-south axis. As a conclusion, this study suggests that it is its size, its density, and its connections to the new city that have enabled Heraklion’s historical core to function as a “city within a city”. For the same reasons, Chania’s historical core is a local area of the city which, because of its significance in terms of its historical evolution, functions as an attraction both for the inhabitants and the strangers.

## Notes

- <sup>1</sup> For this study the urban grid is the pattern of public space linking the buildings of the settlements.
- <sup>2</sup> The axial map is the longest and fewest lines of direct movement that pass through all the open, public space of one settlement and makes all the connections (Hillier, 2001).
- <sup>3</sup> The source of this map is the original plan der Festung Candia gezeichnet in den Jahren 1666-68 von Generallieutenant Hans Rudolf Werdmuller, Library of Zurich. The information about the map are provided in Steriotou (1998)
- <sup>4</sup> Fr Collignon: Fifteen plans of fortifications in Candia(Catalogue of the printed map) 1660, map surveyed by W. Chapman, Chanea, or Khania; both found in Kalligas and Romanos (1977).
- <sup>5</sup> For more details about the reports mentioned, see References.
- <sup>6</sup> For more details about the research see References
- <sup>7</sup> The details about the census of 1961 for the city of Heraklion are found in the research conducted by A. Proveleggios in 1966 for Heraklion.
- <sup>8</sup> See Perdikoiganni, 2002, Unpublished MSc Thesis
- <sup>9</sup> Kalligas and Romanos (1977)
- <sup>10</sup> The details of the findings of this research carried out by Argiropoulos and Tritsis, were found in Kalligas and Romanos (1977)
- <sup>11</sup> The terms “radial” and “griddy” describe the urban grid of each city comparing to an ideal orthogonal grid.
- <sup>12</sup> The measure of synergy describes the correlation between the local and the global integration of a system and it is expressed by a scattegram showing the degree of this correlation.
- <sup>13</sup> The radius-radius analysis was set at the mean depth of the whole system from the main integrator, shown in Table 1.
- <sup>14</sup> Proveleggios, (1966)
- <sup>15</sup> Kalligas and Romanos, (1977)

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<sup>\*</sup> Title originally in Greek, translated by the author

19.20