

The Configuration Map of Bangkok: The Road Network and its Relationship to the City's Evolution

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Abstract

Bangkok is a subject of many studies, but very few investigated it as a spatial configurational system composing of roads. A study by Kasemsook (2003) on three stages of the central road network's expansion of Bangkok is one of those. By focusing on the central area, this study, however, excludes the Bangkok periphery areas in which the speed of spatial evolution has most intensely developed.

The study presented in this paper is an attempt to carry on to continuing the investigation on the Bangkok configuration towards the city's edges. How has the city's configurational system evolved when the recently developed areas on the edges are included in the analysis? Are the changes similar to or different from those found in the central road network expansion? What if the areas on two sides of the Chao Phraya River were separately analysed, what would be the characteristics of the individual systems? To do so, Geographic Information System (GIS) platform together with Space Syntax program were used as an analytical tool.

The findings repeat some similar patterns to those of the former study, but also reveal a currently unique Bangkok's urban development. Overall, the city's spatial system becomes more segregated as the city evolves. The centre of Bangkok

has gradually shifted as the city grows, and two new sub-centres emerge. There is strong evidence on the compartmentisation process of the local area development at the edges, leading to spatial segregation as well as subjected to social exclusion. All these are an indication on the socio-spatial transformation process of Bangkok nowadays.

Key words : Bangkok, road network development, spatial compartmentisation, Space Syntax, spatial structure, spatial configuration

Introduction & Problem Definition

Bangkok is a fascinating city to many people. The city composes of many areas with distinctive characteristics, physically, culturally, socially and economically. All these diverse characteristics have embedded upon one entity which allows them to flourish or make them to deteriorate – the spatial network. Despite of many researches being carried out to study Bangkok's spatial network, very few investigate its configurational property. They usually focused on the plan, the spatial pattern and the urban growth instigated by the road network. As a result, most of the socio-economic focused researches, which concentrated on the 'relationships' between people, economy and power in association with space, were built upon a non-relational spatial system study to some extent, for example, Kaothien and Webster (2000) or Askew (2002). A non-relational spatial system study means a studied spatial system that does not take the relationship of each space to all other spaces in such system as central to the investigation.

It seems that in the case of Bangkok there is a lack of a socio-spatial or a spatio-economic study that take the intrinsic relationship within individual systems – the relationship of spaces within a spatial system and the relationship of varied socio-economic units in their own systems that exist on spaces – as central to its investigation. To be more precise, the relationship between spaces is missing. In this study, this relationship is proposed as the relationship between one road to all other roads, and between all roads to one another, hence configuration.

As the Bangkok spatial system evolves everyday and the centre of evolution is the periphery, seen from the intensity of private housing development replacing orchards, farm land and paddy fields, the investigation focuses on the edge areas of Bangkok. How has the city's configurational system evolved, particularly with the current development at the city's edge areas? How has the road network had structured from the enormity of the city's roads themselves? Are the changes similar to or different from the changes' pattern found in the central road network expansion? What if the effect of the Chao Phraya River passing through Bangkok were taken into account, what would be the spatial characteristics of the individual areas on different river banks? It is hoped that the Bangkok road network configuration and the understanding of it could form a basis for the inter-relationship study among spatial, social and economic aspects, and something else. Thus, it would help us understand how these inter-relationships shape and become the city's images.

The framework of this configuration study is based on two theories of Hillier: 'theory of natural movement' and 'theory of the city as object'. Theory of natural movement suggests the dialectic between spatial configuration and patterns of movement and activity development within that configuration. Hillier indicates that the configuration of grid pattern has a direct effect on the patterns of movement and activity development within that grid, and while the patterns of movement and activity development can directly affect each other, they do not have the same degree of influence upon the grid configuration (Hillier, 1992). Theory of the city as object explains that there is some kind of a dual socio-spatial process in the city development process. This dual process works through the application of spatial laws. This results in a tendency that the city will expand by keeping extending long roads for directional and navigational purposes even though numerous short roads may have to be created to form urban areas – to understand both the city whole and the areal parts (Hillier, 2001).

Methodology

Central to the investigation of this study is the 'spatial configuration of the road network.' Space Syntax technique and computer programmes were selected as a tool for modelling the Bangkok road network and calculating its spatial configuration, in a number of measurements, each of which displays a spatial structure at different levels. The Bangkok road network was spatially modelled by their axial lines. An axial line is the longest line of permeability and longest line of sight (Hillier & Hanson, 1984). Therefore, a straight road would be modelled as a single axial line, while a curvilinear road could be modelled by a series of sequentially connecting axial lines.

The axial model of the Bangkok road network were then calculated for the configuration of all the lines, i.e., spaces, in the system, by Space Syntax computer programmes, particularly by 'DepthMap.' The key to the calculation is the measurement of the relationship of one line to all other lines. This relationship is based on topology of the line; and, the topological distance is the depth generating by the way the line connects to one another. Therefore, one line can locate so near to some other lines in a system, having a short metric distance, while their topological distance could be so deep. A good example of this is the lines on opposite sides of the river.

The configuration itself can be read as followed. A line which is topologically shallow from all other lines is an integrated line, and therefore has a high degree of permeability. A line which is topologically deep from all other lines is a segregated line, and has a low degree of permeability. The degree of integration can be represented in terms of: a) figure, i.e., values, the higher the value the more integrated the line, and the lower the value to more segregated the line; and b) spectrum colour from red to blue, the more integrated the line, the closer the line to red colour, while the more segregated the line, the closer the line to blue colour – or from black to white in monochrome.

There are three measurements carried out to study the Bangkok road network's spatial structure. The first is a global integration which measures the relationship from each individual line to all other lines in the system. The result of this is the global structure of the system. Generally this global structure is made up of a number of integrated lines that forms a so-called supergrid – a group of axial lines having highest degree of permeability across city. The second is a local integration which measures the relationship from each line to the other lines sequentially connecting within two depths from it. The result is a local structure which usually depicts the lines that are of local importance, i.e., being a centre of some areas. The third is connectivity which measures a number of lines directly connecting to each line.

The implication of the integration can be read in many ways. The most important one is its association with movement pattern, particularly pedestrian one (Hillier, 1992). Hillier suggests that high integration means that mean trip length from origin to destination will be short, while it is the opposite for high segregation – long mean trip length. Because of the trip length, it is likely that high density of movement would be found where there is high integration, whereas it is the opposite for high segregation – low movement density. Land-use types benefiting from movement density such as retail and commerce would seek to develop at the high movement density location generated by the grid. In contrast, other land-use types would relinquish such location and seek other location suiting their accepted movement flow.

While the axial lines were computerised in a number of Space Syntax programmes, they had been drawn on the Geographic Information System platform (GIS). The intention was for carrying a further study of the relationship between the integration values and the other attributes given by the GIS map of Bangkok, for example, length of road, road classification, land classification, building types, etc. The Bangkok GIS map used was of 2004. However, a number of surveys had been carried out to check the validity of the map, particularly for the new roads and road intersections.



Figure 1 The axial map comparison of the four studied areas of the Bangkok configurational study (a. Rattanakosin area, b. Rattanakosin and historical Thonburi area, c. Ratchada area, and d. greater ring road area)

Although the focus of the study is on the Bangkok periphery, as a continuation from the study of central road network expansion by Kasemsook (2003), most of the Bangkok area were mapped and modelled. A number of the Bangkok axial line maps were then made out from this city map concerning different urban areas' limits. The ones concentrated here are of four limits. Three of them are of central area. The reason to include them is for re-examining the early stages of the city expansion. However, their axial maps were made with different perimeters to the former study. The last one is of the edge area. These four studied areas are: a) the Rattanakosin area; b) the Rattanakosin area and the historical Thonburi area which locates on the west side of the Chao Phraya River¹; c) the area within the Ratchadapisek ring road, considering the central ring road nowadays; and d) the area within the greater ring road, defining Bangkok's edges and just excluding Suvarnabhumi Airport (Figure 1).

¹ Rattanakosin area is the historical area of Bangkok. It is where the city began. However, prior to the development of Bangkok as a capital of Thailand, Thonburi, which is located on the west bank of the Chao Phraya River and opposite Bangkok, was a former capital. The investigation, therefore, attempts to understand the early development of the city as a system of its own, by limiting to the Rattanakosin area, as well as a system relating to Thonburi area which is so close, and in the early time of Bangkok was of equal importance.

Analyses & Findings

The analyses were carried out in many forms. However, the one presented here focuses on a visual comparison of the configurational patterns of the axial lines, both the global and local structures of each studied area. Findings from a comparison of the integration values will also be briefly given at the end, to give an overall picture of the configurational analysis.

Figure 2 displays the integration line maps of the Rattanakosin area. It shows that lines that are highly integrated, globally and locally, are long lines. The highly integrated lines form the global grid, or the so-called supergrid, which has a deformed-wheel pattern. This is a pattern where a number of integrated lines connect together to form a semi grid at the centre, or being a hub, and a partial rim of the wheel, which are joined together by some other integrated lines, i.e., spokes (Hillier, 1996).²

² Hillier suggests that this kind of pattern is likely to be found in most cities studied by Space Syntax.

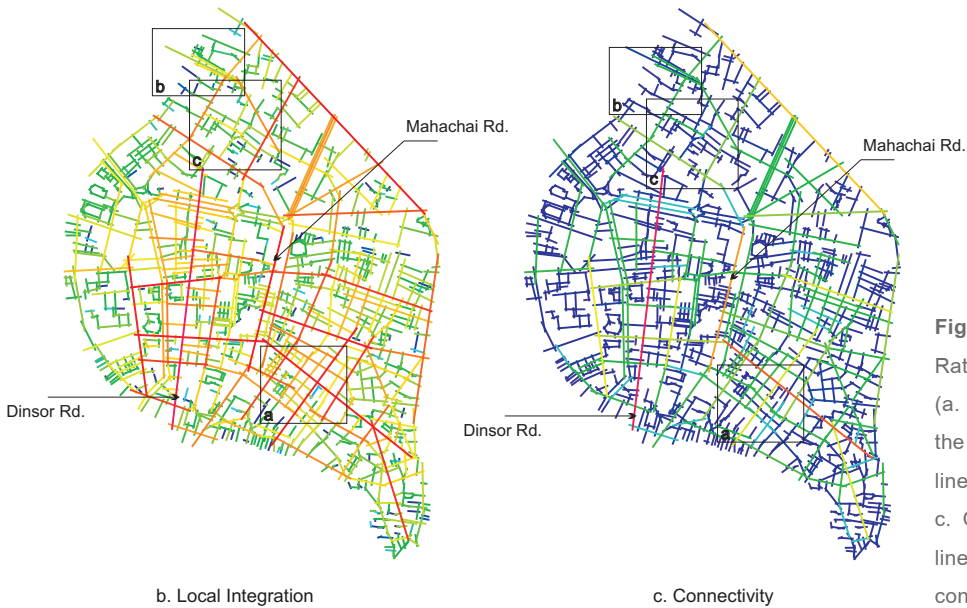


Figure 2 Integration maps of Rattanakosin area
(a. Global integration - the darker the line, the more integrated the line is; b. Local integration; and, c. Connectivity - the darker the line, the less integrated and less connected the line is.)

The map (Figure 2) shows that the canal network has strong effect on the road network at the global scale. This is seen through the pattern of the globally integrated lines, particularly those that form the rim of the deformed wheel. Most of the long lines which both align to and locate along the three ring canals are globally integrated. However, roads that are of globally significant and locally significant the most are not the same one. The road that is of locally significant the most is, indeed, the longest line of the Rattanakosin area, Dindsor Road, while the most globally significant road is Mahachai Road, the canal-aligning road. This pattern could affect area development differently. It should also be noted that the second most integrated line, globally and locally, is the line running east west and connecting through all the ring roads – Charernkrung Road, the very first paved street of Bangkok and a heart of the Bangkok commerce until nowadays.

As for the local grid pattern, the map (Figure 2b) shows that the central and the east area are made up of different grid types from the north and the west area. The local grid in the central and the east area has an orthogonal or quasi-orthogonal grid structure, i.e., the grid structure forming by a number of lines that connect at right or quasi right angle to each other (Box a in Figure 2). Because of the local grid structure and the nature of the lines, which tend to extend beyond the area perimeter and interweave with the surrounding areas as well as the global lines, this makes the eastern area of the Rattanakosin spatial system a highly integrated one. The local grid in the north and the west area has a broken-grid structure, the grid structure forming by a number of lines that sequentially connect to a few more lines at some angles rather than at right angle (Box b-c in Figure 2). Due to line connection of the grid structure, these areas are less integrated than those having the orthogonal or quasi-orthogonal grid structure. In addition, the local grids, whether of the orthogonal, quasi-orthogonal or broken-grid structure, tend to align to the global integrated lines, i.e., the axial lines of the major roads, rather than to each other.



Figure 3 Integration maps of Rattanakosin and historical Thonburi area

(a. Global integration - the darker the line, the more integrated the line is; b. Local integration; and, c. Connectivity - the darker the line, the less integrated and less connected the line is.)

When the integration lines maps of the Rattanakosin and historical Thonburi area are examined (Figure 3) and compared to that of the Rattanakosin area, it shows that overall the combined areas' spatial system has similar structure to that of the Rattanakosin area alone. This is seen through the pattern of the supergrid lines and the integration core. But a closer look reveals that the spatial structure of the historical Thonburi is significantly different from that of the Rattanakosin area. Not only are these differences found at the global, but also at the local scale too. The global structure of the historic Thonburi area has a linear form making up by two-parallel and sequentially-connecting lines, which represent Issarapaab and Arun-amarin Roads. The integration core of the historic Thonburi area is difficult to pinpoint, which is quite contrast to that of the Rattanakosin area. This is due to two reasons: the global linear structure grid form and the majority of the local grid having the broken-grid structure.

The differences in spatial pattern between the east and the west side area of the Chao Phraya River continue and are much more obvious in the spatial pattern of Ratchadapisek area (Figure 4), compared to those seen in the spatial pattern of the Rattanakosin and historical Thonburi area. Overall on the global scale, it is found that although the integration core of the Ratchadapisek spatial system still locates on the eastern side of the river, it begins to moves eastward from locating within the Rattanakosin area to locating just outside and to the east of it (Box a in Figure 4a). The supergid is also formed by long lines, but majority of them locate outside the Rattanakosin area.

When the supergrids of the areas on different sides of the river are compared, they are quite different. The eastern side of the river has the quasi-orthogonal supergrid structure, which is inwardly integrated and centrally locates within the area. The western side has the linear supergrid structure, which is outwardly integrated and locates close to the edge seen from the dark colour of the ring roads (Figure 4a).



Figure 4 Integration maps of Ratchada area
(a. Global integration - the darker the line, the more integrated the line is; b. Local integration; and, c. Connectivity - the darker the line, the less integrated and less connected the line is.)

On the local scale, the canal network has a marked effect on the local area development, although this effect is different on the two sides of the river due to the pattern of the canals. Its effect is a linear fashion development of the local areas along the canals (Boxes b-d in Figure 4). This is seen through the sequentially connecting lines forming the broken-grid structure of the local areas, which locate along major roads aligned to the canals. The local grid lines often end at the canals. Due to the different meshes and forms of the canal networks on different sides of the river, the western local areas developed in this fashion have a fine grid, but they are sparsely distributed along the curvilinear mesh of the western canal network (Box b in Figure 4)³. They are also segregated areas as they do not well connect with the global grid of the city by two reasons: fewer global grid lines in the west and the local areas locate so deep from the global grid lines.

In contrast, the eastern local areas, particularly those locating in the central and the northern area and developed in the linear fashion along the canals, have been continuously distributed along the major canals whose network is of quasi-orthogonal form (Boxes c-d in Figure 4). Despite of their broken grid structure, many of the eastern local areas developed in the linear fashion along the canals are not segregated areas. This could due to the fact that majority of these local areas' grids directly connect to major roads, i.e., the global grid lines. The global integration of the major roads influences the local integration of the areas. However, this is not the case for the local areas in the north (Box d in Figure 4); they are segregated areas, seen from the green and blue colours of the axial lines.

³ It should be noted that the Thonburi area was, and in some part still is, orchards, which requires a fine mesh of irrigation canal network, while the Bangkok area (the eastern side only) was, and again in some part still is, paddy fields, whose irrigation canals' distance could be wide.

There is another significant finding: the further the local area develops, the more likely the local grid will have the broken-grid structure, though this is much more pronounced in the east (Figure 4). Majority of the local grids in the centre has the orthogonal or quasi-orthogonal grid structure, and they are highly integrated. This is contrast to the grids in the edges – having the broken-grid structure and being segregated. These two local area development patterns point out to a major difference between the local grids of the east and the west, at this stage. The grids in the east are much more integrated than those in the west, globally and locally.

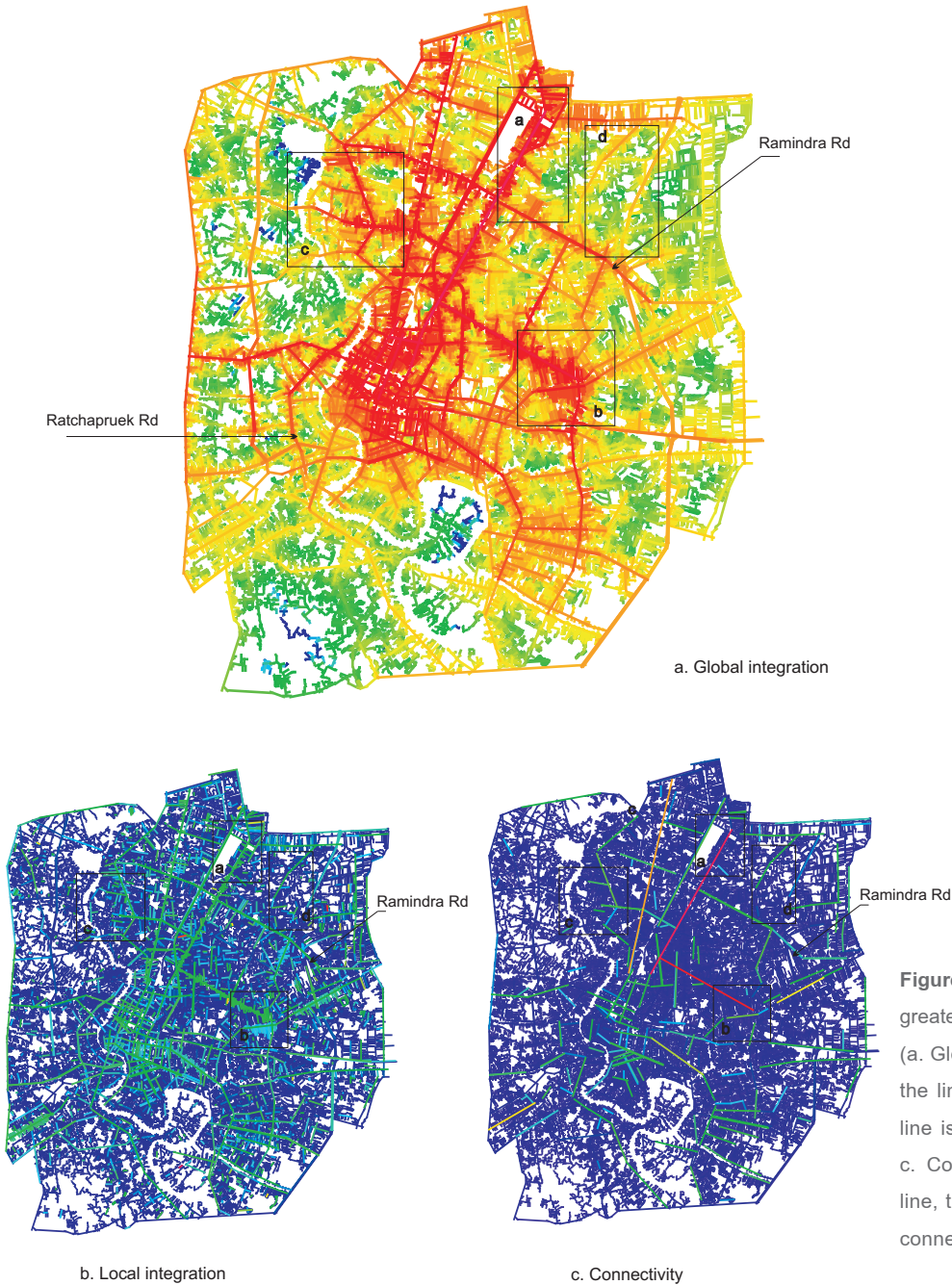


Figure 5 Integration maps of the greater ring road area
(a. Global integration - the darker the line, the more integrated the line is; b. Local integration; and, c. Connectivity - the darker the line, the less integrated and less connected the line is.)

With the current expansion through the edges, the spatial system of the Bangkok greater ring road area becomes highly complex both at the global and local scales and several unique development patterns emerge (Figure 5). On the global scale, the deformed-wheel shape of the supergrid continues to move eastward, whereas its integration core moves northward. It also becomes very clear that the rim of the supergrid now consists of several ring roads, layering from the inner to the outer area (see Ladprao, Kasetnawamin, Ramindra and Srinakarin roads in Figure 5). As for the roads, i.e., lines, making up the supergrid, the longer the road is, the more integrated it will be and the more likely it will locate in the edge.

Another important development is the emergence of two sub-centres (Box a-b in Figure 5). This is seen by an obviously dense area of integration lines with smaller size than and at some distance from the city centre. One is found in the east, where Ramkamhang, Ladprao and Sukkhapiban I roads intersecting. The other is found in the north, an area called Saphan-mai-Donmuang, which locates along Paholyotin Road. The difference between these two sub-centres is that the eastern sub-centre is concentric, while the northern sub-centre is elongate. This emergence points out that when enlarging Bangkok has a tendency to be a multiple-centre city. This is understandable because only one integration core would be insufficient for the complex city as Bangkok.

On the local scale, it is clear that the more the city grows, the less integrated the local area will be. This is due to two characteristics of the local area development. First, the linear fashion development of local areas is found throughout the edges and produce a vast number of segregated local areas, through their broken-grid structure. Similar to the Ratchadapisek's spatial system, the pattern of the eastern local areas developed in this fashion is of grid-like and sparsely, while that of the western local areas is of curvilinear and dense. This is due to different functions of the canals on different sides of the river.

Second, there is strong evidence of local areas in the edge, having been developing through a compartmentisation process, organically and intentionally. The compartmentisation is a developing pattern of local area where the area's grid have limited access or is less likely to interweave with the surroundings, both

the local grids of the other areas and the city's arterial roads. An evidence of the organic development of local areas with this pattern can be seen through their distribution within a number of superblocks, i.e., a large area delineated by the arterial or major roads. A reason for this is the insufficiency of the major and secondary roads in the edges due to the rapid expansion of the city. An evidence of the intentional development is the development of private housing estates, particularly the gated-community, which is highly popular in Bangkok due to domestic security concern. As a result, the areas could be globally segregated but locally integrated (Box c-d in Figure 5). Many of them could be so near metrically, but so far topologically from each other. The compartmentisation is a spatial exclusion process, and it makes the city's spatial system as a whole to be fragmented and segregated. This is a significant finding here as the spatial configuration of the edge areas enables us to understand the true effect of the fragmented pattern of the local area development.

The separation of the spatial networks of the eastern and the western area shows that the spatial network of the eastern area dominates the spatial network of Bangkok (Figures 6-7). Most of the spatial features found in the eastern and the Bangkok spatial system are similar. They are: the pattern of the internal supergrid; the similar major roads making up the supergrid; the location of integration core, although it moves slightly to the north and its size is smaller; the eastern and the northern sub-centre emergence (Figure 6).

In contrast, the spatial system of the western area has an outwardly integrated structure. This is due to three development patterns (Figure 7). The first is the development of the globally linear structure of the supergrid, which centres around three ring roads and a number of roads connect among them (Figure 7a). There is only an area in the west that seems to have an areal development: the area to the south of the historical Thonburi (Box a in Figure 7). The second is the local area development with a linear fashion along the fine-mesh of the canals. The third is the compartmentisation of the recently developed private housing estates. Due to the degree of the local areas' segregation, the spatial system of the western area has to rely on the global road network much more than the system of the eastern area.

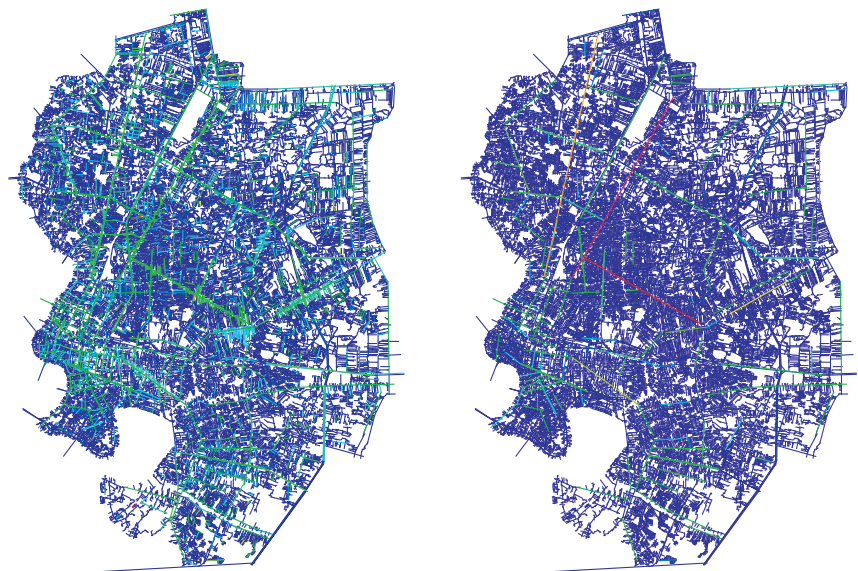
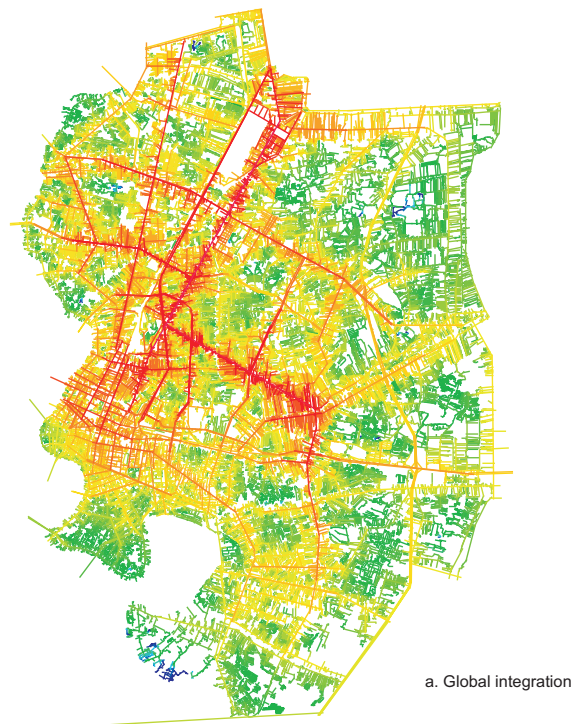


Figure 6 Integration maps of the Bangkok western area
(a. Global integration - the darker the line, the more integrated the line is; b. Local integration; and, c. Connectivity - the darker the line, the less integrated and less connected the line is.)

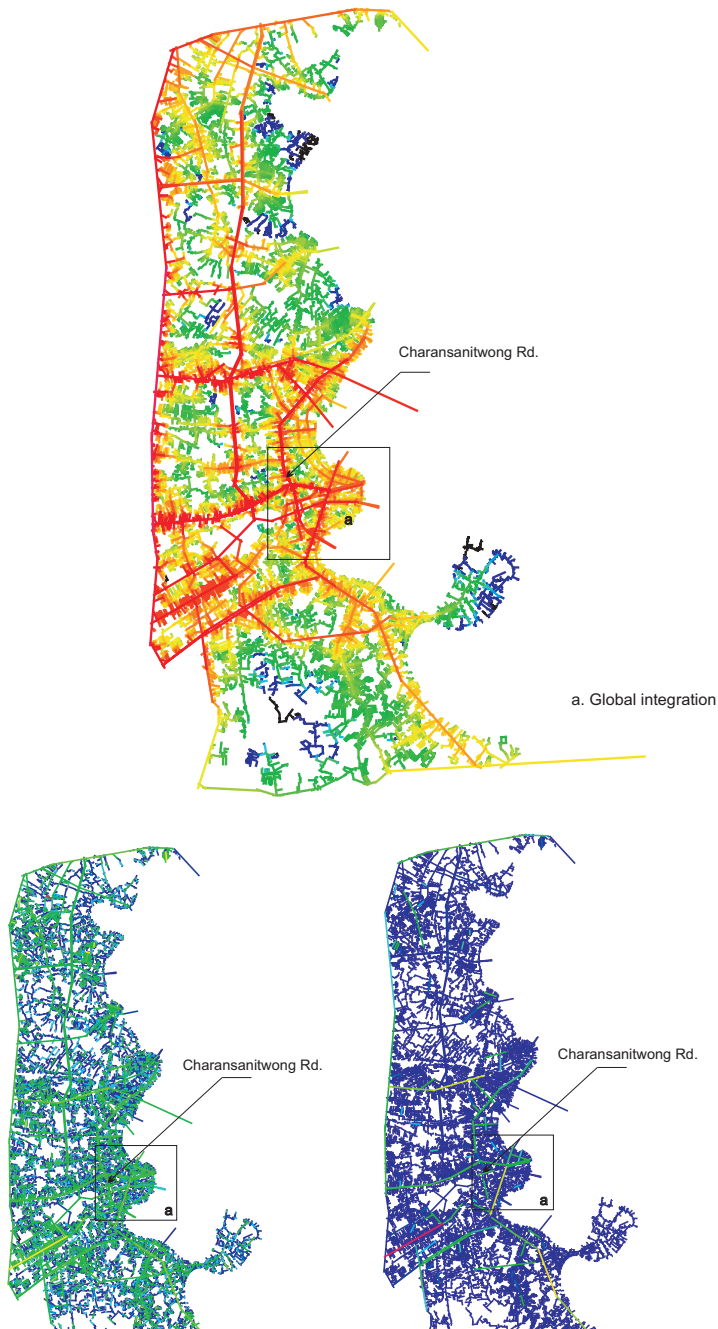


Figure 7 Integration maps of the Bangkok eastern area
(a. Global integration - the darker the line is, the more integrated the line is; b. Local integration; and, c. Connectivity - the darker the line, the less integrated and less connected the line is.)

The figure comparison of the four spatial systems studied shown in Table 1 supports the process of city development suggested by Hillier (2001). The table shows that the more the city expands, the more segregated it will be and the deeper the system it will become. This city's spatial evolution pattern is somewhat anticipated. It is quite obvious that the city becomes globally segregated and has a deep structure (about half less integrated and three-time deeper a structure from the Rattanakosin to the greater ring road spatial system) due to the increase in a vast number of local area developments. Many of the local areas are not well integrated with the city structure, which we can see from the linear fashion pattern and the compartmentisation of the local area development. However, the local areas themselves have developed with such a similar internal structure. This is seen from a marginal drop in local integration from Rattanakosin area to the greater ring road area, and despite the fact that each road has a tendency to have one less connection when the city expands – connectivity dropping from three in the Rattanakosin spatial system to two in the greater ring road system. By knowing that as the city expands the number of roads, i.e., axial lines, increasing enormously and more likely being short lines of the local areas, the raise in average line length would likely to be through the extending of a few long lines, or in some cases adding one or more long or medium-length lines in the system to try to consolidate all the local areas. This is an evidence of the city-as-object process mentioned by Hillier. In addition, the figure comparison also strengthens the findings from the graphic comparison between the spatial systems of the eastern and western areas of Bangkok: their differences; the similarity between the spatial systems of the eastern area and the city; and, the dependency of the western area's spatial system on the global network due to the local segregation.

Table 1 A comparison of the mean integration and other mean values of six studied spatial systems of the Bangkok road network

studied area	no. lines	global integra- tion	local integra- tion	conn- ectivity	mean length (m.)	mean depth
Rattanakosin	1,170	3.4456	6.4203	3.2188	176.41	7.37
Rattanakosin & Historical Thonburi	1,718	2.7779	6.2488	2.9988	166.25	9.36
Ratchada	14,412	2.4226	6.2011	2.6797	167.88	13.63
Greater Ring Road	93,713	1.8173	6.1607	2.5567	188.28	21.55
Eastern Area	65,693	2.1155	6.2794	2.6389	199.73	17.93
Western Area	28,033	1.5087	5.8804	2.3624	162.87	23.27

Discussion

We have set out to investigate the configurational evolution of the Bangkok road network, with a focus on the edge areas, due to their current development intensity. To do so, the configurations of the central road network's expansion were re-examined, but with different areal limits to the former study on the central road network expansion, in order to get a clear view of the changes. It was found that: a) the pattern of spatial changes in the edge areas has continued from that in the central area expansion; b) the canal network has more effect on the local structure than the global structure; and, c) there are marked evidences and unique characters of the global and local segregation and the local area development patterns.

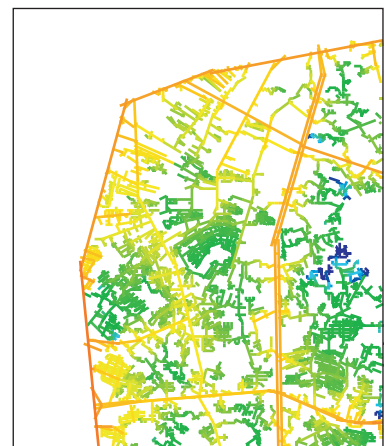
In the case of Bangkok, the segregation of the city as a whole, when it expands, results from the segregation of the two local area development patterns: the linear fashion development along the canal network and the compartmentisation area development. However, their effects on the local areas are different between those locating in the central and the edge areas. Let us elaborate on this issue from the map. Box A in Figure 8 shows some central local areas of Bangkok, many of which have the broken-grid structure. Due to the density of the city roads in the

central area, these local areas' broken grids connect to the city's major roads with very few depths, and have more than one connection with the city lines. Box B in Figure 8, in contrast, shows some edge local areas, some of which have the broken grid structure, and many of which have the orthogonal or quasi-orthogonal grid structure. Because the city's major roads are quite few and far apart in the edges, the grids of these local areas sequentially link, with a number of depths, to the city's grid by one or two accesses.

These evidences suggest that there is a tendency that the internal grid structure of the central local areas will interweave with the city's grid. This makes the central local areas' grids to become a part of the city's grid, and the grid lines themselves function in the city's movement economy process. This is not the case for the edge local areas. Their internal grid structure makes them to be more likely to serve the local purpose, due to their limited connection with the city's grid. These edge local areas, therefore, will likely to be a destination and hardly function in the city's movement economy process. In the other words, the linear fashion and the compartmentalisation of the local area development in the edges will have a greater effect on the spatial system of the city than the central local areas have. It is also worth asking whether the spatial segregation of the edge local area has become problematic, in terms of spatial and movement relationship, in terms of spatial and social relationship, and so on.



a. Centrally locating local areas



b. Periphery locating local area

Figure 8 Examples of local areas
development at the central and
the edge area

The expansion of the Bangkok spatial system is dependent on building or keeping extending long roads. Because the process of building a major road, i.e., long line, is more difficult than that of the local road, i.e., short line, or of the extending the already existing long roads, it would be a good option to develop the local areas along them, and in turn continue to lengthening them. The long roads structure the city's spatial system and provide access to the local areas. Without them the city and the local areas would be disintegrated.

As the city expands and its spatial system becomes more complex, it is inevitably that sub-centres would emerge. However, the location of their emergence and the degree of their integration is an indicative to the transformation process of Bangkok, from a nucleus city to a multi-nuclei city, another new and significant finding here. The spatial realisation of the sub-centres, without an administratively planning with some measures putting in place to guarantee their service accomplishment, is worth a consideration for Bangkok Metropolitan Authority (BMA), who has been planning for so long for the multi-centre Bangkok (BMA, 1996). In the other words, the spatial location makes them a natural centre without a need to give any incentive. Their locations, therefore, could serve as an evidence for a site selection process of BMA's new sub-centre development.

What all these mean to us then. They shows us this is a kind of the city Bangkok is now: a huge city with a dominant city centre, emerging two sub-centres, a vast number of compartmented (and less integrated) local areas, and a few major roads. With these spatial evidences and our general knowledge of the city, in terms of social, cultural and economic of the city's inhabitants, we can begin to make a series of speculations worth a further study. Let us begin with the two obvious examples.

The spatially fragmented city could be a strong evidence on the transformation process of Bangkok to become a social exclusion city. The compartmentisation of the recently developed private housing estates in the edges not only create the spatial segregation but also generates the social exclusion. Their existence points out to the fact that people of similar income groups prefer to cluster with their social group instead of mix with the other social groups. In the other words, people of

some income groups are marginalised for space use, e.g., through movement, by spatial segregation. This is contrast to the city centre where we can find a mix of people in different social groups. The question we should ask is neither we should or should not allow Bangkok to become even more fragmented which would eventually lead to a disintegrated society. Nor do we should or should not plan a new social management to prevent social disintegration. These are something that needs to be dealt with regardless of the degrees of the spatial and social fragmentations. The important question would be whether there is any other organic spatial configurational network in addition to the one we have modelled, or any disguise spatial usage to utilise the fragmented network, and perhaps help holding the city together. In what conceptual does it exist, if there is one? Can we model them? To what extent has such a spatial network complimented the road network, and particularly helping consolidate the society?

Or, with such a complex spatial system, one dominant city centre and two sub-centres suggest that most of the economic transactions would be made in the city centre. This means that the labour force would concentrate in the city centre. The association between integration and movement density (Hillier, 1992), the highly integrated major roads, and the persistent of the traffic problem generated by the movement of the labour force from home-to-work places in the city centre indicates that a different thinking to solve the problem of Bangkok's transportation is required, spatially. This could be a new mode of transportation, a different network of transportation, a new typology of road building programme, a re-direction of urban regulation to counter the city expansion and the compartmentisation of local area development, or etc.

The point is that this spatial configuration map of Bangkok can now be a basis for the investigation between the spatial and the socio-economic aspect, of which the intrinsic relationships within individual systems are central to the study. It can, indeed, also allow us to expand our investigation into the relationship between various physical and spatial factors, for example, traffic, land-use types, building types, block size, plaza distribution, etc. With all these understandings, what we can best hope for is the way we can literally and subtly change Bangkok into a kind of a city everyone wants it to be, or, at least, would be able to inhabit.

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