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SPATIAL GROWTH AND FUNCTION IN A JAVANESE COASTAL CITY

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Abstract

This study addresses the question "What is the appropriate design solution for the developed streets of a Javanese coastal city" The presentation focuses on three major streets in the northern part of the city of Surabaya, which have spread outwards from the historic core. GIS-GRASS, a Geographical Information System, can be used to map areal objects such as land-use, the role and function of streets in the city, traffic, movement and static activities, and linear objects such as rivers and the boundaries of areal planning units. The spatial database recorded here includes the configurational mapping of space syntax. For the local government, whose concern is to prepare design solutions which take account, inter alia, of the role of the street within the configuration of the city as a whole, this is a valuable tool.

Key words: configuration, movement economy, databases, GIS-GRASS

0 Background

Surabaya, the capital of eastern Java (Figure 1), was formed historically through the expansion of the early Indonesian (*Indische*) town and the absorption of local centres and European trading posts. The northern part of the city, which spread outwards from the historic core, preserved the distinctive morphological character of the old centre.

Figure 1 - The map of Surabaya city and the study area

As noted by Handinoto, before 1905 most public and administration buildings were located in this area. One of these – the building where municipal affairs are handled - became the focal point of the area. The existence of this building, not only promoted growth of the surrounding areas growth as a central civic district, but also gradually established a central business district of the city (Handinoto, 1996). Many public and business facilities emerged which were organised by the native Javanese and the Chinese, especially along the main streets of the area. One particular street which is consist of three important segments within the area, namely the streets of Rajawali, Kembang Jepun and Kapasan, which are known as the major streets of the city.

A series of photographs of the major streets within the northern part of the city (Figures 2, 3 and 4 below) illustrate developments in the mode of transport (initially carriages, later motor vehicles) and the increasing density of traffic.

Figure 2 – The street of Kembang Jepun in 1920

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Figure 3 - The street of Kembang Jepun in 1984

Figure 4 - The street of Kembang Jepun in 2004

Together the photographs, maps and plans trace the evolving spatial structure of the area before and after independence, and suggest a relation between the spatial structure and the changing pattern of land-use and land values.

A recent study of the old town of Surabaya (van Ellen and Spijkerman, 1991 and Dajosanjoto, 2005) has indicated that there is an increasing interest in the preservation of the historic urban area. This is partly due to a growing awareness of the coherence of the urban space. The streets of Rajawali, Kembang Jepun and Kapasan, and the surrounding area are also seen today as an important element of the original Indonesian coastal city of Surabaya, which should be recognised as part of the cultural heritage.

One of the most important immediate tasks for local government is to control urban growth. As Streich (2002) has pointed out, it is necessary to inform the public that unsupervised conversion of open space is creating a major problem with many unwanted consequences for society. There is also a need to push forward political discussions and strategies to reduce the rate of change in the landscape as a whole. A local government then, whose main concern is to prepare design solutions which take account of the role of the street within the configuration of the city as a whole, there is a need for appropriate tools to assist in decision making.

1 The concept of the 'movement economy'

Hillier *et al* argue that there is an underlying principle that relates grid structure to movement pattern not only on the main lines into and out of a city, but also in the fine structure, giving rise to a multiplicity of interrelationships between grid structure, land-uses, densities, and even the sense of urban well being and fear (Hillier, 1996). This principle is termed the *movement economy*.

Recent work using the space syntax approach has increasingly highlighted the importance of configurational properties – relations which take account of all other relations in a complex – in understanding the structure and functioning of settlements. Analytical measures such as relative asymmetry (Hillier and Hanson, 1984 and Steadman: 1983) are designed to address these configurational properties at both the building and the settlement level.

In a discussion on urban sprawl problem, Streich suggested that the key to understanding this problem is mobility – understood as freedom of movement on the one hand and the movement actually carried out, on the other (Streich in Buhmann, 2002). This is applicable to the shift of urban activities to the surrounding areas of Surabaya that we discussed above. The mode of transport (initially carriages, later ~~of~~ motor vehicles) and the increasing density of traffic in the area considered to be dominant factor in the development of the streets of Rajawali, Kembang Jepun and Kapasan.

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2 Spatial Databases

GIS is a special type of information system concerned with the representation and manipulation of a model of geographic reality (Napier, 1994). It also has analytical capabilities and can be used to identify the specific use of land surrounding the streets. In the current study, to illustrate the concept of GIS at the simplest level, the historic street network of Surabaya is highlighted, and information about pedestrian movement is attached to each observed street. The correlation between the values of the streets (i.e. integration, connectivity and depth, both at a local and a global level) and the patterns of use can then be investigated. Other information, such as the existing appearance and/or profile of the street, the use of buildings lining the streets, the volume and frequency of encounters, and various static activities along, or within the street may be added to each street as required.

In GRASS (Geographical Resources Analysis Support System) data are stored in a directory structure. Before beginning to work with GRASS, we have to create a "GRASS data subdirectory" (called GRASS database) and specify it later within GRASS. In this directory, GRASS rganizes its data automatically through subdirectories. A few more words about GRASS terminology: as mentioned, a project area is called a location in GRASS. It is defined by its geographical boundaries with information about coordinates and the map projection. Within this location, area subsections, called *mapsets*, can be created. Within the database, data is divided into raster, vector and site (point) data, allowing differential treatment.

3 The study

Initially, the development of the three streets under study were traced in six different stages, commencing with the formal layout of the original Javanese centre (to mid 17th century). Beyond this was a period of increasing density, expansion and the start of functional differentiation of the city, extending to 1964. This historical sequence was chosen to ensure that the streets had an important role within the city as a whole.

The exemplary axial map is toned to show the global integration (Rn = radius infinity) of all lines within their respective zones (cf. a project area or location in GRASS). In addition to the Rn (integration radius n) analysis, an R3 (integration radius 3) analysis was also employed, e.g. one that counts only spaces up to three steps away from each space in the system. This gives a map of local, rather than global integration.

Figure 5
Development stage up to mid 17th century *the Javanese city*

Figure 6
Development stage in 18th century: *integration of the 1st Euro settlements into the structure of the city*

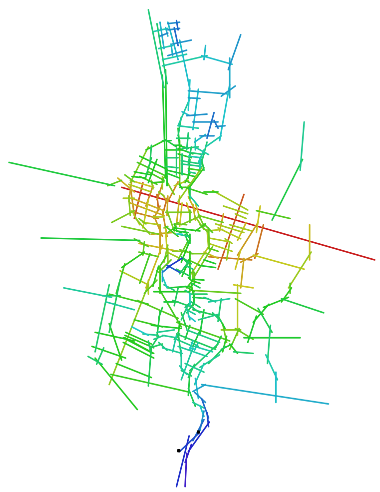

Figure 7
Development stage from 1800 to 1850*: expansion of the colonial city*

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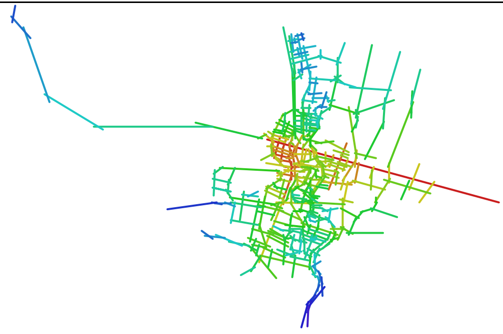

Figure 8
Development stage from 1850 to 1906*: the beginning of the modern city*

Figure 9
Development stage from 1850 to 1906*: the spatial dualism of European city and indigenous city*

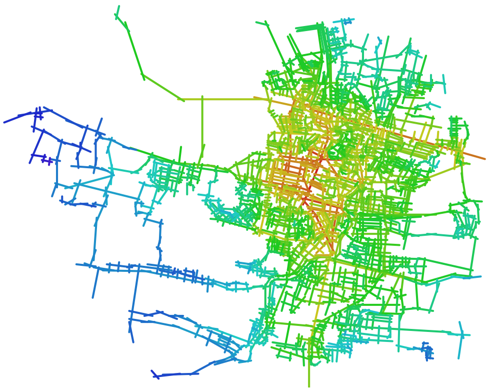

Figure 10 - Development stage from 1981:
the beginning of new Indonesian order

It is no surprise that the results of analysis of the street system applying space syntax indicate the persistence of major integrating lines shown by the three important segments within the area, i.e. the streets of Rajawali, Kembang Jepun and Kapasan. Figures 5 to 10 above show a sequence of six axial maps based on a historic map series from Santoso and Multhaup (1987).

The process shows below uses the integration map presented in Figures 11 and 12 below as a starting point. However, the object is to analyse and measure the role and function of streets within the configurational space of the city of Surabaya as a whole. The integration map is cropped for the project area where the streets of Rajawali, Kembang Jepun and Kapasan, and the surrounding areas are situated. Both the integration map (Figures 11 and 12 below) and aerial photography (Figures 13 and 14 below), then, contain information on land-use and the use of buildings.

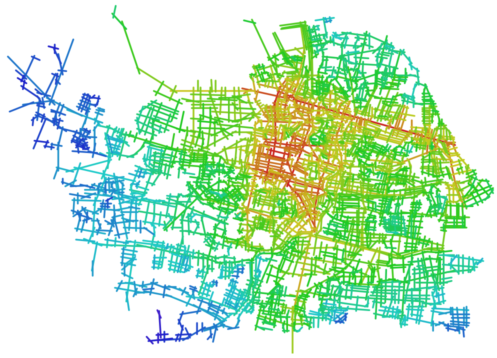

Figure 12 - Global Integration Map in 2004

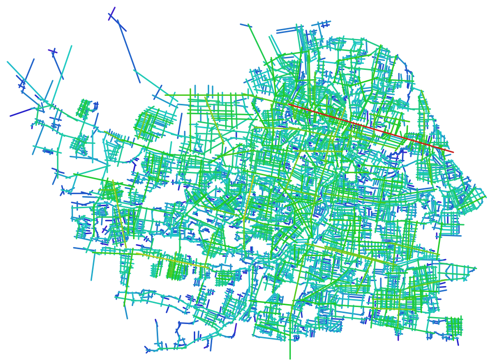

Figure 13 - Local Integration Map in 2000

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Figure 13 - The land uses of the major streets and the surrounding area

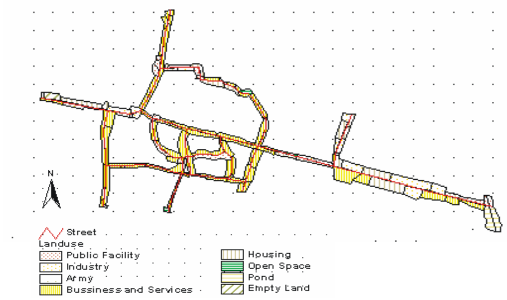

Figure 14 - The land uses of the major streets

Axial representation and analysis of the street system were supported by GRASS. The level of detail of the database is determined by the initial choice of project area. Geographical boundaries are defined by co-ordinates and the map projection according to information collected or made available. It is these maps and the associated data that are used to answer the question “What is the appropriate design solution for the developed streets in a Javanese coastal city?”

Physical data on a street-by-street basis, and socio-economic data such as moving encounters and static activities (i.e. food stalls, newsstands, cigarette stands, etc) on any street are then assembled in the spatial databases and the *mapset.* Figure 14 below shows the average of movement encounters per 100 meter, a ten minute of static activity and traffic (motorcycles and cars) of the three important streets - the street of Rajawali, Kembang Jepun and Kapasan.

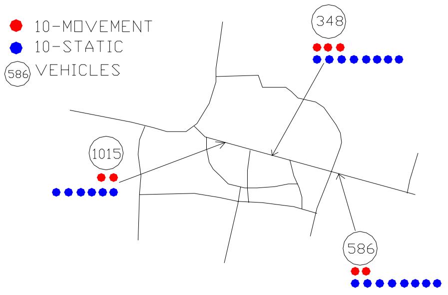

Figure 14 - A ten minutes of movement encounters, static activities and traffics map.

The difference values can be read from the integration map of Surabaya (re-drawn from the most recent maps of Surabaya). The red lines are the most integrated, the blue the least integrated show on the global integration map (Figure 12) and the local integration map (Figure 13) below.

Figures 14 and 15 above illustrate the project area. The streets under study are highlighted on the city street-network as a whole, and land use attribute of the streets under study shows in Figure 16.

The graphic component, coupled with the query capabilities, meant that locations and their associated conditions can be highlighted on the map (Figures 17 to 18). Issues such as the relationship between commercial activities and the major streets of Surabaya can also be clarified by attaching a colour code or raster tone to the spaces concerned. In the case of street development and/or rehabilitation, one of the subjects in which the author is particularly interested is the construction cost.

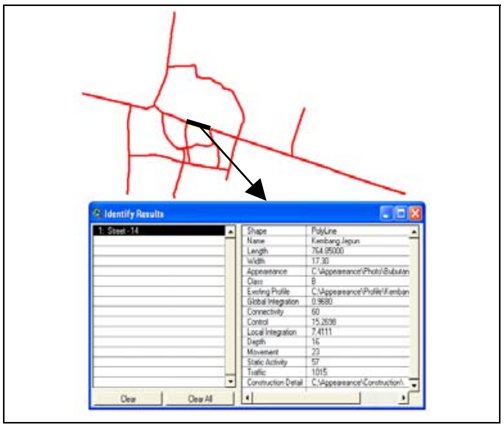

Figure 17 - The spatial database of Kembang Jepun street and its associated conditions

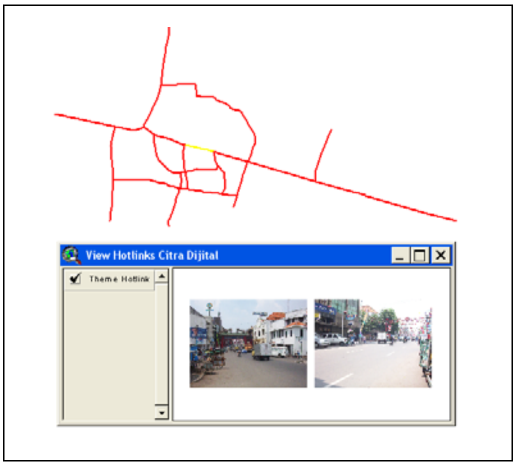

Figure 18 - The appearance of Kembang Jepun

Once the design proposal is prepared and the land uses indicated, it is possible to scan the streets by use of the camera tool, The cross section of any street can be drawn for further detailing. Figures 19, 20 and 21 below show three profiles and its prospective design solutions.

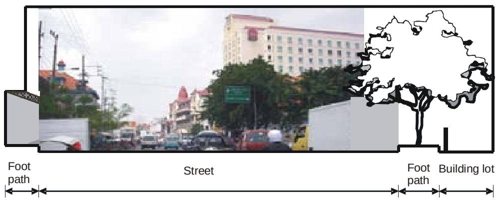

Figure 19 - The profile of Rajawali street

Figure 20 - The profile of Kembang Jepun street

Figure 21 - The profile of Kapasan street

4 Conclusion

In line with Hillier's theory of natural movement, local government has been paying increasing attention to the interrelationship between grid structure, land-use and density along the major streets of the city. Sense of well-being and/or, conversely, fear of moving encounters along the three major roads discussed here, are also issues with which the local government is particularly concerned.

For the above reasons, the re-organisation of the three streets has recently become one of the obligations of the local authority within the central business district. One of the three streets - Kembang Jepun - becomes a food centre in the evenings (Figures 22 and 23). Stalls, stands and restaurants, as well as decoration, create an attractive Chinese atmosphere, simultaneously preserving the old town and generating a level of activity which turns this quiet area into a place that is free from danger throughout the night.

Figure 22 - Kembang Jepun street in the morning

Figure 23 - Kembang Jepun street in the evening

The data, which are presented graphically or extracted directly from the database can, once again, be used to supply answers to questions concerning spatial objects and levels of activity – both moving and static. The user can augment the database at any time, allowing him/her to track the extent of transformation that is taking place in the project area.

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6 Acknowledgements

I express my deepest gratitude to Prof Hanson at the Bartlett School of Graduate Studies University College London for her kind assistance and helping me to come to terms with the space syntax software, and her patience, especially in giving me valuable comments on my work; and Dr. Brown at the Research and Graduate Study, Faculty of Arts, the University of Manchester for his contribution and valuable comments during the preparation of this presentation.