Spatial Dynamics of Marketplaces

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Abstract. Marketplaces are a common topic in literature. However, the questions with their spatial theories have been often subject to the discussions at a level of more abstract concepts or socio-economic factors rather than their actual layouts. This common tendency seems to engender some considerable problems in our theoretical understanding of marketplaces and how they actually work. In fact, the false implications of this lack already exist among architectural literature whereby marketplaces are accepted as architectonic influence on more recent building types like arcades, department stores and shopping centres. Their evidence, circumstantial and hearsay, suggests that the spatial layouts require much precise understanding in relation to the abstract and socio-economic implications.

The aim of this paper is to gain such understanding by exploring the spatial configurations of two cross-cultural and morphologically distinct marketplaces in Isfahan and Istanbul. In order to deal with that, a method is used by adopting 'space syntax', known both as an analytical representation and another theory of space at a level above the individual.

The paper will argue that the spatial dynamics found in the marketplaces have several instrumental and symbolic means that are to do with organising movements and interactions between people in relation to the socio-economic structures. Knowing such inner dynamics of spatial configurations, planning and use from a multi-contextual perspective is central to understand marketplaces and to evaluate their implications on the other related buildings and urban structures.

1 Introduction: Spatial Theories of Marketplace and Their Problems

Among the available theories that only act at a level above the individual, a great deal of attention has been given to marketplaces as socio-economic phenomena and how they *should* or *might* work. The earliest theories that sought to explain the activities and their spatial distribution in marketplaces were based on the 'micro-economic' theory (Holland, 1987). Their central concern was defined by two interrelated questions: **i.)** *What is the rationale that regulates the space allocation process of activities in marketplaces*, and **ii.)** *How does the market economy itself emerge from this process?* Notions like land values, needs, and behaviour patterns in order to provide exchange or mutual advantage over and above the individuals most often explain the space allocation process.

'Location theory' is a prime example of the development of spatial theories from micro-economic assumptions (Isard, 1956). In that, the location of different activities is only seen as the outcome of a combined market mechanism involving three basic elements: *commodities*, *land*, and *transportation*. Land *is* considered as being a large featureless plain and infinitely available to perform productive operations or to satisfy the residential needs (i.e.: shopping). So that, in principle there would be no need to pay for it. On the other hand, what gives land a differential quality and generates its value is the transportation cost to move the product or labour from the place of production (e.g.: farm, factory, etc.) to the marketplace.

The similar view is also pervasive in 'Micro-Economic Theories of Land Use' (Barra, 1989) which deals with the process of *activity*, *location* and *rent* from the individual residents' or retailers' points of view. First, activities will compete for the consumption of land. Then, once the equilibrium has been reached, they will have been chosen a site of particular size as such that the cost of land and transport they have to pay optimises their utility. Competition will also determine the land value in each location as well as the price of commodities at the marketplace.

The classical models of Von Thunen and Weber are, particularly, among the first examples in explaining the effect of transportation cost on the distance and spatial location of activities, as well as the functioning of the land market. Von Thunen (1966), while using an example of *idealised* agricultural region at the centre of which there is a single marketplace where a large number of producers want to sell their products, explains the way in which the transportation cost affects the producers and the consumers. That is also the consequences for the space allocation process, rent, and the price of commodities in the marketplace. Weber (1929) has similarly used transportation as an essential constraint to explain the location of industry in relation to a market of industrial commodities. However, in his case, the consumption of land was not made explicit.

Later, Christaller (1933, 1963) and Losch (1954) to explain the formation of marketplaces and their geometrical arrangements in the building models of larger city systems or regions have developed these classical models of location. Like Von Thunen and Weber before him, Christaller assumes an idealised (unbounded) homogeneous plain where there are central places defined as marketplaces at the centre of urban settlements. Distributed uniformly over this plain is a population homogeneous with respect to income or purchasing power. There is a transportation system that allowed the urban places of the same size to be equally accessible. Transportation costs are directly proportional to distance. Producers and consumers are spatially and economically rational.

Although very important are these theoretical developments, later, some researchers have claimed that people are neither spatially nor economically rational (Berry, Barnum and Tenant, 1962; Gollege, Rushton and Clark, 1966). The notions of *location* and *distance* (with land value and transportation cost) that are being constantly implemented by using mathematical models on the uniform hierarchical arrangement of places in hypothetical cases have been more recently proved to be both no match in real applications and not much effective for offering operational models developed from the work (Barra, op. cit.). More fundamentally, in these models what seems missing is the question of spatial dynamics as most revealing aspects of real structures and the main physical distributor of the socio-economic factors. In other words, if we are to understand the marketplace as spatial domain of socio-economic interactions and

exchange of goods between people, the central problem is to do with the movement and interface patterns of spatial arrangements. These patterns allow overcoming the distance between different categories of people, i.e.: between consumers and producers or retailers, or between different categories of producers or retailers. Let us assume, for example, a farmer wants to sell his product in the marketplace, and a resident of the city wants to buy that product. The process of exchange involves here an interface between the two categories of people by using the spatial pattern of movement to overcome the distance either from the domain of production, or from the house of the residence to the marketplace. This simple notion of *interface* explains even how the spatial dynamics are fundamental for a better understanding of socio-economic interactions and behaviours. Therefore, any rigorous study for the actual way in which marketplaces function should bring these dynamics of the layouts, planning and use in its central problem.

The lack in our theoretical understanding of these aspects of marketplaces has already shown its false implications among architectural literature on more recent forms of commercial and retail structures. Their evidence is circumstantial and hearsay.

2 Architectural Fallacies of Marketplace

Among the architectural literature, marketplace is explicitly accepted as a formal or so-called *architectonic* influence on the building types like arcades, department stores and shopping centres. This view is particularly pervasive among the typological studies (Aloi, 1959; Geist, 1979; Maitland, 1985). For example, Aloi explains: "It is important to realise the distinction between these organisms (the market, the shop and the department store) is not always clearly cut. ...If the department store is the most recent of these organisms -which could be interpreted as an assemblage or symbiosis of ordinary single shops- and naturally make use of the most modern techniques, it must be admitted that the most ancient of these organisations, the market conceived as a large covered mall is architecturally the most interesting. This is particularly true, because the covered market is the commercial organism destined to be the most adaptable to those modern structural techniques..." (Aloi, op. cit., pp. 31-32).

Similarly, Maitland, in his attempt to produce a planning and design guidebook of shopping malls, gives a sketchy presentation of the marketplace as the historical origin of the ninetieth century developments of retail structures. He claims: "The retailing function of the city has always provided some of its most memorable and interesting places. Whether encrusting the frontages of its main streets, as at Pompeii or filling the market squares of medieval towns, or condensed along an enclosed thoroughfare as in the Isfahan bazaar... But, if these characteristics of retailing were apparent in the historical city, and substantially reaffirmed with the nineteenth century developments of the arcade, department store and covered market hall, their significance has been dramatically heightened by the shopping mall of the past thirty years." (Maitland, op. cit., pp. 1)

As evident by these studies, the standard procedure to tell the story of a certain building form seems that it should be supplemented with some information about the historical developments along with its other related forms in the same context. Since they are bound up with loosely defined observations at the level of images and appearances rather than more descriptive methods, the result is far less than satisfactory and unreliable. However, even among more specific studies on the topic there seem to be a special problem not only in explaining the built or urban phenomenon descriptively, but also in understanding it. Such studies present themselves as being conditioned by preexisting external determinants. Among them, there seem to be two fundamentally different and pervasive (but similarly paradigmatic) theoretical approaches which strongly holds the explanations of built-forms of marketplaces.

The first approach, exemplified by the study of Hakim (1987), emphasises the idea of a hierarchical spatial model upon the marketplace according to a *symbolic* framework of the form and location in relation to the city's major mosque. According to Hakim: "This framework is based on the interpretation of the trade or product in terms of its perceived or symbolic standing, creating at least a three-level hierarchy according to the accepted proximity to the Jami... As the first levels of the hierarchy are trades or products encouraged locating close to the Jami, such as bookshops and perfume products. In contrast, the second category should be placed farthest away owing to the potentially offensive noise (e.g.: copper making) or smells or to their symbolic content (e.g.: footwear products). The third category is that of products that do not generate any physical offence and symbolically neutral. They can be located with relative freedom within the hierarchy, and examples would be clothes, jewelry, and head-dress products." (Hakim, op. cit., pp. 81)

From a descriptive point of view, this single explanation with its generalisations and abstractions has forced particular cases of urban forms into an ideal type. Loumi's research (1988) on spatial configurations of Arab towns in North Africa, however, presents that the idea of a single-type of urban form based on such hierarchical models is totally unsatisfactory. Besides, the spatial analysis of the twelve Arab towns found across the region suggest that their grid structures present typological tendencies and morphological individualities, as well as generic properties.

On the other hand, the second theoretical approach locates the explanations of such spatially ordered urban forms in the individual *cultural* subjects by holding more cognitive models that built in individual's heads. The study of the traditional forms of Persian architecture by Ardalan and Bakhtiar (1973) exemplifies that attempt whereby it is claimed: "...Cities and buildings, analogous to the forms of nature, appear complete and beautiful at every stage of their growth...Central to this system is the belief that man exists most wholesomely within a physical environment that is analogous to him. The city in his disposition, is thus to emulate the human anatomy which by inverse analogy, relates to the cosmos. As a growing concept, this one that can grow indefinitely, with a multiplicity of geometric elements developing from it, like cells in a body or leaves from the limbs of a tree. The bazaar traditionally begins at the palace precincts, which symbolise the spiritual head of the body. As the bazaar grows, the vital backbone of the city evolves, and the pedestrian streets leading into the city's body proper inserts themselves as ribs... This structural form represents the religious, political, financial and social integration of the traditional city... The identity and boundaries of man, his city and his universe are once again established." (Ardalan and Bakhtiar, op. cit., pp. 89-93).

This second approach -as it might fall into an opposing camp- is more concentrated to provide a methodology of investigating differences rather than a generalisation of particular cases into a single ideal type. However, the built urban form is; first by adopting highly questionable concepts described in the hope that it is analogous to the forms of nature; then its order is sought in the human mind only, but not in the physical environment itself.

On the whole, neither of the two approaches seem to give an answer to more comparative studies of cross-cultural and morphologically distinct configurations (e.g.: regular versus deformed, or concentric versus linear). Both approaches are deterministic in their theoretical positions. Either, the spatial phenomenon is forced to fit into the false analogies and tried to conceptualise by means of culture or any other preexisting non-spatial determinants. Or, the social factors (and the society at large) are given a specific order and hoped that this would create a desired order in social relations.

However, to know a built phenomenon -either architecture or city- requires a knowledge of what it consists of, and that might equally reveal the possible social factors embedded in the spatial form itself, and how these factors work themselves out. Hillier and Hanson (1984) argue for the descriptive autonomy of spatial phenomenon. And, that should not be seen as a simple reflection of a prior social or economic model. They continue: "The built or urban form is defined as real and autonomous, while at the same time originating from the social activity. The inference is that the relation of society to the spatial form is lawful in a large degree, and in order to understand that form the important task is to concentrate on the form itself prior to any presupposition of external determinants." (Hillier and Hanson, op. cit., pp. 198-222) This is equally essential both for our better understanding of building and urban forms -the largest human artifacts apart from society itself (Hillier, 1985).

In review of the literature, what seems clear is that the actual way in which marketplaces function has been poorly understood, and their space has been subject to a great deal of theoretical abstractions and speculations at the expense of socio-economic factors. In fact, there is a gap between the spatial dynamics of marketplaces and their socio-economic implications which require for much precise understanding of the instrumental and symbolic components of their layouts, planning and use. The main objective of this paper is to find out whether it would be possible to bridge this gap by exploring the spatial configurations of two real cases with a methodology adopted from the 'space syntax' theory. As often known, 'space syntax' is not only a set of modeling and analytical techniques of spatial patterns in buildings and cities, but also another theory of space at a level above the individual to inquire the relations between societies and space. In fact, it has been driven from the later point of view, mainly to seek answers to the question: how and why do people and societies acquire themselves a spatial form, and do these spatial forms matter? To explore these theoretical premises vis-a-vis the available spatial theories of marketplaces is also among the aims of this paper.

3 Raw Data on Two Cases

For this exploratory research, two cross-cultural and morphologically distinct cases have been selected: the one from Isfahan with more deformed and linear configuration, and the other from Istanbul with regular and concentric configuration. Before beginning to explain the particular analysis, this section will give a brief historical background of each case along with their general descriptions at an intuitive level. This is only for -if not for any other reason- that the intuitive descriptions will familiarise the reader with the cases and provide a justification for those whom do not have any prior knowledge of them.

3.1 Case One: Isfahan

Isfahan occupies a site, situated near the geographic centre as well as in the largest and richest oasis of Iran watered by the Zayandah River (Fig. 1). However, there is an uncertainty to the details about the origin of the city. After a battle in 643, Caliph Omar and his armies captured the city. During the next three hundred years Isfahan changed hands often, passing from one dynasty or feudal lord to another, mainly of Fars and Iraq (Bunt, 1966, pp. 20). At this time, the city was consisted of two distinct quarters lying about two miles apart: the Jewish quarter called as Yahudieyeh and the original Jay, later known as Shahrestan. In the 10th century, the city was already well known for its silk textiles and flourishing. Later, Yahudieyeh and Jay were enclosed within a single wall, and the citadel -the moats of that are still remains today- was built.

In the 11th century, Isfahan was captured by the Seljuks whom made it later their capital (Khusran, 1881). At this time, the city originated well to the north and east of its present centre soon grew large in favour of the later area, and the Seljuk capital were centered in the region now occupied by the Masjid-i Jami. The old square Maidan-i Qadim extended from the Masjid-i Jami to the Mosque of Ali and the Seljuk Royal Palace (Qa'leh Tabarak) stood to the east of this square. The marketplace provided as the western boundary of the square, and its route shown as a dotted line divided the city centrally.

In 1228, the Mongols captured Isfahan. Unlike all other cities of the further north the Mongols did not destroy Isfahan, but it did not benefit from their patronage and the 14th century Mongol renaissance either. By that time, religious wars that would later make Shi'ism gradually become a great faith and the state religion in Iran had also seriously damaged the city (Battuta, 1929).

In the end of 16th century, with the Safavids the city's most important period began in its history. The old Seljuk city where the clutter of houses had then grown up around the Masjid-i Jami and the marketplace were left as they stood, and the new city began where the old one left off, to the south and west on the site of present Maidan-i Shah. The new square was plotted on a spot towards which the marketplace debauched on the north. Whilst, to the west laid the new palace quarter with the High Gate and Royal Grandstand called Ali Qapu, and to the southeast respectively the Masjid-i Shah (Royal Mosque) and the Masjid-i Shaikh Lutfullah. The new square was at once a market, a religious square, a polo ground and a meeting place of monarch and citizens.

Figure 1. Isfahan (maps after Ardalan and Bakhtiar, 1973)

Today, the marketplace commence at the Masjid-i Jami in the north, move southwards to the old Seljuk square of Maidan-i Qadim where it provides as the western boundary of what had been a great public square stretched from the existing Masjid-i Jami to the also existing Masjid-i Ali on the southwest, and on the southeast was bounded by the Qa'leh Tabarak. Although the old square -used partly today as a vegetable market- can still be traced, it has been entirely built over. No remains of the old Seljuk Royal Palace can be found today. This section was subsequently linked by an extension of the main market street to the new square of Maidan-i Shah creating the Isfahan's existing marketplace that grew in time still further to the southeastwards to the Zayandah River.

Moving out from the southeast portal of Masjid-i Jami into a small square, one is drawn into the market. It forms a linear street domed throughout of its length, parallel to which small shops run on both sides. Between the shops, at frequent intervals, there are the arched entrances of hans (large commercial buildings with mixed-uses including lodgings, shops, storerooms, offices and workshops), medreses (religious schools), hamams (public baths), turbes (tombs), mescits (mosques), timchahs (shopping arcades) and serais (warehouses). Each varies in size, but has been planned -apart from hamams- around an open and central courtyard. Connected to the main market street on both sides, there are also streets leading to the residential quarters of tightly clustered houses. These streets, normally 4-5 meters wide, penetrate the encircling walls through gateways, and subsequently disperse into two lanes in 2-3 meters wide. In each residential quarter aligned to the main market street, small markets, local mosques or shrines, and public baths are to be found to this day.

Near to the southern opening onto the Maidan-i Shah, the market fans out into an interlocking pattern of domed streets and meet the new square. The Safavids built this particular section of the market called the Qaisariyeh. Each street here has its own gateway, and at each street crossing rises a lofty dome over a central fountain pool. To the periphery of the Maidan-i Shah, which is a 165 meters wide and 510 meters long rectangular space, the market spreads with a double-arcade of shops below and niches above. The market also continues behind the sides of the square, in fact, passes it and leads to the southeast of Isfahan.

3.2 Case Two: Istanbul

The first settlements in the Istanbul peninsula date from the late 3000 or early 2000 BC (Janin, 1964). However, the city's known history begins with the first Megarian colony -a community of tradesmen and fishermen- established at the eastern tip of the peninsula during the middle of the 7th century BC (Fig. 2). There were two other Megarian colonies: the one in Chalcedon (called now Kadikoy) on the Asian part of the Bosphorus, the other in Galata on the northern side of the Golden Horn. The Megarian City on the peninsula called Byzantium encircled a small area within the Wall of Byzas, corresponding to the first of the seven hills. Its harbour, the Port of Bosphorion, was laid just beyond the wall on the Golden Horn. The highest point at the peninsula was the centre of the colony, the Acropolis.

The Ancient City, circa 750-330 B.C. The Byzantine City, circa 408-450 The Ottoman City, circa 1460

Figure 2. Istanbul (maps after Celik, 1986)

In 196, the Romans captured the city and destroyed Byzantium's original fortifications. They built the new ones enclosing a larger area within the Wall of Septimius Severus, including the first and second hills, and the harbour.

In 330, when the seat of the Roman Empire was moved from Rome to Byzantium, the city became its new capital known as Constantinople. The main features of the Severan City determined the basic layout of the new capital. But, more than that, a new set of fortifications were built to incorporate the third and fourth hills, thereby quadrupling the size of the Greco-Roman city (Grosvenor, 1895).

During the early 4th century, many residential areas were built in the suburbs outside the Wall of Constantine (Hearsey, 1963; Krautheimer, 1983). This spurt of building activity led to the construction of another set of walls, the Wall of Theodosius. After the 5th century, the city would not expand beyond this wall, and they would define the capital's western boundaries until the middle of the 12th century. But during the same period, the city became filled with forums, monuments, commercial and residential buildings. By the 5th century, the city had acquired three principal forums -the Forum Augusteon (Milion), the Forum Constantine and the Forum Tauri- along its main thoroughfare called the Mese. The Mese extended from the Forum Augusteon towards the west; then passing close to the present site of the marketplace; and having bifurcated, each branch finally leading to a major gate in the city. In addition, later, the Forum Bovis and the Forum Arcadius were also built.

In 1453, with the Ottoman conquest and their declaration as the capital, the city's history entered into a new era. Shortly after the conquest, the city's reorganisation -lasted about a century- began from the old capital of the Byzantiums to the new one of the Ottomans (Celik, 1986). Among the first major tasks of the Ottomans were the repairs of the western boundaries, the Wall of Theodosius, and the remaking of the entire capital into a Turkish-Islamic city. There were also three important buildings erected; the Old Palace to the north of the Forum Tauri, the Kulliye of Mehmet II (religious complex) on the fourth hill, and the Old Bedesten (market hall) siting today in the center of the marketplace.

In the 16th century, with the rapid population increase, Istanbul witnessed another time of great building activity and new neighbourhoods. The city was endowed with many important monuments under the patronage of the Ottomans. During the 17th and 18th centuries, Istanbul continued to develop along the same lines it had in the 15th and 16th centuries. However, due to the gradual decline of the Ottoman power the scale of the development was by no means comparable to that of the previous centuries.

At present, the marketplace is located in the traditional trading district of Istanbul extending from its harbour on the Golden Horn to the Beyazit Square (Forum Tauri). It is also in proximity to the city's main traditional thoroughfare, Divanyolu (earlier called the Mese), which follows a line running along the main ridge between the Square of Hagia Sophia and the Beyazit Square. The Beyazit Square, the only open public place survived to the present from the

Byzantine forums, is located in the vicinity of the marketplace.

The marketplace was first started to be built shortly after the Ottoman conquest of the city, with the construction of the Old Bedesten, and then the New Bedesten (Gulersoy, 1990). However, later the outer walls of the two buildings became aligned with wooden stalls and booths. As their numbers were increased, the rows of the similar ones were built against the opposite walls. At the same time, the narrow streets formed in this way were covered with temporary materials like canvas awnings. But, following a fire in 1701, the market was rebuilt in the masonry and to vault it over without changing the plan of the street network or the number of the shops. Finally, the area between the two bedestens was became completely filled in time. The form of the market today assumes a system of multiple galleries in parallel, yet curiously doglegs in its longitudinal axis. On the lower slopes, apart from shops one can also find the quarter of hans (commercial buildings for manufacturers and wholesalers) which are planned around one or more open courtyards with workshops or shops superimposed on the floors above of warehouses with surrounding galleries.

4 A 'Syntactic' Methodology

The framework of the syntactic analysis was based on two basic tools called *convex* and *axial* maps to model and capture several syntactic properties of the two cases quantitatively. By using the basic tools further illustrations were also made to develop an alphanumeric analysis of these properties and their graphical representations to clarify the spatial configurations in terms of permeability and direct visibility or accessibility.

The convex map breaks up the spatial layouts of urban forms into the two-dimensional extensions of spaces called convex spaces (Fig. 12a). By definition, the convex spaces identify the largest and fewest possible segments that can be fully perceived at one time within the layout. The convex map reveals the 'local constituents' since each segment has a boundary of its own, and it is defined by every point that has a direct accessibility to every other point in that convex segment. Whereas, the axial map deals with the linear extension of the fewest and longest straight sight or access lines that cover all the available connections between the convex spaces (Fig. 3). The axial maps try to capture the overall sense of connections that is available to a possible observer or passerby while moving about the marketplaces, and therefore represent the 'global constituents' of the layouts.

As a direct implication of these two analytic modelling tools, the spatial configurations can be seen in their sense of operating at two different scales at once. Whenever one moves in the layouts, through the convex spaces perceives the local organisation of the space the person is in. But at the same time, through the axial lines of longest sight and access the global organisation of the space is also perceived.

On the basis of the two representation tools, the main aim of the syntactic analysis is to define quantitatively the extent to which each space is connected directly or indirectly to all other spaces in the layout.

5 Analysis: a Multi-Contextual Perspective

The syntactic analysis in this research was carried out to explore the markets at four distinct contexts. These involve the applications of the two basic representation tools on the spatial layouts. At each context, first, the basic tools were adapted and made their convex and/or axial map representations. Then, a series of quantitative analyses based on the space syntax theory and the computer programs (Axman PPC 2.5, written by Sheep T Iconoclast, 1992; NewWave 1.0, written by Sheep T Iconoclast, 1985) were computed to find out the important spatial dynamics. For the reader's reference, all the analytical variables and their definitions used in this paper are given as Appendix at the end.

The four analytic contexts are: **i.)** *Market Within Global Urban Context*, **ii.)** *Market Within Local Urban Context,* **iii.)** *Market as It is,* and **iv.)** *Market and Social Categories*

5.1 Market Within Global Urban Context

The analysis first concentrates on the cases within their large urban contexts to find out how they are related to each city's global systems and patterns of movement. Figure 3 shows the ground maps of Isfahan (1919) and Istanbul (1940) modelled with the internal streets of the marketplaces. The reader should be reminded about the selection of these maps. Since the earlier decades of the twentieth century, the urban layouts of both cities have been subject to a continual phase of replanning and rebuilding activities in the hope that these efforts would produce a 'regularised' and 'remodernised' city planning (Architectural Review, 1976; Celik, op. cit.; Kayvan, 1996). In order to eliminate the implications of this rebuilding phase and to have a more reliable picture of the relations between the marketplace and each city's traditional urban pattern, the maps were chosen from the periods before these transformations. The modelled map, in the case of Isfahan, includes the traditional site of the Seljuk and the Safavid cities to the northern banks of the Zayandah River. Whereas in Istanbul, it covers the Byzantine and Ottoman city's main traditional sites along the Mese thoroughfare from the Topkapi Palace and the Square of Hagia Sophia to the Aquaduct of Valens.

Figure 3 also illustrates the 'axial map' representations of the ground maps, as digitised into the computer. Syntactic analysis of the axial maps produces two kinds of outputs: an alphanumeric data in the form of line numbers with spatial parameters assigned to each; and a graphic data in the form of integration maps in which lines are coloured up in accordance with their value on the previous parameters. Although the later are rough approximations compared with the former, it allows us to have an immediate grasp of the structures of the markets within the global urban contexts.

Figure 4 shows the global 'integration' maps of Isfahan and Istanbul illustrating the distribution of integration in the axial maps. From the point of view of natural movement and global interface patterns, the integration map is the important result of computation. In these maps, the colours of the spectrum represent the integration values of lines from red for the most integrated through to indigo for the most segregated. This allows us to see how integration -a syntactic description of how far a space lies from every other spaces- spread through the urban structure.

Figure 3. Marketplaces and Their Axial Map Representations within the Global Urban Context of Isfahan and Istanbul

One of the important outcomes of the analysis is the strong correspondence between the location of the market and the global integration core. In Isfahan, the computer in the southeast and the central areas selects the 10% most integrated spaces (Fig. 5). These spaces also strongly connect the market's internal streets and its adjacent major public square (Maidan-i Shah, once used as market square) to the southern part of the city through a major axis, called 'Chahar Bagh'. Similarly, in the case of Istanbul, the 10% most integrated spaces also concentrate into the central location in the form of a deformed cross lying next to the marketplace. The core not only picks up several axes hitting the marketplace, but also tends to connect it towards the harbours of the city on the Golden Horn (Eminonu, once called the Port of Bosphorion) and on the Sea of Marmara (the Ports of Kumkapi and Kadirga). On the other hand, the segregated areas of the quite residential zones lie peripherally to the most integrated central areas.

The graphical representations of this correspondence can be better expressed by the alphanumerical data. When looked at the numbers of the 25% most integrated streets, the most integrated spaces of Isfahan pick up at least 15 highly integrated axial lines found along the market streets, which make up the 12% of the global integration core (15 out of 126 lines). Whereas, in Istanbul, the result is 7 market streets picked up by the integration core, and that makes up 14% of all the most integrated axial lines within the core (7 out of 51 lines).

More local perspective is offered by the local (radius3) integration maps. In Figure 6 the urban structures of Isfahan and Istanbul are literally read at a different scale, within their three axial steps. The maps illustrate the distribution of the highest values of integrating spaces (shown by red, orange and yellow lines). The locations and several internal streets of the markets are also captured (shown by lines with black dots at both ends) as locally integrated centres within their global urban contexts.

We can also show that both markets play a key role in creating the part and whole structures within their cities. Since different radii of integration reflect the different scales of the urban structure, it turns out that the important to understanding part and whole is the understanding the relations between the different radii of integration (Hillier, 1996). Figure 7 illustrates on the left the axial maps of the cities with the market streets plotted in black dots. The scattergrams

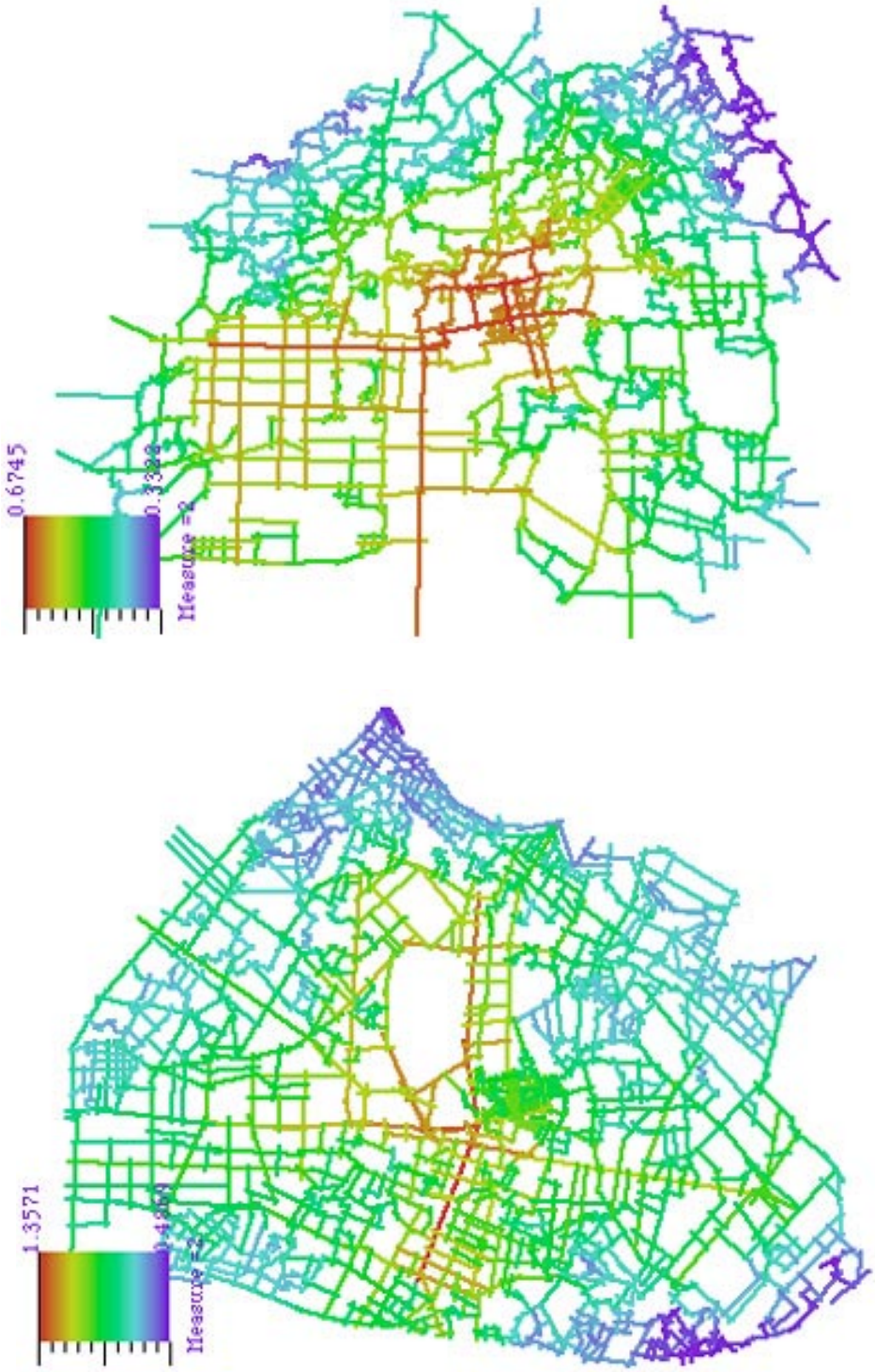


Figure 4. Distribution Global Integration in Isfahan and Istanbul

on the right plot each line in each city's axial map a point located according to its degree of global (radius-n) integration on the horizontal axis and its degree of local (radius-3) integration on the vertical axis. The red points are the lines which make up the marketplaces, and form a good linear scatter about their own (gray at the background) regression line by crossing the main regression line at a steeper angle. The linearity implies a good relation between local and global integration, the steeper slope across the regression line implies that the most integrated lines within the city, which are the lines from the edge towards the centre, are locally than globally integrated. Their local integration is

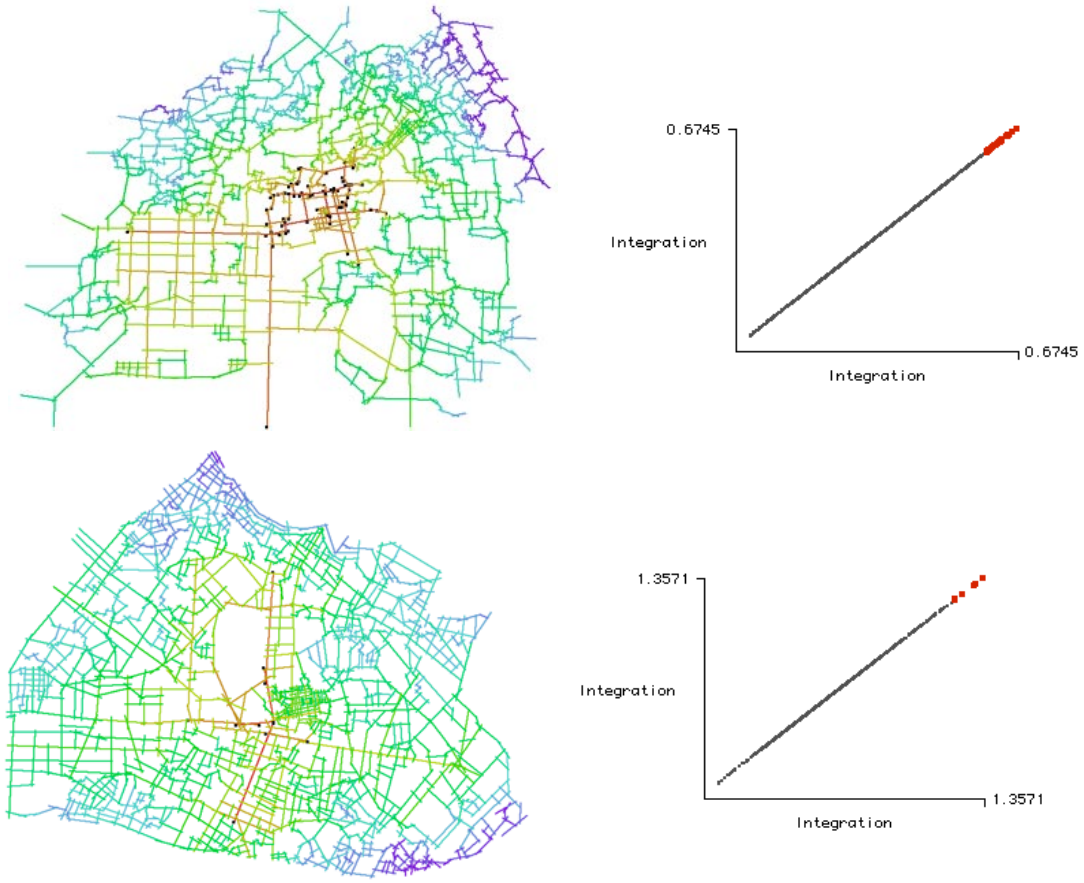


Figure 5. Scattergrams of 10% Most Globally Integrated Spaces (in red dots) and Their Locations (in black dots) within the Contexts of Isfahan and Istanbul

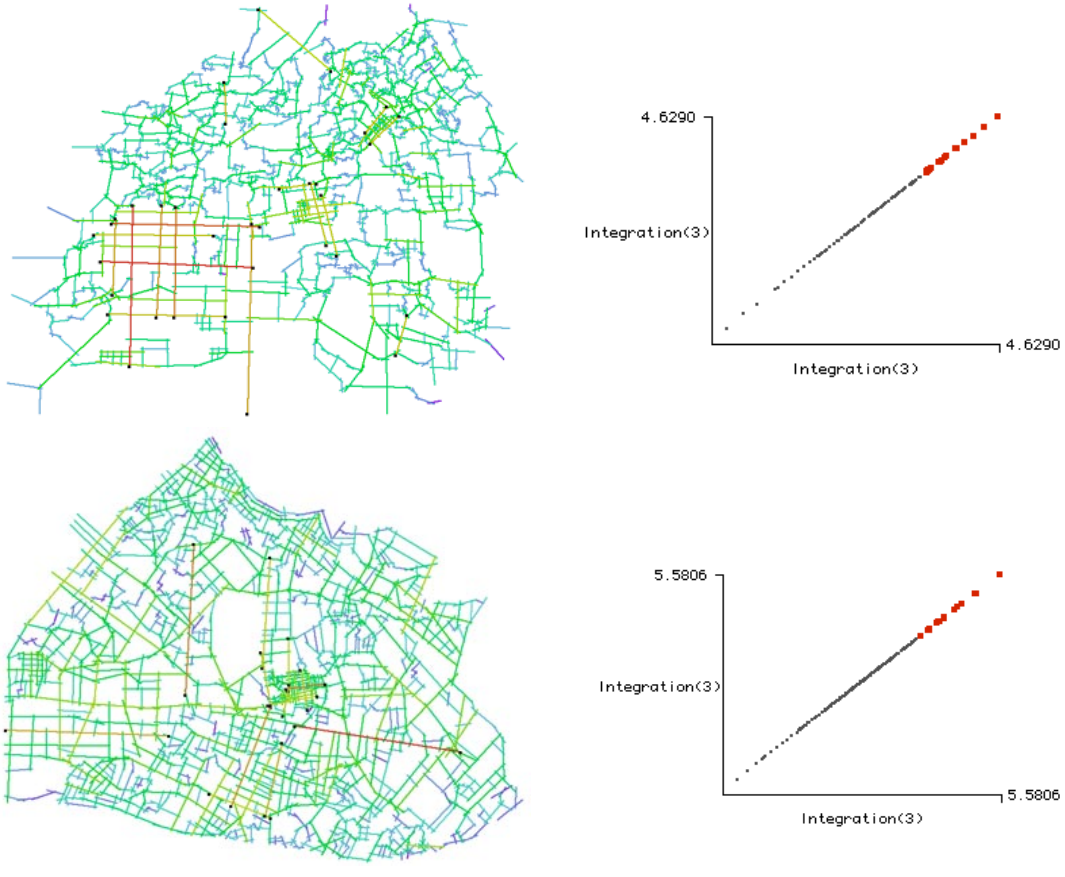


Figure 6. Scattergrams of 25% Most Locally (radius-3) Integrated Spaces (in red dots) and Their Locations (in black dots) within the Contexts of Isfahan and Istanbul

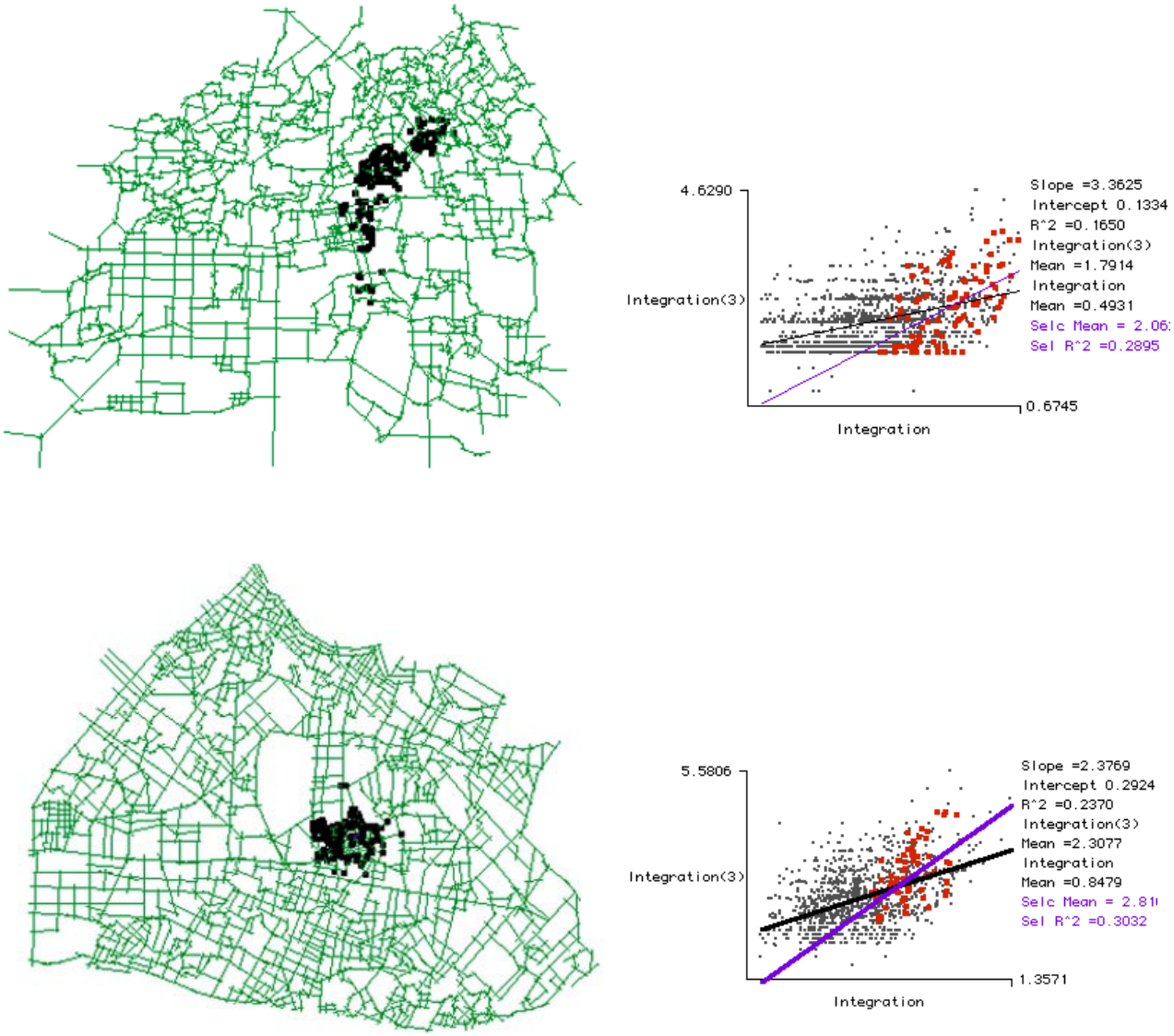


Figure 7. Scattergrams of the Marketsplaces (in red dots) and Their Locations (in black dots) within the contexts of Isfahan and Istanbul

intensified for their degree of global integration. The strong local integrators which define the slope of red points for the local area are invariably these edge-to-centre lines. We find this effect of local area in both cases. It means that as one move along the most integrated lines (like Chahar Bagh in Isfahan or the Divanyolu thoroughfare in Istanbul) then the markets make themselves available as well-structured local aggregations of the urban grid. In other words, they are powerful centres.

5.2 Market Within Local Urban Context

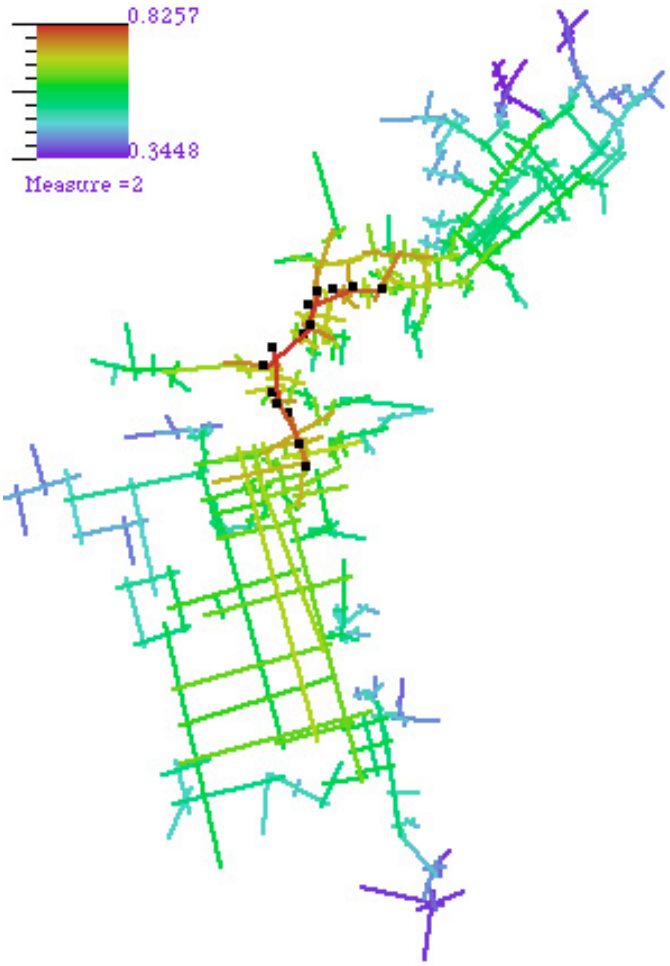
One of the results within the global context was found that the markets emerge as local centres. This was further emphasised here by exploring the cases within their local urban contexts. Figure 8 shows the axial maps modelling the markets into a smaller surrounding area defined within three steps.

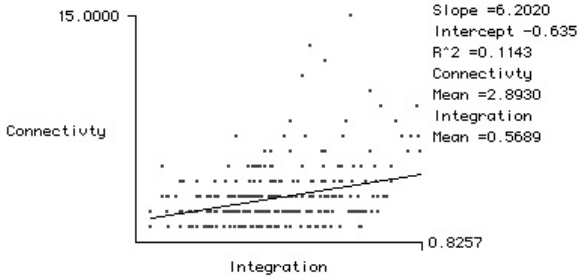
In both cases, the 10% most integrated spaces (Fig. 9) are distributed among the internal market streets only. Therefore, the markets clearly stand out within their surroundings. The integration map in Isfahan (in black dots) primarily selects the linear market route with the penetrating lines from the surrounding area. However, the northeast end of the route, called the vegetable market (on the site of the old Seljuk Square), does not take place in the core. This particular part of the market, despite selected as locally integrated in the global urban context (Fig. 6), turns out to be much segregated. The core winds out by following the market route in the middle, and emerges into the new square (the Maidan-i Shah). In Istanbul, while the 10% most integrated spaces also concentrate into the marketplace, the two major thoroughfares are selected as best integrators.

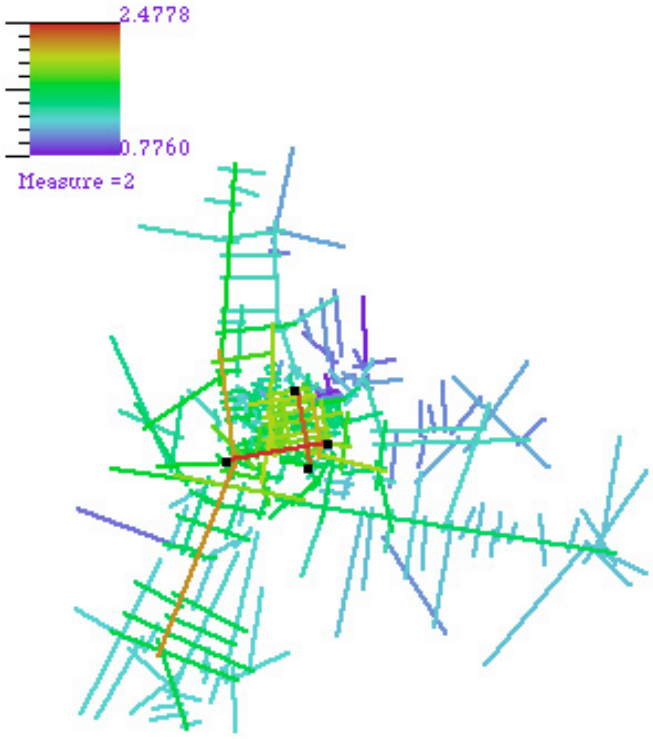
(after Ardalan and Bakhtiar, 1973)

(after Gulersoy, 1990)

Figure 8. Marketplaces and Their Axial Map Representations within the Local Urban Context of Isfahan and Istanbul







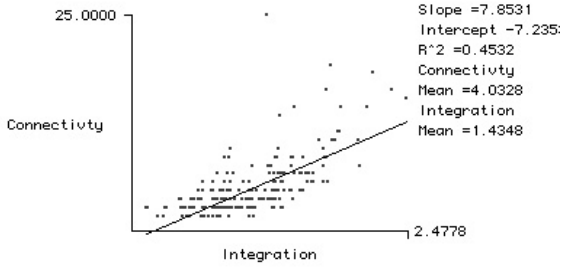


Figure 9. Distribution of Global Integration and 10% Most Integrated Spaces (in black dots) within the Local Urban Context

In this context, as the scale of the analysed areas reduced from the global to the local, it is also noticed that the two urban systems begin to show some differences in spatial properties (Table 1). One of them, intelligibility, is the degree of correlation between the connectivity and integration values of each space. The two systems as analysed in their global contexts had very weak values (Isfahan R2= 0.107, Istanbul R2=0.136). As the analysis shifted into a more local context, the intelligibility values become higher than before (Isfahan R2= 0.114, Istanbul R2=0.453). However, the value of Isfahan is still weaker than Istanbul.

The mean integration (MeanRRA) is also very informative property in terms of seeing the key differences between the spatial structures. In Isfahan, this value was found 0.493 within the global context, which means that the urban system is relatively deep and more segregated than Istanbul (0.848). In the local urban context, the value for Isfahan (0.569) slightly improves, however that is still very deep and more than two-times segregated than that of Istanbul (1.435).

Table 1. Syntactic Properties of Marketplaces within Global and Local Urban Contexts

SyntacticProperties	Isfahan(Global)	Isfahan(Local)	Istanbul(Global)	Istanbul(Local)
No. of Space	1334	327	1186	224
MeanRRA	0.493	0.569	0.848	1.435
MeanConnectivity	3.077	2.893	4.020	4.033
MeanRRA(r3)	0.165	1.723	2.308	2.425
Intelligibility	0.107	0.114	0.136	0.453
CorrelationRRA/RRA(r3)	0.165	0.169	0.237	0.573

5.3 Market as it is

The syntactic analysis in this context was carried out according to the following considerations. First, the markets are considered in terms of their internal configurations. Then, they were explored in two distinct modes: firstly, in relation to the world beyond their boundaries; secondly, in relation to buildings that defines them. It was hoped that the former mode might reveal the interface and movement patterns between the inside and the outside, therefore the relations of the different categories of users (i.e.: sellers as inhabitants or more permanent users and buyers as visitors or less permanent users). Whereas, the later mode might uncover the internal patterns between the different categories of sellers in each market. In other words, it is our hypothesis that the reasons for the morphological differences between the two cases might be of the differences between the interface patterns among the users.

5.3.1 Spatial Relations to the World Outside

In Isfahan, the 10% best integrators (shown in red) are mostly the space outside and those entrance spaces penetrating into the marketplace (Fig. 10). The form of the global integration core is not continuous and deep, but shallow linking the main entrances to the market route only. The similar spaces were also found locally integrated when derived a high correlation of 0.903 between the global and local integration values (Table 2). Meantime, the continuous axial segments of the route hold the highest control values. Therefore, this route becomes the major control core of the market by which not only the shops, but also the entrances of other buildings such as medreses, turbes, mescits are also controlled (Fig. 11). These zones, however, are not cut off from the major route. They immediately open onto it. The similar situation also exists at the near of the south opening and much denser parts of the market onto the Maidan-i Shah.

On the other hand, in Istanbul, the 10% integration core takes the form of a concentric grid, mainly focusing to the internal streets around and through the Old Bedesten with 5 major penetrating axes from the outside (Fig. 10). The space outside is also among the best integrators. The segregated areas where the quarters of hans spread peripherally are not too far from the integration core, but usually one axial step away. From a more local point of view, the 10% radius-3 integration core and its similarity with the 10% global integration core is also striking. Particularly, the correlation between the global and local integration values gives a high R-squared value of 0.950 (Table 2). The control core is held by those spaces located in and around the Old Bedesten (Fig. 11).

In addition, the two markets present some individuality that can be best illustrated by the alphanumeric data of syntactic parameters. The spatial pattern of the market in Isfahan shows a weaker value of intelligibility (R2= 0.211) when compared to that of the Istanbul (R2= 0.656). However, as considered the mean axial integration values, both markets are quite integrated and close to each other in their values (1.724 in Isfahan and 1.781 in Istanbul). A further comparison, which clarifies the previous graphic data (Fig. 10), is among the integration values (RRA) from the space outside. Isfahan has a higher value (3.913) than Istanbul (3.313).

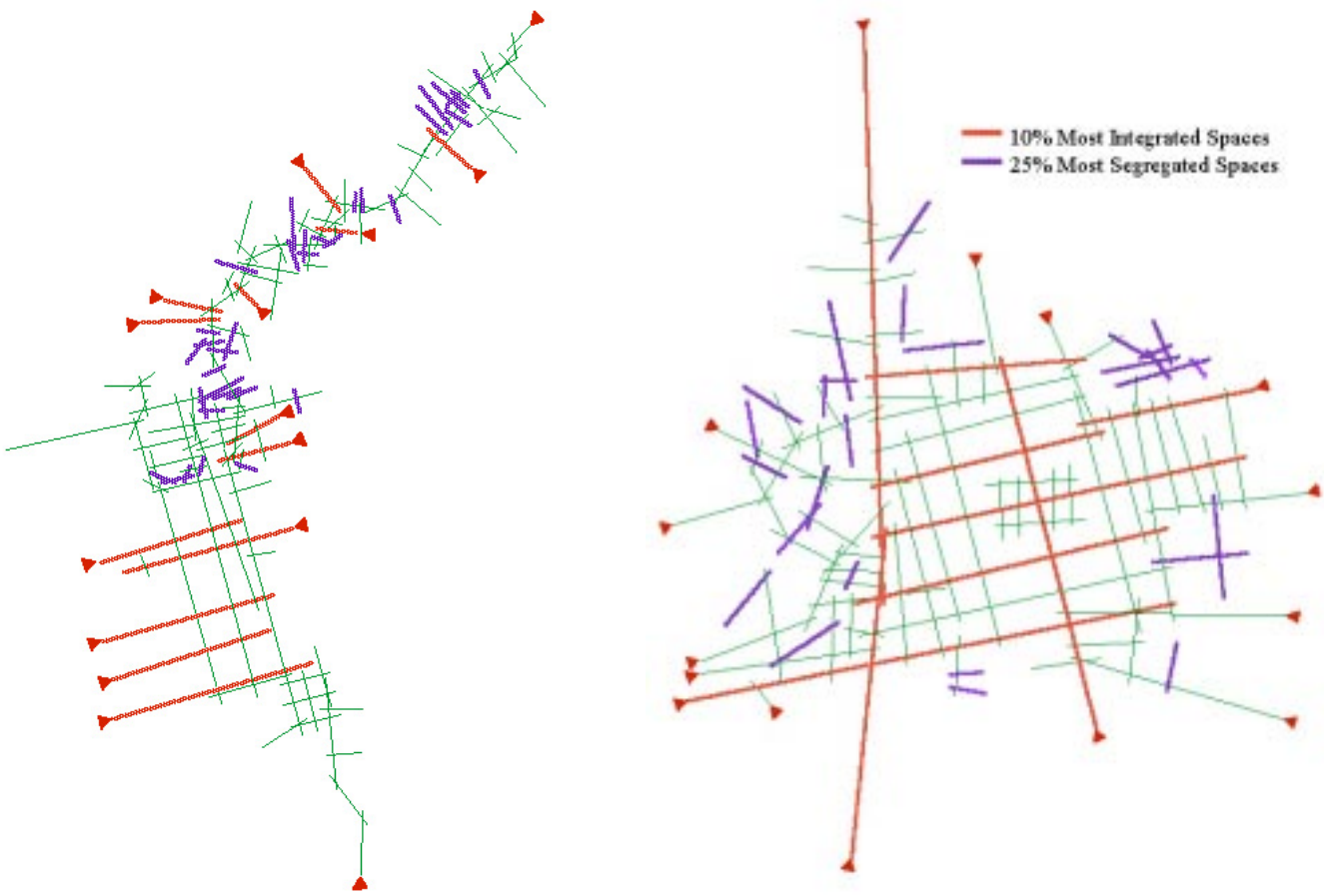


Figure 10. 10% Integration and 25% Seregation Core Maps

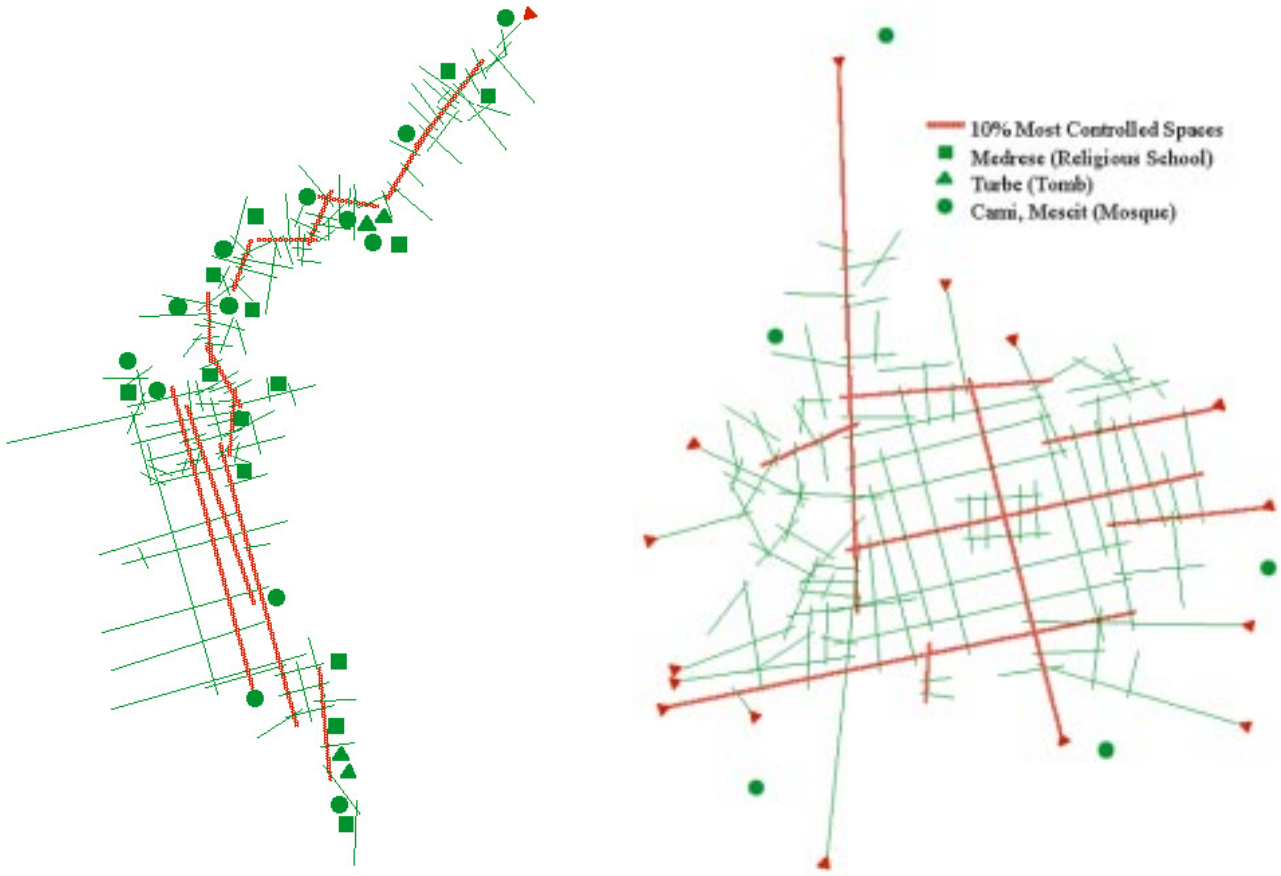


Figure 11. 10% Control Core Maps with Locations of Institutional Buildings

Table 2. Syntactic Properties of Marketplaces in Relation to Outside and within Themselves

SyntacticProperties	Isfahan(Outside)	Isfahan(Inside)	Istanbul(Outside)	Istanbul(Inside)
No. of Space	137	136	102	101
No. of Islands	85	23	95	81
GridAxiality	0.150	0.085	0.212	0.198
AxialRinginess	0.316	0.086	0.477	0.411
Mean RRA	1.724	0.692	1.781	1.595
RRA from Outside	3.913	x	3.313	x
MeanConnectivity	3.474	2.868	4.471	4.198
Intelligibility	0.211	0.123	0.656	0.599
CorrelationRRA/RRA(r3)	0.903	0.189	0.950	0.748

Finally, the graph representations called 'justified graph' (Fig. 12b) developed on the basis convex maps (Fig. 12a) are useful to capture some fundamental differences between the cases. In these representations, circles and their permeable links by lines represent convex spaces, and all the spaces of the same depth value are lined horizontally above the space outside. As a result, in each market system not only the interrelations of permeability between the convex spaces can be seen immediately, but also the relations to the space outside provide a better picture by illustrating the whole at once. At first glance, the convex organisation in Istanbul tends to be more globally distributed among a number of spaces. This tendency might allow routes to form rings across the whole system by connecting different parts of the market. Whereas, the system in Isfahan is not globally distributed as Istanbul. In fact, the rings forming routes and connections between the convex spaces are made at more local levels rather than the global level of the market. The degree of convex ringiness is informative here in order to capture the differences. Particularly, the value in Istanbul (0.204) is higher than that of Isfahan (0.143). In addition, the systems as justified above the space outside can be also compared in their overall convex depths. The market in Isfahan is deep as much as 12 convex steps from the outside, whereas in Istanbul it is as much as 9 convex steps.

Figure 12a. Convex Maps of Marketplaces

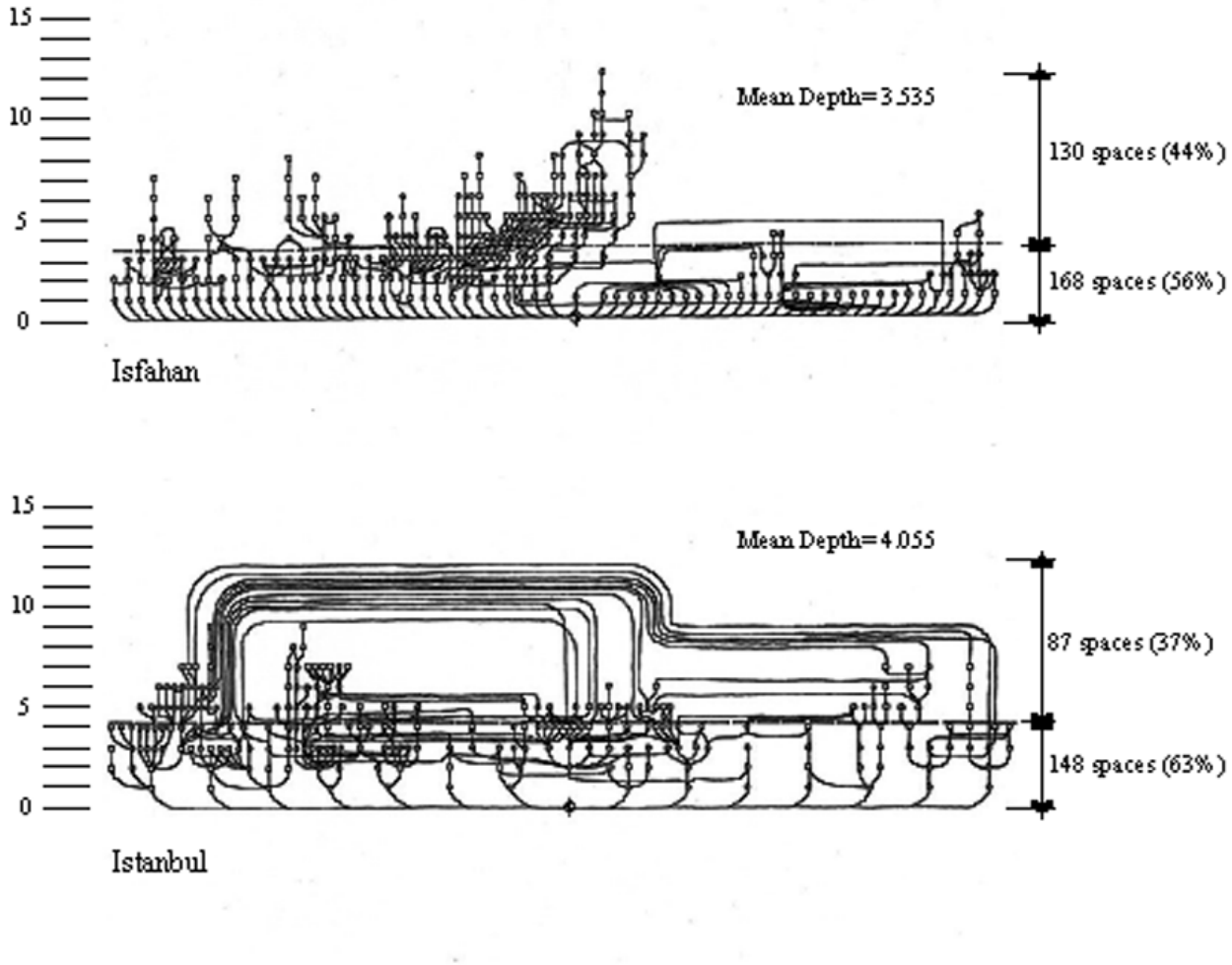


Figure 12b. Justified Graph Representations

5.3.2 Spatial Relations Within

In this part of the analysis, the internal spatial configurations were purely seen within themselves without taking account of the carrier (the space outside). The 10% best integrating spaces in Isfahan form a global core concentrating mainly to the middle part of the market route in the direction of the Maidan-i Shah. The core, however, does not connect the one end to the other (Fig. 13). And, the northeast end of the market, where originated, stays mainly segregated despite being locally integrated. On the other hand, as we have seen in the first mode analysis with respect to the space outside, the high value of correlation between the globally and locally integrating spaces is not the case here. Much lower correlation value of 0.159 suggests that the local centres selected by the local (radius-3) integration core works much effectively over and above the global. Since it is particularly concentrated into the different local quarters (Table 2).

In case of Istanbul, the global integration core is similar to the previous analysis (Fig. 10). The core shows ringy characteristics holding the 10% best integrating spaces together, mainly around the Old Bedesten. In relation to the segregated areas, most of the best integrators are not far, in fact maximum two axial steps away. On the other hand, the strong correlation between the global and local integrating spaces (R2 = 0.782), suggests that the spatial configuration has no much local effect over and above the global integration core (Table 2).

Furthermore, some alphanumeric measures can be emphasised in comparison. For example, the grid axiality gives a good numerical indication of the major difference between the morphological properties. In Isfahan, a low value of 0.085 shows that there is a great degree of deformation. In Istanbul, despite the deformation of the street system towards the eastern edge, a higher grid axiality value of 0.198 indicates that it is a grid-like system as a whole. These values not only support our intuitions prior to the analysis, but also make them rather precise about the morphological differences. Finally, in terms of the mean integration values there is a drastic difference. The market in Istanbul has a higher value of 1.615 compared to that of Isfahan (0.692), which means that it is more integrated and shallow as a whole.

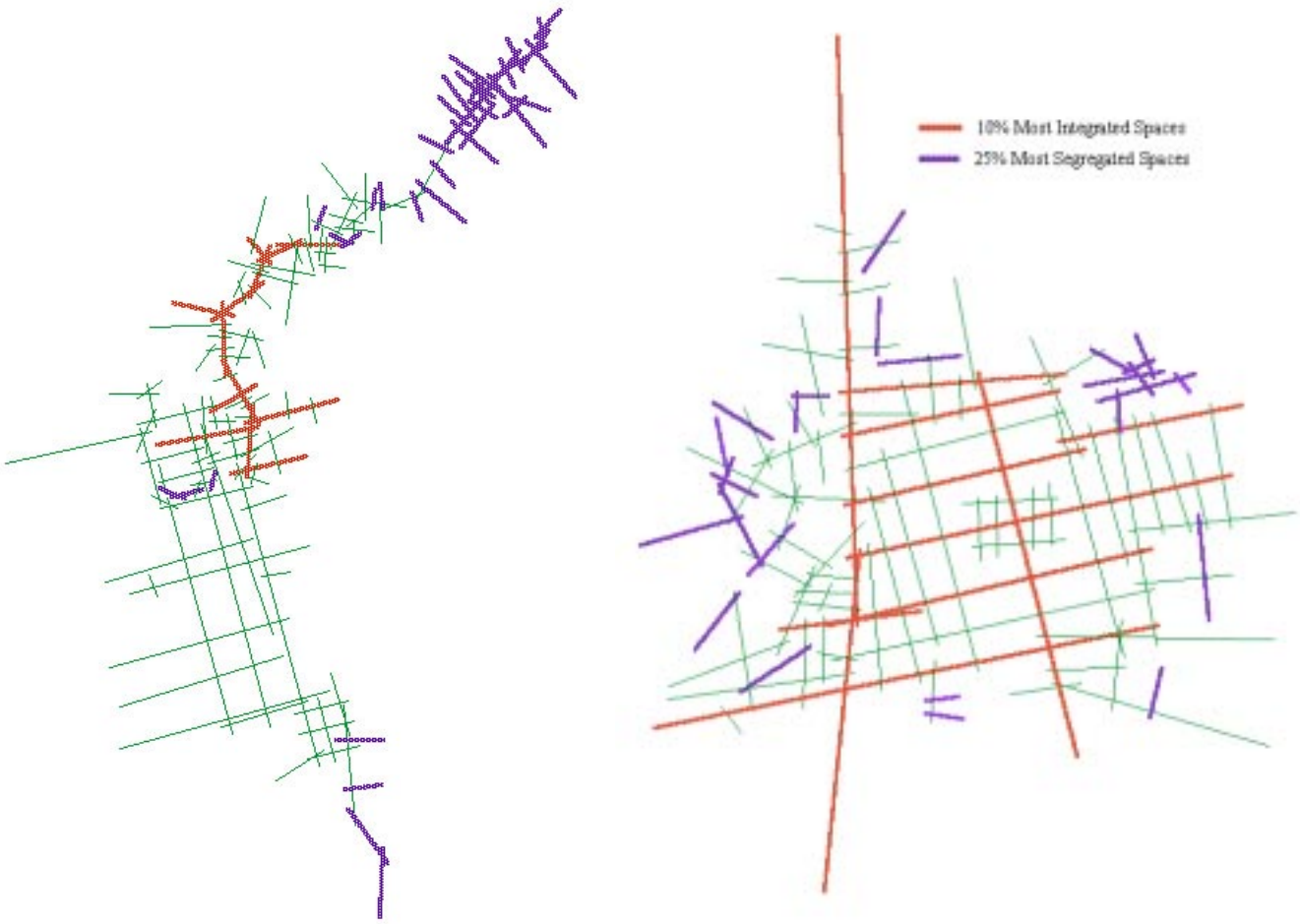


Figure 13. 10% Integration and 25% Seregation Core Maps

5.4 Market and Social Categories

So far, the paper has only considered the spatial configurations of the markets. In this context, it explores the semantics (i.e.: social categories) and their relations with the configurations. In Figure 14, the convex maps illustrate the distribution of trades represented with a colour code where each convex space is allocated according to the type of trade carried out by the shops opening onto that space. The blank spaces show that there is no shops opening onto them. In these maps, there are certain tendencies revealing how the shops and other commercial buildings (e.g.: hans, timchahs, serais and kervansarays) are arranged and their activities are carried out.

Since most of the convex spaces are occupied by the shops carrying out the same line of trade, the spatial allocation according to the different types of trades is manifested in Isfahan with the exception of 5 spaces only (out of 297). The exceptional ones allocating more than one colour refer that there are several trades carried among the shops opening onto these spaces. On the other hand, in Istanbul, the number of these spaces has a higher value of 59 (out of 234) than Isfahan.

When the labels of the buildings examined the institutional or religious buildings like mescits, turbes, and medreses (Fig. 14) frequently punctuate the market route in Isfahan. These buildings have their entrances directly onto the market route. In comparison with Isfahan, there is only one mescit and one medrese within the marketplace of Istanbul. The other institutional or religious buildings are not located inside, but spread outside.

Furthermore, the mean values of some syntactic measures give a more reliable picture of their locations (Table 3). For example, in Isfahan, the maximum percentages of space-use among the total number of 192 convex spaces belong to the shops dealing with products like vegetables, textiles and wholesale in textile. Similarly, in Istanbul, the textile shops are also the maximum space-users. The shops dealing with jewelry, leather-made products, and ready-made clothes follow them. On the other hand, some space-users have certain similarities in nature to each other. The mean integration values show the consistencies in the way in which these users are located in the markets. For example, the dealers in the spices have the highest integration value of 1.655 in Isfahan. The next highest mean integration values belong successively to the dealers in the market for rural shoppers, the coppersmiths and the dealers in the leather-made products and the carpets. Whereas In Istanbul, the highest value (1.226) belong to the dealers in the jewelry. That is followed by the similar space-users to those found in Isfahan: namely the dealers in the copper/silver household and tourist articles, the leather-made goods, the carpets and rugs. The last three also have the highest mean local (radius-3) integration values in their location. In addition, the dealers in the wholesale and manufacturing businesses occupy the locations with the lowest mean integration values.

The locations of both the market for rural shoppers in Isfahan and the dealers in the tourist articles in Istanbul have the highest mean connectivity and mean control values. This means that over and above the neighbouring spaces these space-users have a good connection and the highest control. As far as the mean connectivity measure -another local measure- is concerned, the next highly connected locations in Isfahan are occupied successively by those dealers in the leather-made products, the skilled-hand crafts and antiques, and the coppersmiths. Whereas, in Istanbul, the shops dealing with jewelry, leather-made products, carpets/rugs occupy the other best connected locations after the tourist products like metalwork household goods.

Figure 14. Convex Maps with Trades Distribution

Table 3. Syntactic and Space-use Properties of Trades within the Marketplaces

Isfahan	MeanRRA	MeanRRA(r3)	MeanConnectivity	MeanControl	CxSpace-Use(%)
Textiles	1.031	0.894	2.428	0.986	15
TextileWholesellers	0.97	0.854	2.129	0.957	16.25
Metal&TimberworksCraftsmen	0.798	1.132	2.750	1.112	2
CraftsmeninJewelery	0.990	1.386	2.500	0.889	2
Brass,Aluminium	0.972	1.072	2.562	1.029	8
SheetMetalworks	0.608	1.204	2.600	2.659	5
Coppersmiths	1.445	1.138	4.333	1.985	3
SkilledHandcraftsandAntiques	1.026	1.058	4.818	2.134	6
LeatherProducts	1.416	2.570	7.333	3.109	2
Spices	1.655	3.144	4.000	1.099	0.5
ShopsforRuralShopper	1.466	2.695	9.000	3.833	1
Vegetables	1.128	1.375	2.419	0.727	16.25
Handworks	1.297	1.620	3.580	1.158	17
CarpetandRugs	1.379	2.016	2.666	1.138	2
OtherWholesales	1.121	1.207	2.480	0.990	13
Istanbul					
Textiles	1.160	1.649	3.200	1.017	22.3
TextileWholesellers	0.750	0.802	1.722	0.907	7.0
Metalworks(TouristicProducts)	1.210	1.875	3.950	1.151	8.0
CraftsmeninJewelery	0.790	0.931	2.066	1.050	6.0
Jewelery	1.226	1.910	3.448	1.014	18.0
LeatherProducts	1.184	1.728	3.333	0.900	11.0
ManufacturersinLeathers	0.901	0.951	2.000	0.902	2.0
SkilledHandcraftsandAntiques	0.978	1.516	3.272	0.992	8.0
Clothes	0.994	1.360	2.720	1.076	9.0
ManufacturersinClothes	0.818	0.563	1.000	0.500	0.7
CarpetandRugs	1.179	1.844	3.312	0.927	6.0
Storages	0.878	0.896	1.625	0.808	3.0

6 Discussion

Despite the variations in morphology and geographical locations between Isfahan and Istanbul, one of the important findings of this research is the strong correspondence between the location of the marketplace and the city's global integration core. The integration core is probably the most important super-structure in the urban configuration. Since the core selects the distribution of highly integrated lines of sight and accesses, it is a reliable predictor of how cities generate contact and what kind of patterns of contact they engender. The similar tendency that was found by the ways in which the urban integration cores connect the markets beyond the cities outside boundaries (including harbour areas) provides the access of products and services as well as strangers of the cities into these trading arenas. Meanwhile, as some authors claimed (Hakim, op. cit.), the residences are not hierarchically separated from the markets. They are relatively near them by living in the peripheral locations. This suggests that a strong natural interface is likely to take place between the residents and the strangers in the marketplace where products and services are offered. That will, in return, reinforce an even stronger probabilistic interface involving an 'exchange' relationship between the seller and the two different groups of buyer (the strangers and the residences). In other words, the close correspondence between the location of the marketplace and the global urban core confirms that the concept of 'centrality' on the basis of the integration has a robust and much precise role. This finding, particularly, goes against the view of the centrality of marketplaces based on the notions of *geographical location* and *distance* adopted by the authours of the quantitative and economic geography (Christaller, op. cit.; Losch, op. cit.).

From a more economic standpoint, the 'exchange' interface between the seller and the buyer is important. In the distribution of products, there seem to be two conventional methods; one can either offer the products at the marketplace to which the consumers come (i.e.: shopkeeper); or travel with the products and offer them to the consumers at his residence (i.e.: peddler). The former mentioned leads necessarily to the development of marketplaces, and equally makes their physical layouts crucial. Whereas, the later mentioned does not require any marketplaces in conventional sense. Yet, today's products are more often offered on the market and not by peddlers. With the sale of large quantities of products, complicated accounting and organisation, not only the production but also the offering necessitates an increased capital investment and demands a permanent as well as globally integrated marketplace. The required increase in capital investment is made only possible through the transfer of production from a customer-oriented production to an anonymous market-oriented production. In other words, that is through the free interface of buyers and sellers in the economic activity.

Meanwhile, both markets are the traditional cores of agglomerations located today within the larger site of

commercial districts. The correspondence found in the more local urban context between the traditional market street network and the integration core have suggested that the markets also stand out, to even a greater degree. They are the local centres of economic agglomeration where both production and offering of products have been traditionally carried out at one place. By strong integration, as the natural movement patterns are channeled into their streets, they can also take control of the overall commercial movement within their larger trading districts. From the shop-owner's point of view, this agglomeration at a highly integrated location can be seen as advantage to cut the production or marketing fees comparing to the same activities carried by scattered shops. In addition, individual shopkeepers or craftsmen who own the means of production can get together and act politically as members of a larger form of solidarity based on the division of labour (Durkheim, 1968).

The spatial relations within each market, on the other hand, have revealed the interface patterns between the different categories of users. Both markets are highly integrated from the world outside their boundaries. Especially, the evidence of a shallow core connecting the main entrances into the major market streets suggests that the maximum movement traffic in and out of the markets will take place freely at these spaces. Inside, the inhabitants will control the movement patterns of the visitors, or the shop-owners; therefore the local and the global parameters correlate each other. However, there seem to exist different ways of achieving this control and the movement patterns.

In Isfahan, there is a stronger relation between the social categories of shop-owners or craftsmen and their spatial distribution than in Istanbul. This strong relation organises the spatial distribution of the social identities in such a way that it somehow reflects the division of labour within the marketplace. It also reinforces the local aggregations, and keeps the shop-owners strong. For example, the evidence of several religious or institutional buildings like mescits, turbes, medreses located in close local relation to each trade activity, their segregated locations in the market's global street network, and the strong control over their boundaries, all emphasise the local guild membership in the same trade. The encounters among the same guild members are intensified through the direct spatial links rather than the global links across the market. Commercial encounters between the seller and the buyer, however, take place in the major market route. The strong spatial relation between the mescits and the guilds in which the shops are often incorporated also indicate the close ties between the religious and commercial life. This might suggest that the socio-spatial agglomeration of the guild members be based not only on the economic grounds, but also on the religious and ethics. In fact, the religious buildings provide a sanctuary for the same guild members who frequently gather to pray together, thus reinforce their membership ties. Connected with the mescits, the medreses are for the training of younger members to become apprentice tradesmen or artisans in the same guild. These segregated areas are the places where normally the visitors or buyers have less access. Yet, their quiet locations are achieved without totally isolating them from the major market street into which the movement of all visitors is channeled.

In Istanbul, on the other hand, the correspondence between the social categories and their spatial distribution is sparser than in Isfahan. Since several locations within the market are shared among the different trade members, particularly, the tendencies towards the closed spatial locations and the categorical purity of local guilds are weaker. On the other hand, we cannot find strong and locally distinct relationships between the trades and the other institutions. All of these suggest that the solidarity among the shop-owners or craftsmen seem to be based on the economic grounds more than the religious or ethics. This would allow, however, all users whether buyers or sellers to interact one another by using the same movement pattern, which is more globally distributed and intelligible than that of Isfahan. Hence, there would be created much denser global structure and overall control across the market.

Along with the differences, the two markets also reflect certain consistencies in the shop-owners perceptions. For example, the shops selling products that are more popular among the consumers (including tea, coffee, spices, carpets, leather-made products, copper-silver household or tourist articles, products for rural shoppers) occupy the most accessible locations from the outside to draw a potential from the maximum natural movement. The same shops are also located in highly connected areas to their neighbouring quarters of trades. And, this might lead us to the notion of 'related selling' whereby the customer is persuaded to make another purchase from the next shops selling different goods. The shops involved in wholesale and manufacturing are mostly located in the deepest and the least accessible parts of the markets since they offer their products in large quantities.

7 Conclusion

In this paper, an attempt has been made to explore what there is to be known about the space of marketplaces. The available studies of marketplaces have shown that their spatial aspects are often idealised, and the departure point is mostly taken as some abstract concepts or non-spatial factors like socio-economics. But, these factors prove to be so basic and generalised, thus cannot yield about the link between the space and their socio-economic implications. There are no doubts that in commercial activity people need to exchange their products to ensure their economic survival. However, what is even more important in the study of marketplaces is how economic behaviour ordered in society, as well as in spatial relations by rules restricting trades, movement and interaction patterns. This information is, in return, often shared and taken for granted by the members of society. Therefore, it is to a great extent social behaviour, which is reproduced, in everyday spatial relations.

The paper has shown that this is also true for the space of marketplaces. Their spatial configurations explored from a multi-contextual perspective are predominantly related to the social relations. Knowing the ways in which this is actually done is even more crucial to understand the differences between the cross-cultural examples. The examination of the two marketplaces in Isfahan and Istanbul has revealed that the morphologically distinct cases have certain instrumental and symbolic means that are to do with organising movements and interfaces involving the socio-economic interactions among people. However, they are also strongly related to the two different ways of social structuring of space. More awareness of the spatial dynamics seems inevitable to obliterate what is of the actual in the space of markets, as well as to evaluate their implications on the design of new building and urban structures.

Appendix

i. Justified graph and the notion of 'depth'

A justified graph is a representation in which convex spaces (or axial lines) of a building or settlement system (S) are shown by circles and their permeability by lines, and all convex spaces of the same depth value are lined up horizontally above the space outside called 'carrier'. Every convex space in the layout can be assigned a depth value according to the minimum number of steps that must be taken to arrive in that space starting from the carrier. A step is defined as a movement from one space to another.

By definition, the depth between two spaces *a, b* of a system *S* is noted as *D (a, b)*. It is equal to the minimum number of connections that must be used to reach *a* through *b* or vice versa. Thus, the depth is a non-metric distance measure, and about the properties of separation or integration in the system.

ii. Mean depth value (MD)

Mean depth is a general indicator of the depth of a system from the carrier or from a particular convex space (or axial line). The mean depth from a space *a* in a system *S* is defined by the expression:

$$MD(a,S) = \frac{\sum_{bi \in S} D(a, bi)}{\sum k-1}$$

k is the number of spaces in system *S*.

iii. Connectivity

This configuration variable defines how many other spaces is only one step away from each convex space or axial line. It is calculated by counting the number of connections that each space has to its neighbouring spaces. The higher the connectivity value, the more a space is connected to neighbouring spaces. Connectivity is a local variable since it takes into account the relation of a space to its immediate neighbouring spaces only. To describe a system as a whole, the mean connectivity value of all its spaces can be also used. This basically refers to the average connectivity of each space.

iv. Control value

Control value (CV) expresses not only the number of neighouring spaces a space has, but also the extent to which that space can control access to its immediate neighbouring spaces. Therefore, this variable is an extended version of connectivity, and another local measure. This is calculated by first giving each space a value of '1', then each space distributes that value of '1' equally among its 'n' number of neighbouring spaces (1/n). Spaces with many neighbours gain more than they give away, whereas spaces with few neighbours will give more than they gain. Values are, finally, summed up for each space to find their respective total control value. Spaces which have a control value larger than '1' will be strong in control those below '1' will be weak in control.

By definition, the control value of a space *a* is given by the following expression:

$$CV(a) = \sum_{D(ab, b)=1} \frac{1}{\text{Val}(b)}$$

Val (*b*) is the number of connections of a space *b*.

v. Integration: Relative asymmetry (RA), Real Relative Asymmetry (RRA)

Integration identifies how well integrated or how segregated each space are in relation to all other spaces in a spatial configuration; it is therefore a global value. A space is integrated when all the other spaces in the system are relatively near and few intervening spaces must be traversed in order to reach from one space to another. Whereas, a space is segregated when all the other spaces in the system are relatively far and large number of intervening spaces must be traversed in order to reach from one space to another. The integration of a space *a* in a system *S* is calculated by, first, counting the mean depth (see above) in terms of how many steps must be traversed to get to every other space in the whole system. This number is then put into the following expression where the *RA (a, S)* (Relative Asymmetry) value is calculated:

$$RA(a, S) = 2\ [MD(a, S)-1)]\ /k-2$$

MD (a, S) is the mean depth value (see above) and *k* the number of spaces in the system. For all *a, S* : $0 \leqq RA(a, S) \leqq 1$

Finally, the RRA (Real Relative Asymmetry), which is the integration value is calculated by dividing RA value with "diamond value" (see Hillier and Hanson, 1984) in order to make the value commensurable throughout any size of spatial systems. The RRA of a space *a* in a system *S* is expressed as follows:

$$RRA\ (a, S) = \frac{RA\ (a, S)}{RAD\ (k)}$$

k is the number of spaces in system *S*, and *RAD* (*k*) the diamond valuewhich is calculated as follows:

$$RAD(k) = \frac{6.644k \times \log10\,(k+4) - 3.17k + 2}{k2 - 3k + 2}$$

To describe an urban street system as a whole, the mean integration value of all its spaces can be also used.

vi. Restricted integration (integration3, or RRA.r-3)

This is a restricted version of integration variable computing the integration for all spaces in a system within their three steps, therefore is more local measure than the global integration. Higher values indicate more segregated spaces in terms of their local areas within three steps, while smaller values mean more integration.

vii. Relative axial ringiness or Relative number of axial rings (RR)

The term called 'ringiness' refers to the formation of rings of spaces (, or lines) in a system. The measure of ringiness captures the number of circulation loops in the system, thus allow ‘ringy or us to state how much the global structure of the system is distributed' among the spaces. The relative ringiness is defined by the following expression:

$$RR = \frac{2k-5}{L - k + 1}$$

L is the number of connections in the system, *k the* number of spaces in the system, and *(2k-5)* represents the maximum number of independent planar rings in a graph of *k* spaces. Lower values indicate higher degree of relative ringiness.

viii. Intelligibility

A spatial configuration's intelligibility is an important phenomenon to architecture. The space syntax defines the intelligibility of layouts in terms of the relationship between the local and global properties. This definition suggests that a spatial system is intelligible, or understandable, when the information which is directly available (connectivity) to the user gives a good sense of position with regard to the layout as a whole (integration). Intelligibility addresses the way people can learn about large patterns from their experience of small parts. It is a spatial variable, which describes a layout system as a whole. Intelligibility is defined as the correlation between the integration and connectivity values. The precise measure of intelligibility is the linear correlation between the integration value and the connectivity of all the spaces of a system. The higher the correlation the more one can infer location within the layout system as a whole according to directly available information.

ix. Axial integration of convex spaces

This measure gives the comparison of the number of axial lines to convex spaces.

$$RA\ (ax/cx) = Lax / kcx$$

*k*cx is number of convex spaces, and *L*ax number of axial lines crossing all convex spaces.

Lower values indicate a high degree of axial integration of convex spaces. It should be noted that the result is a number between '0' and '1'.

x. Grid axiality (GA)

This variable allows making the comparison of each axial system to an orthogonal (perfect) grid with the same number of islands. Therefore, by this comparison that can be stated the difference between the order properties of the two axial systems unequivocally in their numerical forms. The GA is defined as follows:

$$GA = \frac{(\sqrt{I} \times 2) + 2}{Lax}$$

I is the number of islands and *L*ax= number of axial lines.

The result is a value between 0 and 1, where higher values indicate a stronger approximation to a perfect orthogonal grid and lower values a greater degree of axial deformation.

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