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THE SOCIO-ECONOMIC IMPLICATIONS OF THE SPATIAL CONFIGURATION IN GREATER CAIRO METROPOLITAN AREA

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Abstract

The aim of this paper is to present the implications of the physical urban form on the socio-economic aspects of the Greater Cairo Metropolitan Area. The purpose here is to understand the relationship between the socio-economic conditions of a settlement and its overall spatial structure. The spatial characteristics of socio-economically disadvantaged areas were compared with the rest of the city to explore the reasons behind in-equality in socio-economic aspects from a syntactic point of view. As it turns out, these disadvantaged areas have a strong internal spatial structure, but lack external integrators that link them to surrounding areas and the whole city. When correlating social and spatial factors, socio-economic differences are significantly correlated with the spatial structure of the street network. For instance, the regression analysis shows a strong correlation between literacy and crime rates, and angular global integration values. However, this is not the case for local integration. As such, poor spatial structure is a key factor of impeding development in areas of deprivation. Therefore the role of spatial configuration needs to be put on the agenda in future master plans of Cairo.

Keywords: *Space Syntax, socio-economic differences, informal areas, Segment Analysis*

Theme: *Urban Space and Social, Economic and Cultural Phenomena*

INTRODUCTION

The urban transformations of the Greater Cairo Metropolitan Area have been described extensively in terms of urban society, spheres of activities, architectural style, and building conditions (Mohareb, 2009); even the impact of Cairo's urban fabric on the degree of deprivation has been confirmed qualitatively (DRTPC, 2009). However, there exists hardly any quantitative analysis concerning the socio-economic implications of Cairo's urban morphology. The aim of this paper is to present the implications of the physical urban form on the socio-economic aspects of the Cairo metropolitan area.

Several studies of European (Vaughan, 1999; Vaughan et al, 2005; Legeby, 2010) and South American cities (Greene, 2002) show that spatial segregation could lead to economic marginalization and social exclusion. As implied, a city's highest globally integrated areas will then be the richest areas and the globally most segregated areas will then be the poorest areas. However, in cities in the less-developed world like the Cairo metropolitan area, the poor areas − for example, historical centres − tend to be along the highly integrated streets (Sims 2003 in Piffero2009), while the richest areas are located along the highly segregated streets, voluntary segregation. This phenomenon could be a result of Cairo's fragmented development process (Abu-Lughod, 1971; Raymond, 2001; Salheen and Attia 2003; Sims, 2009).

Many scholars acknowledge the processes of rural-urban migration as a key factor affecting urban growth and urbanization (Pacione, 2005). Several studies show that people move to cities for economic reasons. Conversely, rural issues, such as surplus labour result from urban growth, usages of mechanical farming systems, and pressure on land through subdivision of plots and push people to out-migration. Urban factors such as higher wages in cities motivate people to rural-urban migration (ibid). These causes of migration have a spatial impact, which in turn affects socio-economic aspects of migrant dwellers (Vaughan, 1999).

Rural migrants are usually illiterate, with almost no education, and unskilled. In the cities, they are absorbed into odd jobs provided by the informal market and forced to settle in the lowest rent areas, as they cannot afford home ownership. Upon their arrival, migrants settle at any price near the city centre to be closer to the job opportunities. Later on, when the migrants' socio-economic circumstances improve, they tend to move to the periphery, where the cheapest houses are available (Davis, 2006; Barros, 2004).

Several studies show that the majority of slums consist of migrants living in high population density with poor, overcrowded housing and an inadequate infrastructure. Migration is often associated with the formation of slums, in particular when the authorities poorly coordinate the urbanization process. Often the absence of good strategic urban planning leads to the formation of fragmented and heterogeneous patterns of planned and spontaneous settlements (Sobreira, 2003). In cities in the less-developed world, the poor areas tend to be located in the highly spatially integrated streets, while the richest areas are located along the highly segregated streets (ibid). If this is the case, why do these poor areas not benefit from their strategic spatial location in the long term? What, then, is the relationship between the socio-economic degradation of a settlement and its overall spatial segregation?

To answer these questions, we investigated Cairo metropolitan areas with the space syntax method. We compared the spatial characteristics of disadvantaged areas with the rest of the city to explore, from a spatial point of view, the reasons behind socio-economic inequality. Then social factors of illiteracy, unemployment, crime, and poverty rates are correlated with the spatial parameters through the use of GIS to reveal the extent to which they are related.

Space syntax measures quantitatively the spatial properties of urban segregation. The idea is that social information is embedded in the spatial configuration of urban space. According to space syntax research, the urban grid of any city will show that it is made up of a dual network:

the foreground network, comprising few longer lines representing main routes, and the background network, comprising a large number of shorter lines representing residential streets. Urban centres emerge where there is a high degree of congruence between these two networks (van Nes and Stolk 2012); the phenomenon has been referred to as “pervasive centrality” (Hillier, 2009; Al Ghatam, 2012).

The spatial structure of the urban street grid shows the distribution of the potential movement routes of people. As research has shown, spaces with high syntactic values generate higher co-presence and interaction than spaces with low values. There exist two different measures of potential movement in the urban street network: to-movement potential (closeness centrality or syntactic integration), or the potential accessibility of a segment regarding to all others; and through-movement potential (betweenness centrality or choice), or how likely a space will be crossed with respect to all other pairs of segments (Hillier, 2009). The syntactic measures of each segment can be applied in relation to all other segments in the system, on a global scale or specified to local distance. In other words, the type of the syntactic attributes, whether global or local, will vary according to various radii, where a large radius indicates more of a global extent of the measures. Space syntax uses three weights of distance: the metric distance, which defines a street network by the shortest paths; the topological distance, which calculates a street network in terms of fewest turns; and the geometrical distance, which measures a street network regarding to least angle change.

Step depth (or point depth) measures how far a line or a segment is from the selected root line or segment in terms of topological, metric, or geometric distance. Angular step depth calculates the shallowest angular path from the root segment (or segments) within the system, and records the path length on the segment (Turner, 2004: 25, 28).

As several space syntax studies show, there is a strong correlation between the spatial configuration of the urban fabric and socio-economic conditions (Hillier et al 2000; Greene, 2002; Vaughan, 1999; Karimi and Parham, 2012; Rodriguez et al, 2012). Like these studies, our research aims to understand the implications of Cairo’s urbanization process from a spatial configurative point of view by revealing how both space and society are interlinked in cities of the less-developed world. The main premise here is that the spatial configuration of settlements is an important factor in creating more developed areas. As research has shown, the spatial configuration influences the movement patterns in streets and therefore affects the location of economic activities. These urban transformation processes are called “natural movement” (Hillier et al 1993) and “movement economy” (Hillier, 1996).

2. Methodology

This inquiry uses several data sources for the case study to correlate the spatial parameters with the socio-economic variables. These include: survey maps from GOPP (General Organization for Physical Planning), and demographic data obtained from Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS) and from Human Development Reports (HDR, 2008) and Public Security Bureau (PSB).

The 2012 map of Cairo is acquired from a road-centre line map[1]. According to the 2012 map, the study area excludes all new urban communities and covers only about 498 square kilometres of the main urban agglomeration of metropolitan Cairo rather than its gross area within the administrative boundaries [figure 1].

The study includes the following. First, the segment map of the city is analysed by UCL

[1] Even if a good satellite image for the whole Cairo were available, constructing an axial map for the city would take too much time. Nevertheless, the road-center line map was corrected in ArcGIS using advanced editing tools, and all vertices were checked and all arcs were generalized.

Depthmap using angular analysis. Parameters of angular integration (NC/MD) and angular Choice (log (CH+2)) were calculated at different metrical radii from local to global: 500, 800, 1200, 2000, 5000, 10000, and n (infinity). In addition, angular step depth from the segments with higher topological choice on local and global scale was measured to investigate the spatial properties of the city. Second, different key attributes of socio-economic indicators such as illiteracy, percentage of people living below the poverty line and unemployment rates[2] were then integrated into MapInfo and ArcGIS for socio-spatial studies. Finally, the results from the spatial configuration analyses were visually overlapped with maps of the socio-economic conditions and statistically correlated using the JMP software.

Figure 1 Map indicating the study area within Greater Cairo Metropolitan 2012**.**

. Morphological analyses

Figure 2 shows the global angular integration analysis of Cairo in 2012. The model highlights the significance of the west-east corridor starting from Mohandseen in the west to Heliopolis in the east, where the red, orange and yellow lines can be seen. These highly integrated lines are located within the residential areas for the high-income dwellers. On the other side, the green and blue patches of segregated settlements are located mainly on the peripheries and along the railway track. These areas appear vividly in the entire city. Initially, these patches show large fragmentations of the city, and correlate with the settlement pattern of various social groups, which differ considerably from each other from a socio-economic perspective.

[2] These indicators were selected according to data availability.

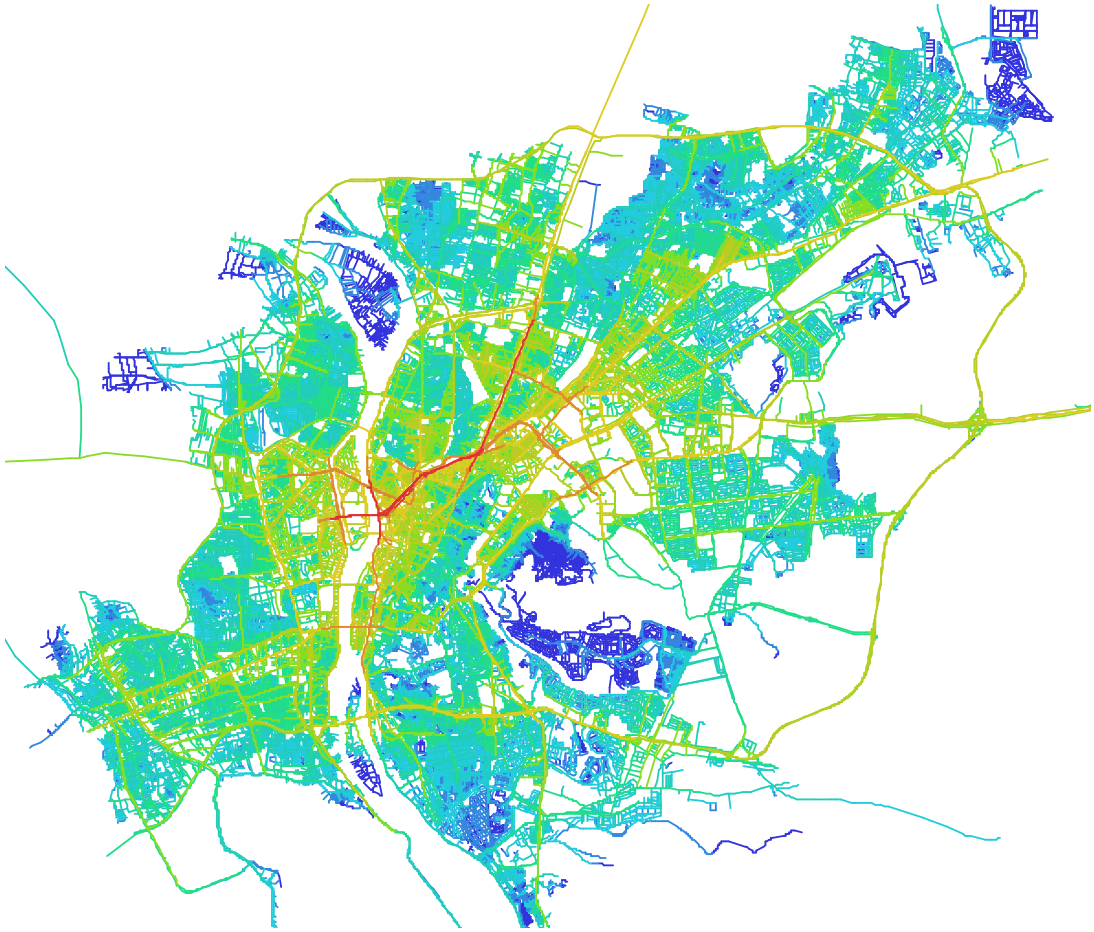


Figure 2 Angular global Integration of Cairo 2012.

3.1 Cairo's integrated core

Figure 3 shows the integration cores of Cairo at various metrical radii, with the ten per cent most integrated lines marked in red. In the case of radius n, a "deformed wheel" structure is shaped by the highest integrated lines. The strong integrators (the spokes) link a semi-grid of short lines in the central area (the hub) to lines on the edge of the city, the ring road – the rim (Hillier, 1996: 137). The ring road has a high integration value at radius n, which corresponds to the high amount of vehicular movement. This explains why such a global integrator of the city, the ring road, loses its integration at local scale. The local scale corresponds to short trips. However, it is also clear that Cairo CBD has high integration values at global as well as local scales, which explains its high degree of vitality. Nevertheless, Cairo CBD loses some of its integration when the radius decreases. The integration core of Cairo moves towards the northeast with a low radius. It is noteworthy that the historical area, Fatimid Cairo, is not highlighted at all in the integration analyses with different radii. In fact, the plan of that area, in general, consists of narrow and curvy streets with frequent dead ends showing that the settlement's buildings were placed with few considerations of street connectivity. Seemingly, the irregularity of the city's road network fits the absence of wheeled transport in Cairo at the time (Raymond, 2001). These spatial conditions may explain why this area is deteriorating and has inferior socio-economic conditions.

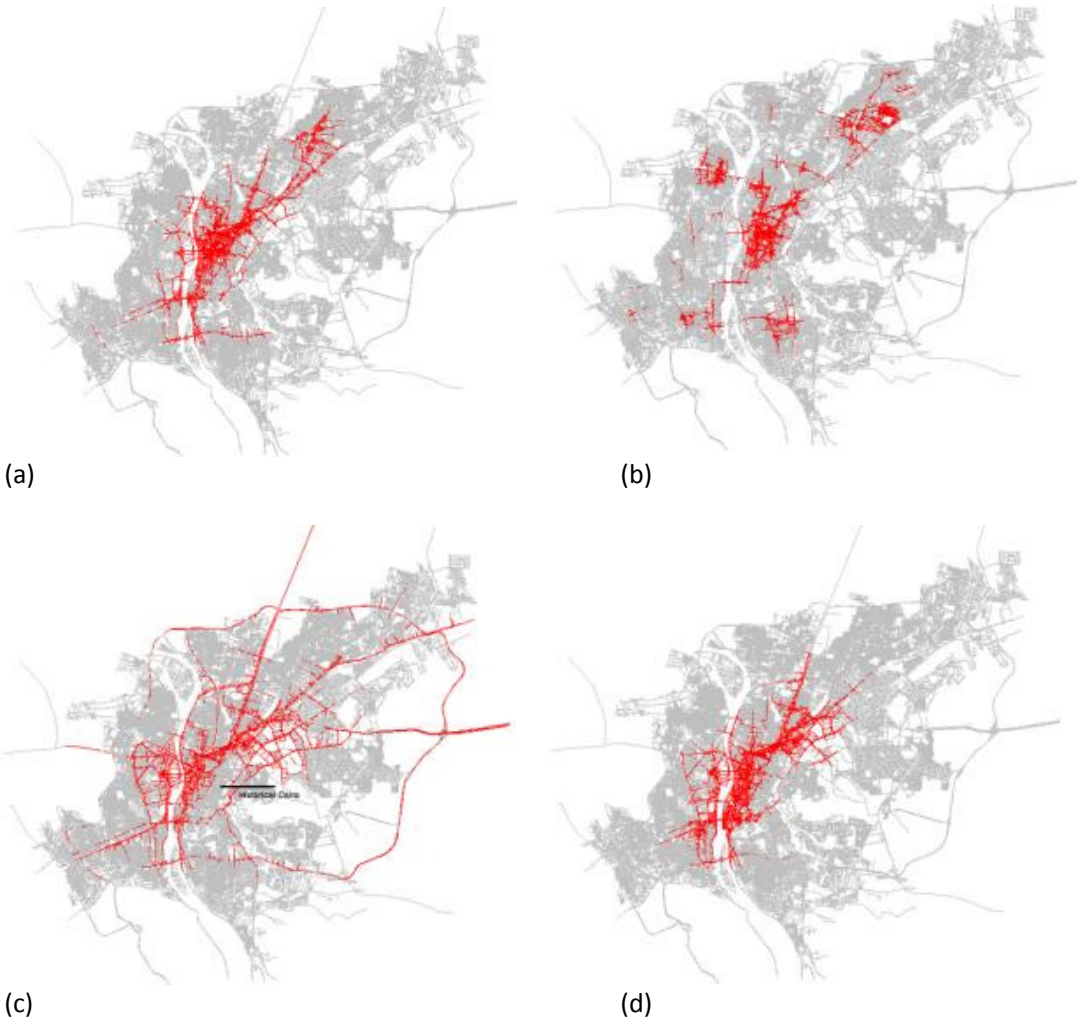


Figure 3 Angular Segment Analysis showing the 10% most integrated lines of the study area. (a) Radius n. (b) Radius 10,000. (c) Radius 5,000. (d) Radius 2,000 meters.

3.2 Spatial Characteristics of Cairo's Informal areas

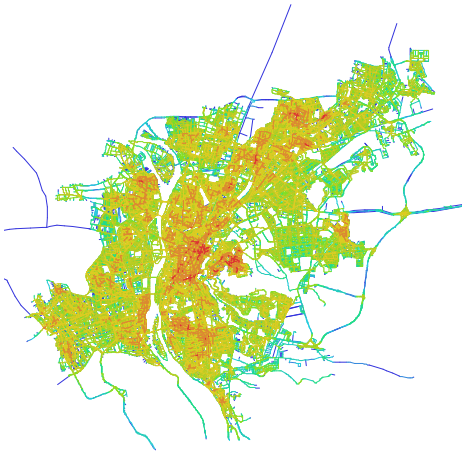
Figure 4 shows the angular global choice analyses at different radii. At the first glance, no morphological difference can be detected between formal and informal settlements, as informal settlements disappear within Cairo's main route network. It is also notable that several of the informal areas are located along one or more definable edges, which tend to be highways or roads along railways and walls. However, these areas are poorly connected to these edges, which have the highest global choice values and tend to be a part of Cairo's overall main route network. These spatial integrated edges bypass informal areas. The poor connection between local streets to the main routes contributes to the isolation of these neighbourhoods from the rest of the city. Nevertheless, these edges represent a spatial potential for residents of informal settlements to access potential workplaces and other activities across the city.

Another spatial characteristic of informal areas is the dense internal spatial structure, which tends to form a polarized pattern that stands alone in isolation from the surrounding areas. This strong spatial structure appears vividly at local angular choice, radius 1200 meters and below [Figure 4 b and c], which corresponds to local sub-centres. It is important to note that the administrative boundaries of informal areas are not conditionally spatial, as it can be seen that a particular spatial structure is divided into more than one informal area. An example of that is Boulaq El Dakrour, where administrative boundaries are not congruent with spatial ones. In

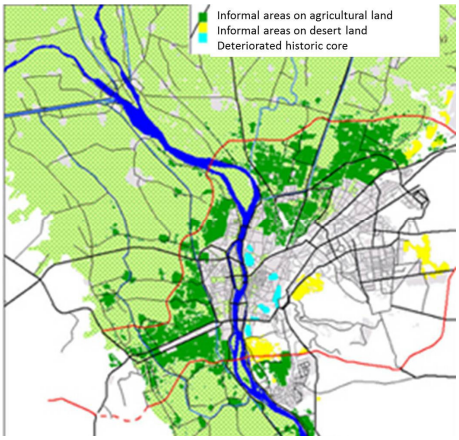
other words, the gridiron urban pattern continues beyond the administrative boundaries of Boulaq El Dakrour. Conversely, the administrative zones of other districts, such as Mansheit Nasser, could include more than one type of urban pattern [Figure 4 e]. This phenomenon of discrepancy between spatial and administrative boundaries has been reported before in unplanned areas in Agra (Parham, 2012).

(a)

(b)



(c)



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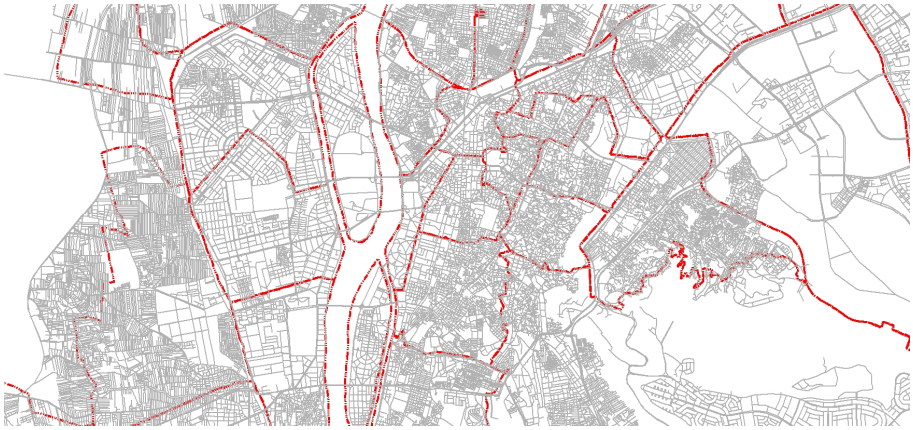


(e)

Figure 4 Global and local-scale angular choice analysis. (a) Log (CH Rn +2). (b) Log (CH R1200+2). (c) Log (CH R800+2). (d) a map of informal and deteriorated areas (Sims, 2003). (e) discrepancy between spatial and administrative boundaries.

When comparing the map of informal and deteriorated areas [Figure 3 d] with the maps of the angular choice analyses with radii 1200 and 800 [Figure 3 b and c], some notable correlations can be found. There is a weak correlation in the case of informal settlements established on agricultural land compared with those established on desert land. That is because informal areas on desert land tend to have a strong internal structure of self-organized organic pattern, whereas those on agricultural land tend to follow the pattern of the basins (ahwad), which run in a linear and gridiron form [Figure 5]. Consequently, informal areas on desert land are usually more segregated than those on agricultural land. If this is the case, it should be no surprise that informal areas built on agriculture land such as Boulaq El Dakrour show better housing and socio-economic conditions than those built on desert land such as Mansheit Nasser (Sims 2003; Census of Egypt, 2006; Piffero 2009).

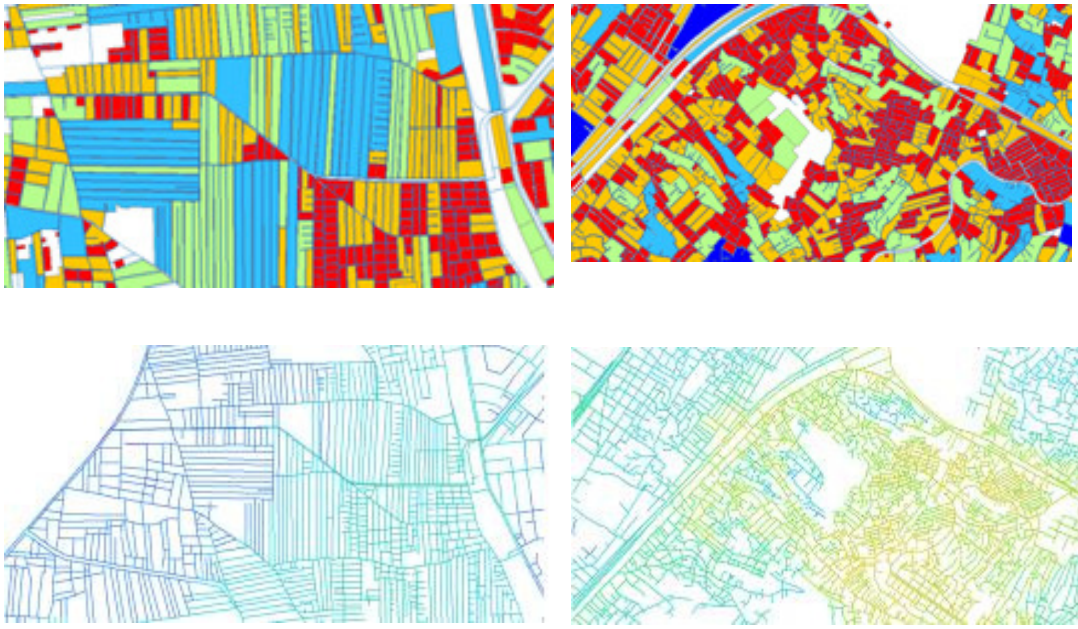


Figure 5 The urban block size and node count R1200 in Boulaq El Dakrour (left column) and Mansheit Nasser (right column).

Another interesting experiment that reflects the spatial features of informal areas is the measure of angular step depth from the root segments with higher local (radius 500 metres) and global (radius10,000 metres) topological choice. A scatter plot showing the correlation between local and global topological choice was created to define easily the segments with higher local and global values. The angular step depth was then calculated from the selected segments with the highest values from both analyses at the same time. Next, the map colour range was inverted where red segments have lower values while blue ones have higher numbers. Figure 6 (a) shows the results: informal and deteriorated areas have higher angular step depth, so they can be easily distinguished, to a certain extent, from the entire urban mass.

Cairo's historical Bazar area shows that its internal streets are poorly accessible because of a curvy street pattern. The outer routes, such as Gawhar Al Qaed Street (Al-Azhar), have better spatial accessibility, thus enhancing a clustering of commercial activities. The same features can also be seen in the deteriorated area of Boulaq, on the eastern bank of the Nile [figure 6 b]. Similarly, Mansheit Nasser has several street segments with a low angular step depth along Al-Nasr Street (Autostrad), thus providing better socio-economic conditions for residents living there compared with those clustered away from the main route. Social exclusion takes place vividly in the settlement of Zabaleen (The Garbage collector neighbourhood), which is a Christian Coptic quarter at the southern far end of Mansheit Nasser. Hence, the poor living conditions in these kinds of areas seem to be supported spatially by bad connections between the internal and external routes.

When we compare the map of step depth from the main routes in Cairo with the map showing the location of various types of deteriorated areas in figure 4 d, we find a strong match between the streets with many angular steps from the main routes and the location of deteriorated areas. However, two differences can be noted. First, some informal areas like Imbaba, north-west, have a higher accessibility to the main routes, which explains the existence of Souk El-Monira (El-Monira market) within the area. Second, some eastern and northern quarters of the metropolis, where the elites live, are partially segregated[3]. Nevertheless, the correlation between the dispersal of segregated streets and urban deterioration can be observed clearly.

[3] Cairo has developed following a "patchy" process without clear organic linkages between various parts. The circular, radial and angular structure can be found in many cities, but not in Cairo (Salheen and Attia 2003).

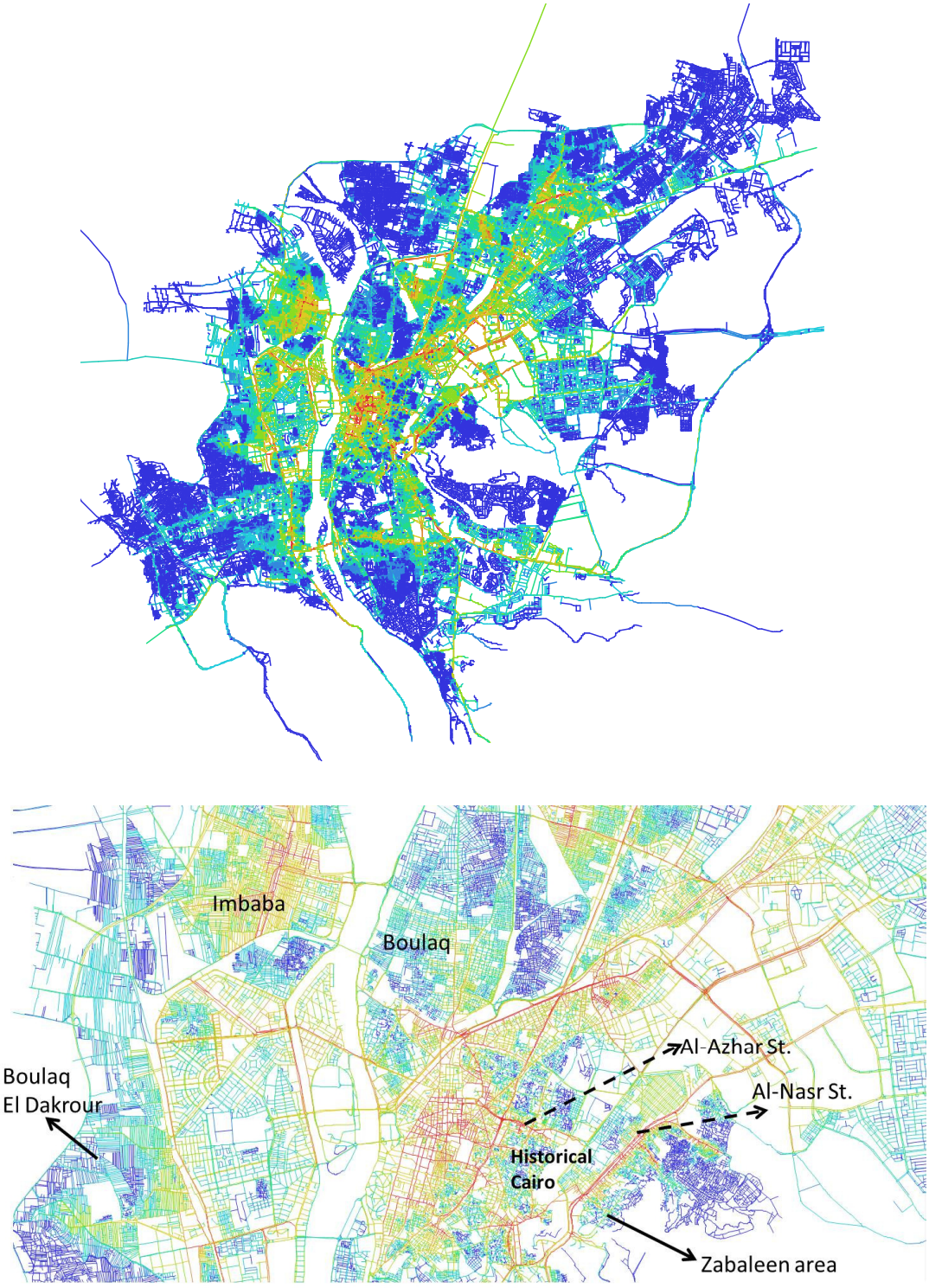


Figure 6 Angular step depth from the segments with high local (R500 metric) and global (R10000 metric) topological choice at the same time (top) with a closer snapshot for some informal and deteriorated areas (bottom).

4. Correlating social and spatial factors

Social and configurational parameters of the study area were compared thematically including ten equal classes with a colour spectrum that goes from dark red (for higher values) to light red (for lower values) for social variables and from red (for most integrated) to blue (for most segregated) for the spatial configurative attributes. The discrepancy between spatial and administrative boundaries suggests the need to analyse the socio-economic performance and syntactic attributes at two levels: at district level, as an initial assessment; and then at a Shyakha (neighbourhood) level for accurate results. Our analysis at the neighbourhood scale does not include the western part of the metropolitan city because of data limitations on some indices such as poverty line.

As can be seen in figure 7 (left column) the west-east corridor shows a high rate of literacy rate, whereas the northern and southern (excluding Maadi) areas show high rates of illiteracy and unemployment. Nevertheless, the correlation between illiteracy and unemployment is too weak both at the district (r2 = 0.0015) and neighbourhood (r2 = 0.0316) levels. That is logically accepted because many residents of informal areas have low incomes, which impedes education affordability. This justification has been verified statistically by exploring the relationship between literacy rate and the percentage of people beneath the poverty line[4]. In fact, the correlation between these two social variables is very high for both district (r2= 0.9932) and neighbourhood (r2 = 0.9979) scales. The rich neighbourhoods are clustered and isolated in the eastern part of the city, which contributes to a strong social segregation between Cairo's advantaged and disadvantaged people.

The distribution of crime in figure 7 shows opposite results than the social status of the neighbourhoods' dwellers. The richer districts have higher crime rates whereas the areas of poverty have lower rates. This implies that areas of advantaged residents are more likely to be targeted by criminals (Adel, 2011). Sims (2009) stated that informal areas are notorious for fostering fundamentalism. Another possible explanation is that many residents of informal areas have the same origin indicating strong social cohesion, where outsiders are easily distinguished and therefor anti-social behaviour is discouraged. The statistical analysis per district shows a negative significant relationship between crime rate and population number (r2 of 0.5469) [figure 7 middle column].

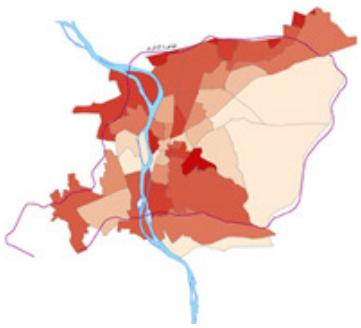
It appears that high population density enhances a natural surveillance in which residents monitor potential criminals. However, when revealing the correlation between crime rates and population density, the two variables are not consistent with each other (r2 of 0.0402). This contradicts Jacob's ideas regarding high concentration of people in urban areas (Jacobs, 1961). Nevertheless, an explanation for crime rate patterns is not easily found, since a weak inverse relationship has been found between crime and illiteracy rates (r2 of 0.2333) and unemployment rates (r2 of 0.1785). However, the high occurrence of crime itself contributes to a spatial division between the depressed and prosperous areas at various scale levels in terms of hedges, fences and a settlement patterns in a neighbourhood isolated from the main route network and the city.

In the maps with the angular global and local integration analyses [figure 7 right column], the mean value for each syntactic attribute was obtained by separating the segments within or relatively within each administrative zone. As discussed previously, the angular global and local integration analyses show that Cairo's central core has high integration values and that peripheries have the lowest integration values. Many central areas such as El-Sharabia (adjacent

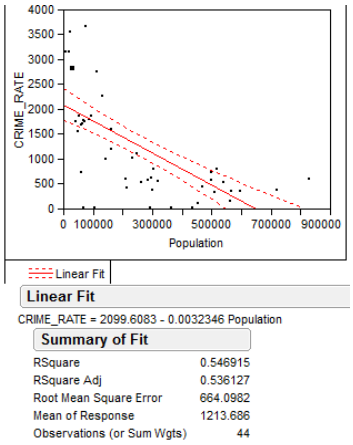
[4] Unfortunately, there is no available numerical study about income level in Cairo. Even those researches which provide thematic maps about income distribution are very few and old, the latest map dates back to 1996 census (see El kadi, 2009 and DRTPC, 2009).

to Masr train station) and some of the old historical areas of Cairo have low global integration values due to physical segregation caused either by railways, or the spatial configuration of the street network itself[5]. Such physical segregation disappears on a local level with a metrical radius of 1200 units and lower, due to the strong internal spatial structure of these areas.

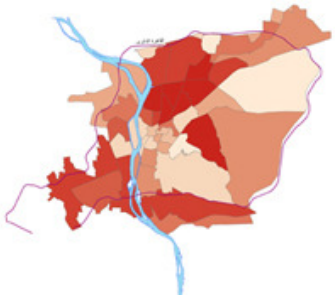
Cairo's global and local integration analysis show a remarkable difference manifesting in the strong west-east corridor. This corridor is distinguished significantly in the angular global integration map compared to the angular local integration analysis, where this corridor seems to shrink and shift towards the south.



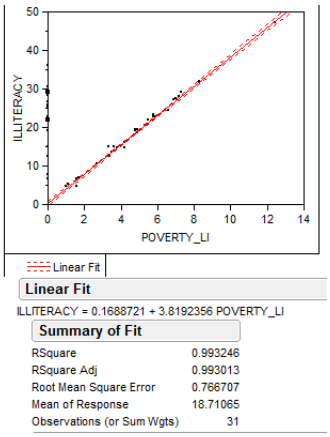
Illiteracy rate (+10) per district (according to Census of Egypt 2006)

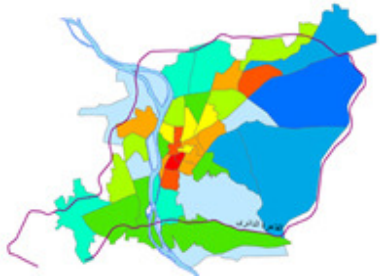


Angular Global Integration Rn per district

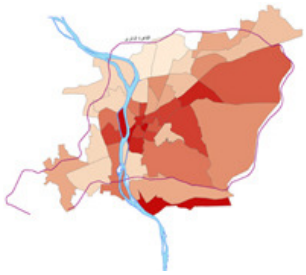


Unemployment rate (+15) per district (according to Census of Egypt 2006)

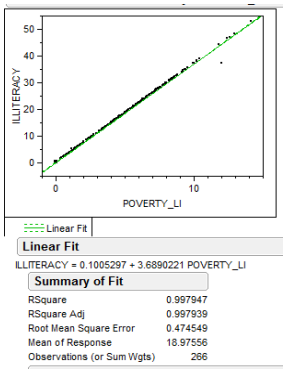


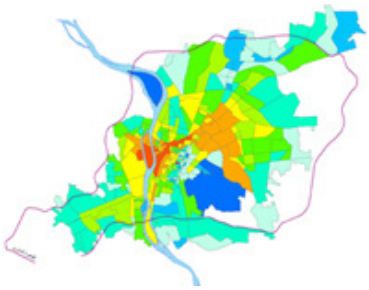


Angular Integration R1200 per district



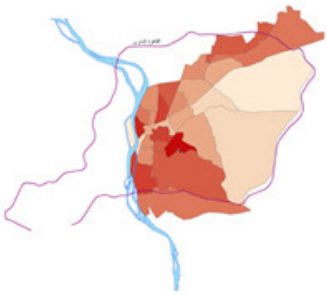
Crime rate per district (according to PSB's reports)





Angular Global Integration Rn per neighbourhood

[5] Greene (2002) postulated that such cases are internally segregated, though externally not, as they tend to develop in a laberinthic way due to many reasons leading to self-segregated areas.



People beneath Poverty Line per district (according to HDR, 2008)

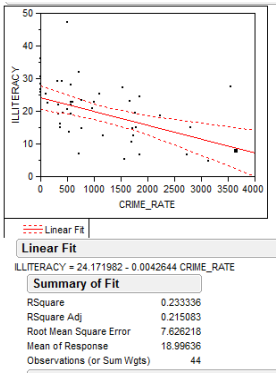
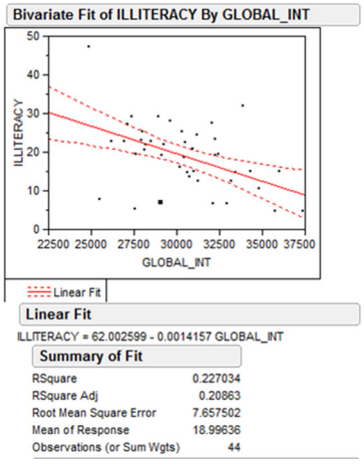
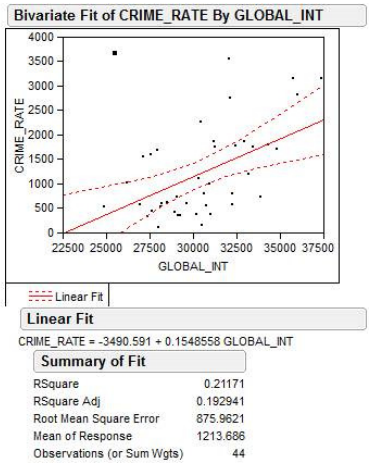


Figure 7 Socio-economic factors on both district and neighbourhood scales (left column); Correlation between social variables (middle); and Syntactic measures (right).

To what extent do the socio-economic variables follow spatial configurative measures? Figure 8 shows the results from the regression analysis between social and spatial variables, which reveals a significant correlation between some social variables and global integration on the district level when excluding the richer districts in the east (Heliopolis and Nasr City) and south (Maadi)[6]. These correlations become stronger when older districts such as Boulaq and Al-Moski in the central area are also excluded. For instance, we found a significant inverse relation between literacy rates and global integration (r2 of 0.4673) when the districts of Heliopolis, Nasr city, and Maadi are excluded. The correlation coefficient rises (r2 of 0.5771) when an additional district, Boulaq, is excluded. Likewise, global integration correlated negatively with the percentage of people beneath the poverty line, in 19 districts, (r2 of 0.5736) and positively with the crime rate (r2 of 0.4267) in 41 districts, excluding Heliopolis and Maadi. Adding four more districts (Almoski, Adarb Al-Ahmar, Gamalia, and Sayda Zainab) to the exclude list raises the relationship between the global integration and the crime rate (r2 of 0.6097).

As to the local integration analysis with a metrical radius of 1200 units, no correlation is found to any social variable. This is also the case for the analysis at the neighbourhood scale. The explanation is that the administrative boundaries are political rather than spatial. Nevertheless, the regression analysis in figure 8, in general, demonstrates the strong consistency between social and spatial factors.

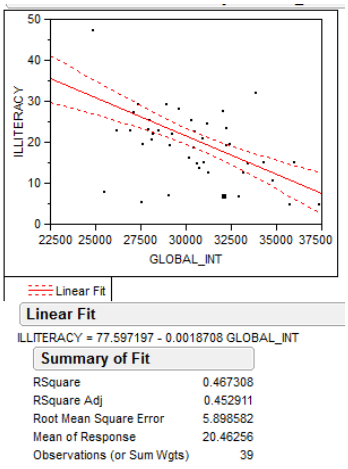




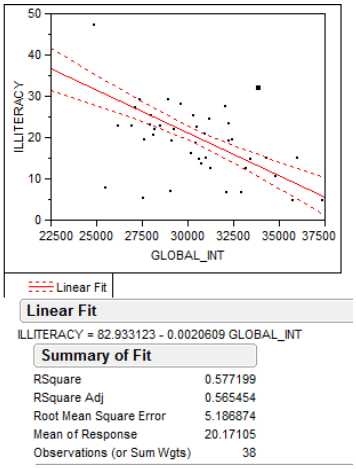
(a) Correlations of angular global integration with illiteracy and crime rates considering all districts (N= 44).

Figure 8 Correlation between social variables and syntactic measures.

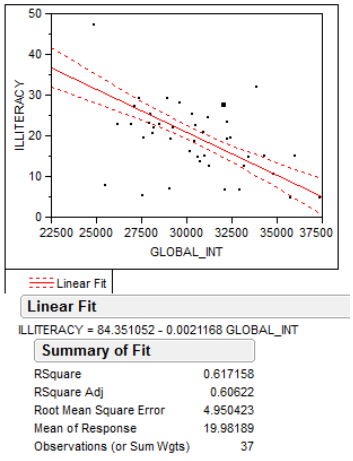
[6] It is worth mentioning that we explored firstly the correlation considering all districts (N=44), but a weak correlation was found on both local and global levels. Accordingly, we tried to recheck the correlation to see whether it will be improved when isolating the three districts as they may have an impact on the model since their partial segregation is due to their location on the edge of the system.



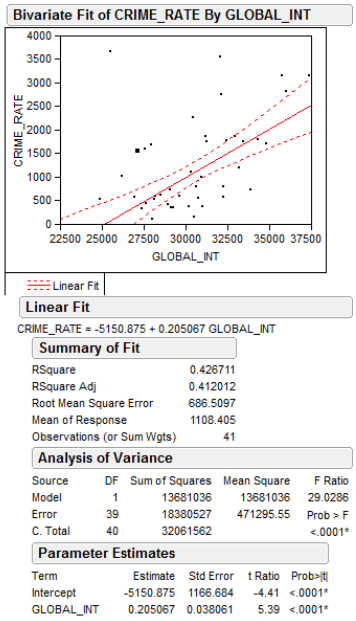
(b) Excluding: Helioplolis, Nasr city and Maadi



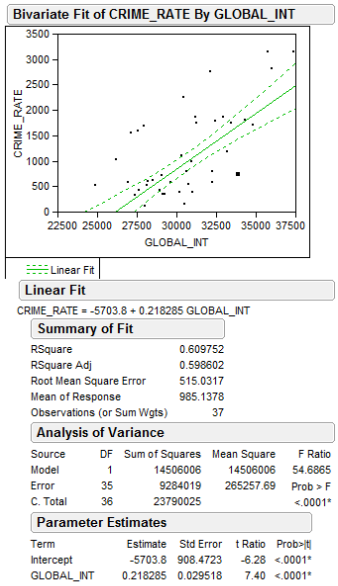
(c) Excluding: Helioplolis, Nasr city, Maadi, and Boulaq



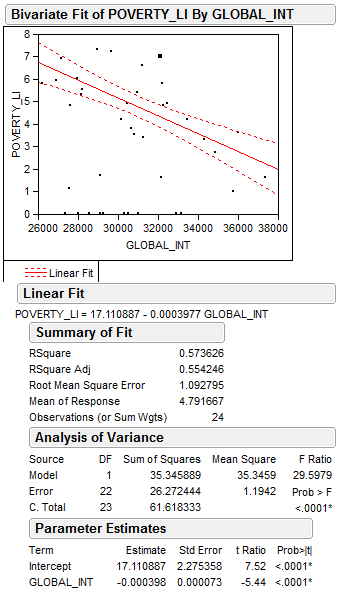
(d) Excluding: Helioplolis, Nasr city, Maadi, Boulaq and Almoski



(e) Excluding: Helioplolis and Maadi,



(f) Excluding: Helioplolis, Maadi, Almoski, Adarb Al-Ahmar, Gamalia, and Sayda Zainab



(g) Excluding: Helioplolis, Nasr city, Maadi, Boulaq, Almoski, and all other districts with no data on people beneath poverty level.

Figure 8 Continued.

5. Conclusion

The role of Cairo's main route network plays a significant role in the way dwellers from various neighbourhoods can participate in micro economic activities. If a main route goes through a neighbourhood, or a neighbourhood is well-connected to the main route network, it shapes possibilities for economic as well as social interaction between residents of a neighbourhood and through travellers. The Bazar area in the centre of Cairo is well connected to the main route, Al-Azhar Street. This area has high values on the spatial analysis with a low as well as high metrical radius.

When a neighbourhood is disconnected from the main route network, the local residents are separated from the whole city. Often, residents within such an area tend to be a homogenous social group, either a group of high-income residents, or a poor group of minorities sharing the same religion, origin, and so on. The Zabaleen area in Mansheit Nasser is an example for that theory; its inhabitants live their own lives completely separated from other inhabitants and visitors of the metropolitan area. It would seem that the spatial structure of a neighbourhood and how it is connected to the whole city lead to social segregation.

The statistical analysis demonstrates that there is a strong correlation between some social variables such as literacy and crime rates, and angular global integration. However, with respect to local integration, poor spatial structures influence the socio-economic development in the disadvantaged areas.

The socio-spatial differences identified between informal areas built on agricultural land and those built on desert land provide an understanding of how space and society are interlinked. The greater the correlation between the angular analysis with high and low metrical radii, the better it shapes the spatial framework for micro economic activities of a neighbourhood's residents.

When comparing Cairo with other cities, the spatial structure of Cairo's informal areas is similar to other cities of the less developed world analysed with space syntax. Examples are the analyses of the informal settlements in Santiago (Hillier et al, 2000; Greene, 2002), Jeddah (Karimi et al, 2007) Dar es Salaam (Kohlert, 2006), and Agra (Parham, 2012). For instance, Hillier et al (2000) and Greene (2003) examined the role of spatial configuration in enhancing or impeding the consolidation process of informal settlements in Santiago de Chile. They found that the consolidation process of such settlements was directed by the so-called "edge economy". Nevertheless, the differences appear only in terms of the radius at which the internal spatial structure can be identified (Parham, 2012). The study of Cairo has contributed to further knowledge by revealing the difference between how an informal area performs when it is built on desert land or on agricultural land.

A similar study of Dar es Salaam shows the same pattern (Kohlert, 2006). Dar es Salaam is an excellent illustration of the interplay between architecture and society, that is, the extent to which planned space influences society and, conversely, to which building and design are always responses to societal changes and expressions of functional and societal correlations, making them essential tools for influencing our environment in a positive manner.

The investigation of the urban history of Dar es Salaam explains the development of segregated sub-centers, which can be visualized with space syntax. Conversely, space syntax can be used to simulate the effect changes will have and how one might repair historical segregations to form more integrated areas, with fewer problems concerning insecurity and social disadvantage, and to unite a city center and, say, a harbour zone.

For a future masterplan for Cairo, it is important to compare the structure resulting from the historical development with the space syntax findings, and to analyse the city structure to find the sub-centers and try to combine centers. Cairo has a lot of areas, both informal and wealthy

ones, with their own centers. It will also be important to combine these to have the liveliness of the informal ones, with their relative security resulting from so many people on the streets "supervising" each other, along with the quietude of the wealthier quarters. With these combined centers, the districts are no longer separated and grow together and help each other.

What is needed is a method of many small steps involving a great deal of joint action and active participation on the part of the residents themselves. This is a way to overcome past implementation problems. Particularly for cities in the less developed world, where we find poverty side by side with a strong momentum for change, such an approach seems more promising than large-scale projects imposed from the outside, with expectations that are too high and that meet with little acceptance and are often abandoned before completion.

An urban restructuring offers a chance to unite individual centers and points of attraction that developed in different cultural periods over the course of history in a joint network of attractive, citizen-based zones and make a connection possible via meaningful expansions.

Our findings emphasize that the role of spatial configuration needs to be taken into account in the future master plans of Cairo. The challenge is to overcome a spatial fragmented settlement pattern on various scales, which contributes to social as well as economic segregation.

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