

The spatial flaws of new towns: Morphological comparison between a Chinese new and old town through the application of space syntax, spacematrix and mixed use index

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Abstract:

Man new towns are established in China with the intention of providing desirable places to live. Nevertheless, these new towns often lack the flourishing street life, small businesses, and variety of social activities that old towns have to offer. This paper explores the spatial reasons why old towns tend to perform socio-economically better than new towns by adopting Space Syntax, Spacematrix, and Mixed Use Index (MXI) through geographical information system (GIS). These three analytical tools are first applied separately and then combined within the GIS matrix to compare Chinese new and old towns in terms of degree of spatial network configuration, building density, and degree of land use mix. The included case study will utilize the example of Songjiang, Shanghai, which features both a distinctive old town and new town section.

Songjiang Old Town features more urban areas with a high-level of spatial values from the perspective of street network configuration, building density, and land use mix as compared to its new town. These high spatial value urban areas promote a vital city centre, the type of which is absent from the new town. Meanwhile, Songjiang New Town's problems are caused by a lack of well-integrated main roads and local streets, a low degree of interaction between buildings and streets, and low degree of land use mix as well. Certain spatial principles explaining how the neighbourhood unit is poorly designed in accordance with current planning and urban design practice are identified in this article. Alternative spatial indicators for aggregating areas with a high degree of urbanity are proposed for avoiding these flaws in future practice.

Keywords: *New town development, urban morphology, urban design, GIS, space syntax.*

1. Introduction: Achievements and problems of new town developments in China

New town developments have been widely accepted as a planning strategy to decentralize the overcrowded populations and disperse functions in large Chinese cities. This new town movement emerged in Europe in the beginning of the twentieth century and since became an important urbanization strategy in contemporary Asia (Keeton, 2011; Ye, 2011). China experienced unprecedented economic and urban growth since the implementation of its reform and opening-up policy in 1978. The nation's urbanization rate jumped from 17.92% in 1978 to 46.59% in 2009, respectively, with 300 million people moving from rural areas into cities (National Bureau of Statistics of China, 2010). An urban decentralization strategy focused on the establishment of new towns was embraced by Chinese planning authorities to handle the urgent demands of migrants to reduce urban problems including congestion, overcrowded houses, etc.

New town construction has rapidly increased across China since the 1990s. Around 100 new towns were planned and several have been constructed over the past two decades (Zhou, 2008). Chinese urban planners incorporated some experiences from past European new town developments in decision-making on location choice, economic development, and transportation policies. Many new towns successfully became the growth centres of their respective regions because of the relocation of industry and other vital sectors. However, these new towns are not good examples of creating vital and lively urban areas (Brömmelströet and Stolk, 2007; Keeton, 2011; Zhou, 2012).

The concept of using the residential neighborhood unit as the pattern for planning new development was proposed by Perry (1929) and then introduced from the USSR to China in the 1950s. The idea was to create a calm and quiet housing area with relatively safe streets separated from the rest of the traditional city structure. After half a century of development, the residential neighborhood unit pattern combined with comprehensive master planning and zoning aiming to create functional separation together formed the theoretical foundation of Chinese planning practices. This approach has a high degree of operability which is easy to implement for the various governments and construction companies. The master plan outlines street networks, where main roads are used to form boundaries for different residential neighborhood units. In turn, the distances between the main roads and the local streets are decided by the specific requirements of constructing each local residential neighborhood unit. However, this residential neighborhood unit concept is based on the ideas of "vehicle transportation first" and "functional distribution." The practical effects are a lack of street life, and dull, mono-functional neighborhoods. This approach has been increasingly questioned from the perspectives of sustainable development and promoting urbanity (Dai and Wu, 2013; Li et al., 2008; Sheng, 2012; Zhou and Zhang, 1999). For better or for worse, this practice was widely applied to all new town planning, affecting the urban face of the entire nation.

In this paper, the concept of "urbanity" will be used to describe an area's degree of socio-economic performance, as measured by high degrees of functional mixture, street life, presence of small-scale businesses, and a high degree of density of the built mass. Although the definitions of urbanity are various, in short, an area's degree of urbanity depends on its socio-economic performance influenced by urban form (Montgomery, 1998; Marcus, 2007).

The lack of high degree of urbanity is still a typical characteristic of Chinese new towns, which stands in stark relief to their old, organic counterparts. Therefore, according to the urban socio-spatial dialectic, some correspondence between the low degree of urbanity and the spatial arrangement of new towns should exist. Some researches use qualitative analysis or personal experiences to seriously question the development of residential neighborhood units, especially in terms of the internal street network hierarchies and mono-functional land use aspects (Li et al., 2008; Zhu, 2006). Nevertheless, these criticisms tend to be unsystematic and abstract. Therefore, it is necessary to provide an objective understanding of urban form by identifying the spatial flaws of new towns by quantitatively comparing their properties with those of their historically-developed counterparts.

2. Case selection and research design

Songjiang is located near the Shanghai City Centre. Its traditional district, now known as Songjiang Old Town, has a history dating back to the sixteenth century. Things changed rapidly after the 1990 establishment of the Shanghai Special Economic Zone (SEZ) propelled two decades of rapid economic growth. International business was attracted by the special economic privileges of the SEZ, generating a massive flow of working migrations to Shanghai (Den Hartog, 2010). In order to alleviate stress on the urban core and provide for an increasing population, the “One City Nine Towns” project was approved in 1999. It proposed to build a series of new towns (each housing 300,000 to 1,000,000 residents) around Shanghai. Songjiang New Town is the “One City” in this plan (Figure 1).

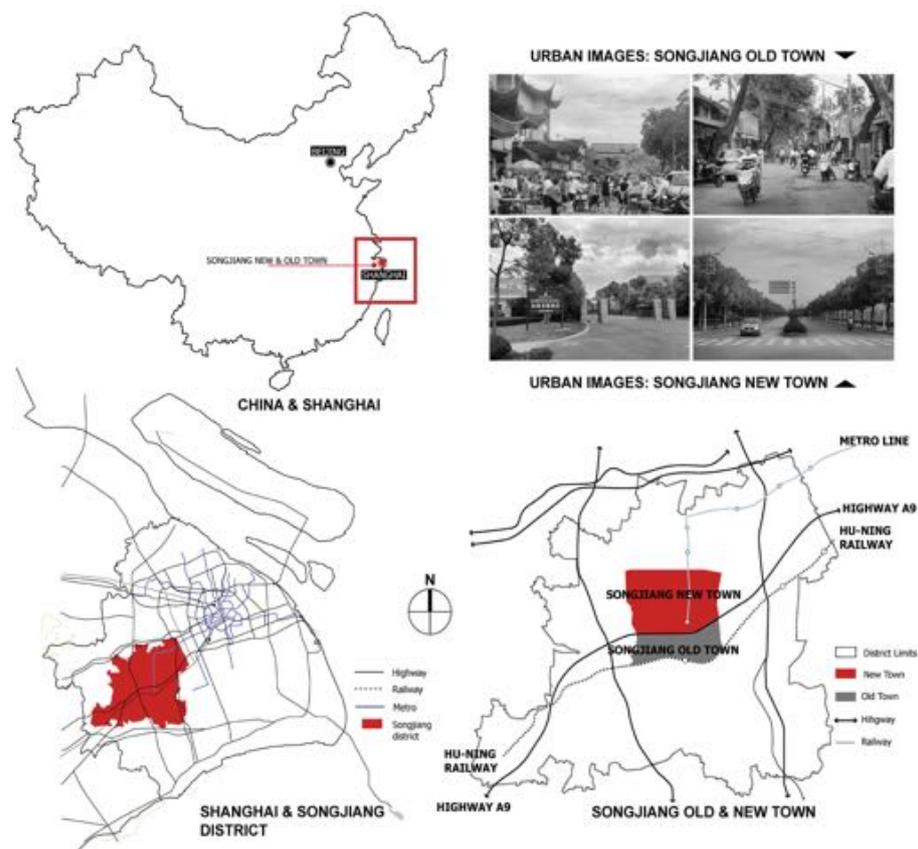


Figure 1. The cases of Songjiang new and old towns.

The historic Songjiang Old Town is marked as the grey area located between Highway A9 and Hu-Ning Railway in Figure 1, while the Songjiang New Town is shown as the red area developed north of Highway A9. Key infrastructure projects and the economic sectors were finished in the first development phase (2001-2003), including universities, a central green park, and the city hall. The second development phase (2003-present) focuses on residential projects, as it aims to receive the population transfer from the Shanghai City Centre. As of the time of this writing, the new town construction is almost complete. Only a few housing projects and parts of the financial center are still under development. The main road network is complete, several universities are in use, and basic facilities, such as primary schools, hospitals, and some retail stores have been provided. After only ten-years of construction, Songjiang New Town covers an area of more than 20 km². Some consider such rapid development to be an urban miracle (Zhou, 2010).

Unfortunately, the livability and urban vitality of this new town did not increase in line with its physical growth. As Figure 1 shows, the image of Songjiang New Town seems unanimated and suburban. In contrast, Songjiang Old Town is much better in generating various urban activities and vibrant street life. Although the old and new town share close proximity, and similar transportation features and population densities, their degree of urbanity remains very different.

What then are the spatial differences between Songjiang New Town and its older counterpart? To what extent do the various spatial properties trigger the different socio-economic performances of the old and new towns? A quantitative and objective assessment is needed in the first instance. The first step is to redefine the most representative spatial properties of urban form from the urban morphology tradition by reviewing Conzen's "town-plan analysis" method. The basic, tangible elements of Conzen's method are: (1) town plan (i.e., streets, plots, and buildings), (2) patterns of building form (i.e., plots and the buildings located on it), and (3) patterns of land use (Conzen, 1960; Whitehand and Conzen, 1981).

The possibility of combining space syntax with the Conzen urban morphology tradition has been discussed for some time (Stanilov, 2010; Karimi, 2012). Recent advances in new quantitative spatial analysis methodologies such as space syntax, spacematrix, and mixed use index (MXI) make it possible to measure and compare various spatial properties with one another. For instance, the space syntax method has been applied to develop strategies for handling the spatial flaws of British new towns (Karimi et al., 2009). The idea of combining the space syntax and spacematrix methods to achieve a more comprehensive understanding on urban form was proposed by van Nes, Berghauer-Pont and Mashhoodi (2012). The strong correlation between street network configuration and building density found in their research inspires Ye and van Nes (2012, 2014) to further develop this technique as a comprehensive analysis method. Some initial applications have been made in the study of new towns' spatial maturation process as well (Ye and van Nes, 2013). This paper follows in this research vein to quantify and measure the morphological differences between Chinese new and old towns with the aim of identifying potential spatial flaws of Chinese new towns.

The space syntax, spacematrix, and MXI methods will be applied separately to compare three key spatial properties: street network configuration, density

and building types, and land use mix, respectively. Next, the results will be combined together through GIS to provide a comprehensive understanding of spatial differences between the new and old towns.

3. Applying space syntax to compare the street network configuration between Songjiang new and old town

The space syntax method encompasses a set of theories and techniques for the analysis of street network configuration in terms of topological, geometric, and metric distances (Hillier and Hanson, 1984; Hillier et al., 1993; Hillier, 1996; Hillier, 1999). In the angular analysis with a high metric radius, the main routes through and between urban areas are highlighted, whereas the various local centres in a built environment are highlighted with a low metric radius (van Nes and Stolk, 2012). The angular analysis with a topological radius can add topological considerations into it. As shown in Figure 2, both Songjiang New and Old Town's main roads are well connected in angular analyses with topological radii, although the local streets in the old town appear to be better integrated than those of the new town. Main differences between the new and the old town are revealed in the angular analyses with a metric radius. The new town performs poorly in the angular analysis with a low metric radius, whereas its old counterpart contains several large areas with highly integrated main roads and local streets in the angular analyses with both high and low radii. The historical centre of the old town especially has very high values in all analyses. In the angular analysis with a high metric radius, most of the old town's main roads obtain high integration values, whereas several of the new town's main roads demonstrate average integration values.

Combing all the various space syntax measurements together into one map can simultaneously demonstrate both spatial potentials for local neighbourhood centres and highly integrated main roads in each town. The raster method in GIS is used to convert all the spatial data into cells in order to provide a possibility of comparing and combining the vector-based space syntax data with the polygon-based spacematrix and MXI data. The size of the cell's raster cannot be too small, or else it will separate building variables from street network integration variables. However, too large of a cell raster size will reduce the precision of the vector-based analysis. Therefore, an ideal raster size of 150 x 150 meters per cell is used in this research.

First, the results from all of the space syntax analyses are converted from Depthmap into ArcGIS. Second, the numbers are roughly divided into high, middle, and low values via the natural break method. The purpose of this is to minimize each class' average deviation from the class' mean values, while maximizing each class' deviation from the mean values of the other groups. Lastly, the final configuration rates are provided according to both analyses with topological radii and metric radii (Figure 3).

The combination of various space syntax analyses yields an interesting result. Highly integrated main roads and local streets are well connected in Songjiang Old Town, shaping a large urban area containing both high global and local integration values, marked in yellow and red. This represents the town centre of the old town, a pleasant environment that supports the overlap of different mobility flows (i.e., vehicle transportation, bicyclists, and pedestrians). The area is a vital urban space where numerous social and economic activities take place. In contrast, only new town's main roads are highly integrated,

and they are mostly intended for vehicle transport. All of the other areas are poorly connected, both globally and locally. Although the town centre is well connected by main roads, its connection with local streets and surrounding areas is rather poor.



Figure 2. Various space syntax analyses of Songjiang new and old town.

Which spatial differences cause the poor performance of spatial integration in Songjiang New Town? Three neighborhoods containing town centres and neighborhoods in both new and old town are selected as comparative examples. Their maximum step depths and relationships between global and local integration are compared (Figure 4). In other words, all the Songjiang New Town cases tend to have cul-de-sac road structure. It is clear that all of the cases in Songjiang New Town double their step depths compared with its historical counterpart. Specifically, the maximum step depth from the inner roads to the surrounding main roads in Songjiang New Town's residential areas is around eleven to twelve, and eight in the town centre. In contrast, the step depth is only five or six in the residential area of the old town, and four in the historic town centre. Therefore, it is reasonable to assume that cul-de-sac road structures in the new town lead to an increase in high step depth and contribute to poor spatial integration of its street and road network.

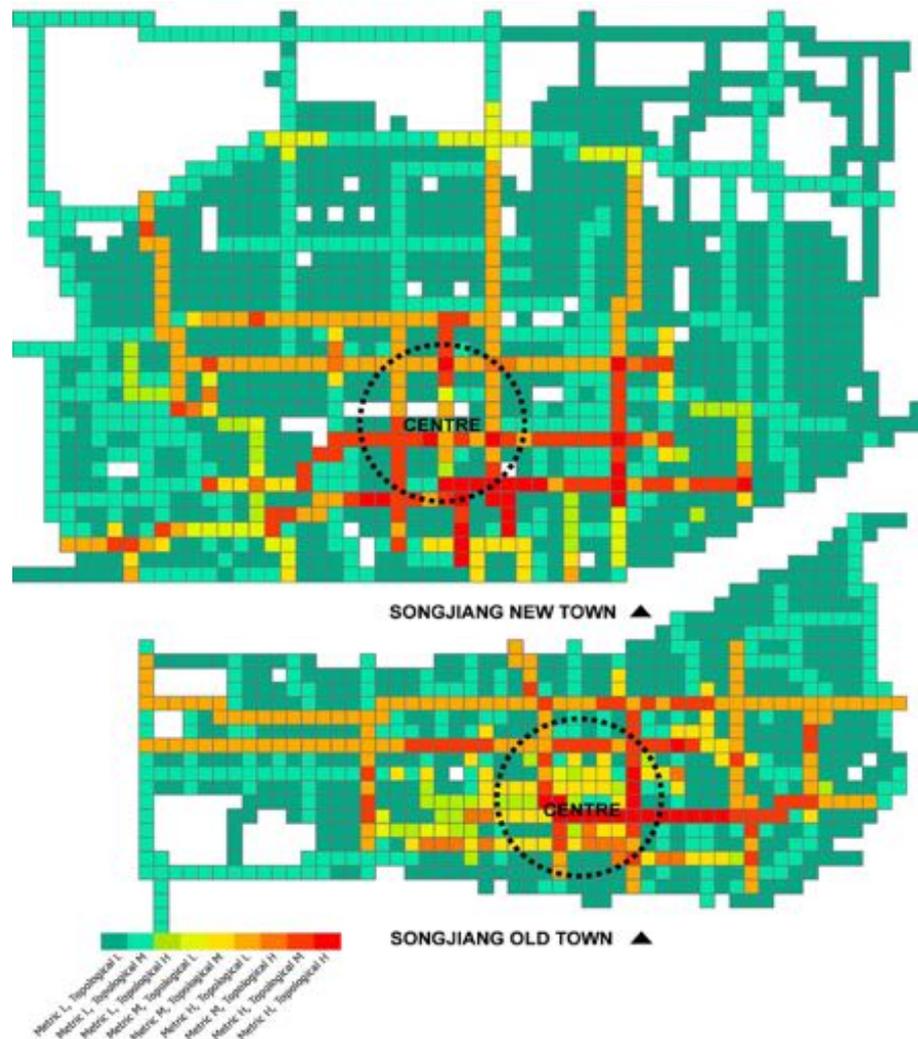


Figure 3. The comparison of street network configuration between Songjiang new and old town through the space syntax method.

A regression analysis of the scatter plots in the selected areas supports this assumption. The integration values in those plots are exported from Depthmap and calculated in SPSS. One red dot represents one street in the chosen neighborhood. The x-axis reflects the street's local integration values while the y-axis reflects the street's global integration values. The line in the diagram is the regression line, and it fits with the plots. Its slope rate reflects the corresponding rate between the global and local spatial integration values on the same streets. If the selected neighborhood has corresponding spatial integration values in both the global and local scale, the slope rate will be around 45°. Otherwise, it will be located close to the global (y) or local (x) axis. In addition, the R square mentioned in the diagram is a number between 0 – 1, which represents the accuracy rate of the model. The higher the number, the better the linear model describes the real situation. In other words, the streets have both corresponding global and local integration values.

The regression lines of the three local neighborhood areas surveyed in Songjiang New Town are almost horizontal, and the R square numbers are very low. That represents a group of plots containing either high global

integration and low local integration, or low global integration and various local integrations. Those two kinds of groups tend to be separated rather than overlapping, representing a gap between surrounding main roads and local streets. In contrast to the poor situation in Songjiang New Town, the research shows that some neighbourhood areas of the old town perform better. The regression lines in these areas are far from horizontal and have a higher R square than their new town counterparts. Overall, both of these analyses prove that the use of a cul-de-sac street structure in the new town contributes to poorly-integrated local streets and main roads. This pattern makes only the main roads accessible, limiting access to most local streets. Obviously, this spatial mechanism cannot support the overlapping of various mobility flows, which obstructs the development of lively, vibrant urban areas.

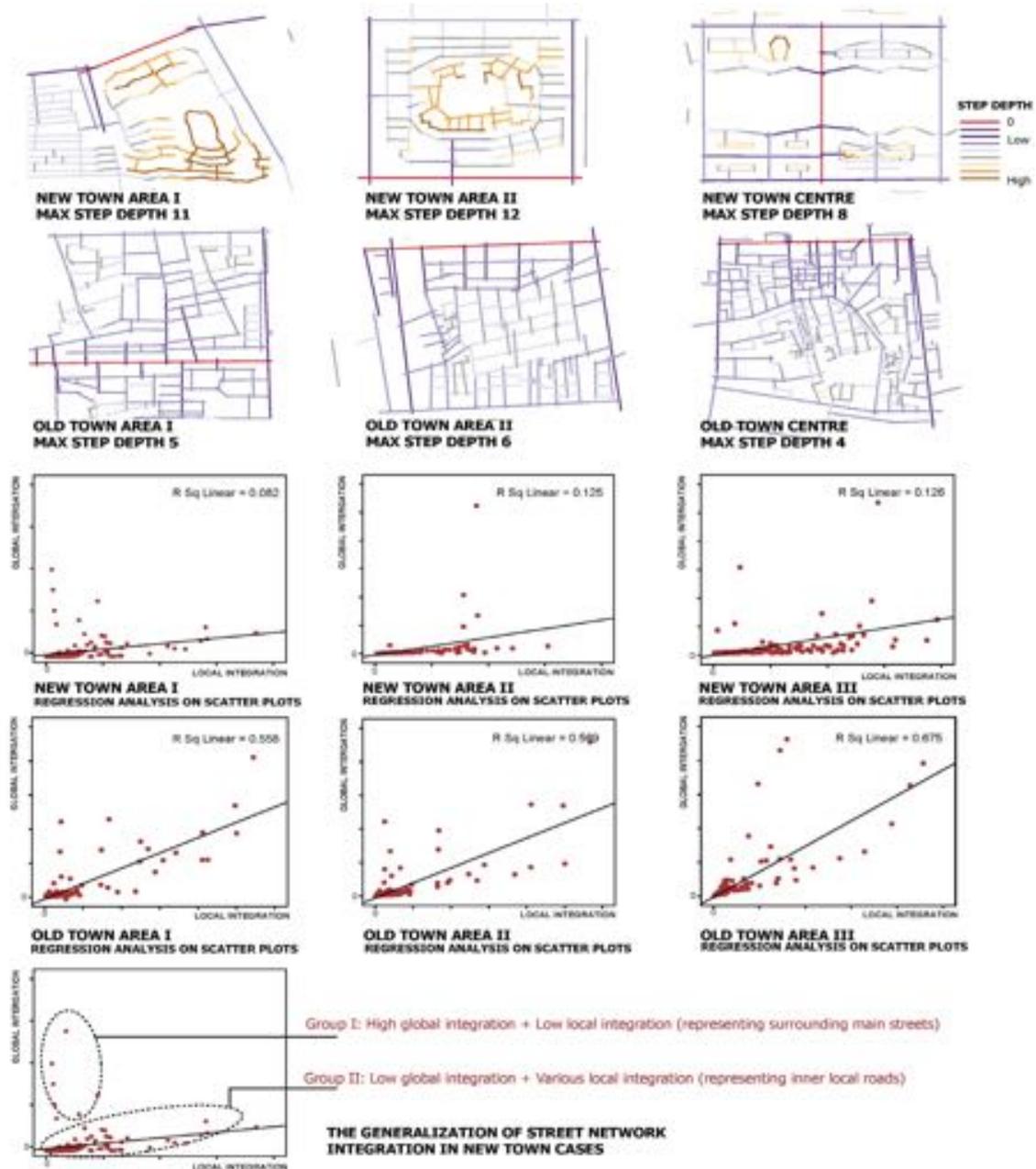


Figure 4. Defining spatial integration problems through step depth and scatter plots analyses.

4. Applying spacematrix to compare density and building types between Songjiang new and old town

The spacematrix method contributes to quantify density and various building types (Berghauser-Pont and Haupt, 2010). This classification makes it possible to quantitatively describe the combination of intensity, compactness, pressure, non-built space, and height, which can be used to differentiate between urban forms in a more efficient way than ever before (Berghauser-Pont and Haupt, 2007:63). Spacematrix is inspired from the work of Johan Rådberg (1988, 1996) and it correlates the following measures with one another: floor space index (FSI), ground space index (GSI), and the average number of floors or layers (L). Here FSI on the y-axis gives an indication of the built intensity of an area while GSI on the x-axis reflects the coverage, or compactness of the development. The L represents the average number of storeys. The building types are classified into low-rise, mid-rise, and high-rise based on floor numbers. The building types are also separated into point type, stripe type, and block type based on building forms. The entire built environment can then be divided into nine categories (from A to I).

According to the building type's influences on urbanity, low-rise point and low-rise stripe types belong to the low value, while mid-rise stripe and block types and high-rise block type belongs to the high value. The remaining categories belong to the middle value. Through the use of GIS, the spatial property of density and building types in both of Songjiang's new and old towns can be compared visually and quantitatively. Uniform raster size can provide a convenient means to compare these results with the results of the other two analyses.

In addition, it is necessary to mention that Berghauser-Pont and Haupt's spacematrix method is developed in Dutch context where the building density is relatively lower compared with China. Whether the original parameter sets in spacematrix need to be adapted should be clarified. According to current planning requirements, Songjiang new town is allowed to develop low-rise townhouses with two to three floors while its old town counterpart contains many old low-rise buildings as well. The majority of both towns are constructed by middle-rise (six floors) and high-rise buildings (higher than seven floors), although the percentages may be different in two cases. Buildings in both two towns can also be defined as point type, stripe type, and block type. Therefore, it is reasonable to conclude that the original parameter sets of spacematrix do not need to be revised since building floors and building types in these two Chinese cases can still be divided into the same three levels and fitted into the original diagram. Nevertheless, these building factors may vary in different Chinese towns, especially in these mega cities. A judgment is still required from case to case in future applications.

As Figure 5 shows, both cases demonstrate a large number of cells with a high value in the spacematrix analysis because of China's high-density development strategy. The two share similar densities but different building types. Specifically, a high number of high-rise point types can be found in Songjiang New Town, whereas the middle-rise stripe and middle-rise block type are dominant in the old town, especially in the town centre area. The FSI-GSI tables also illustrate the same features. The major distribution of GSI in Songjiang Old Town is located between 0.15 and 0.35, whereas it moves toward 0.1 and 0.25 in the new town. In other words, Songjiang New Town tends to be built up with more point and stripe building types rather than block

types. Comparatively speaking, that means that the total amount of potential interactive space between buildings and streets is significantly less in the new town. Several research projects prove that the spatial possibilities for interaction between buildings and streets (such as active frontages facing the streets) affect the chances of creating vital and lively urban areas (Gehl, 1987; Jacobs, 1961; Joosten and van Nes, 2005). These types of spatial features obviously affect the aggregation of street life in Songjiang New Town.

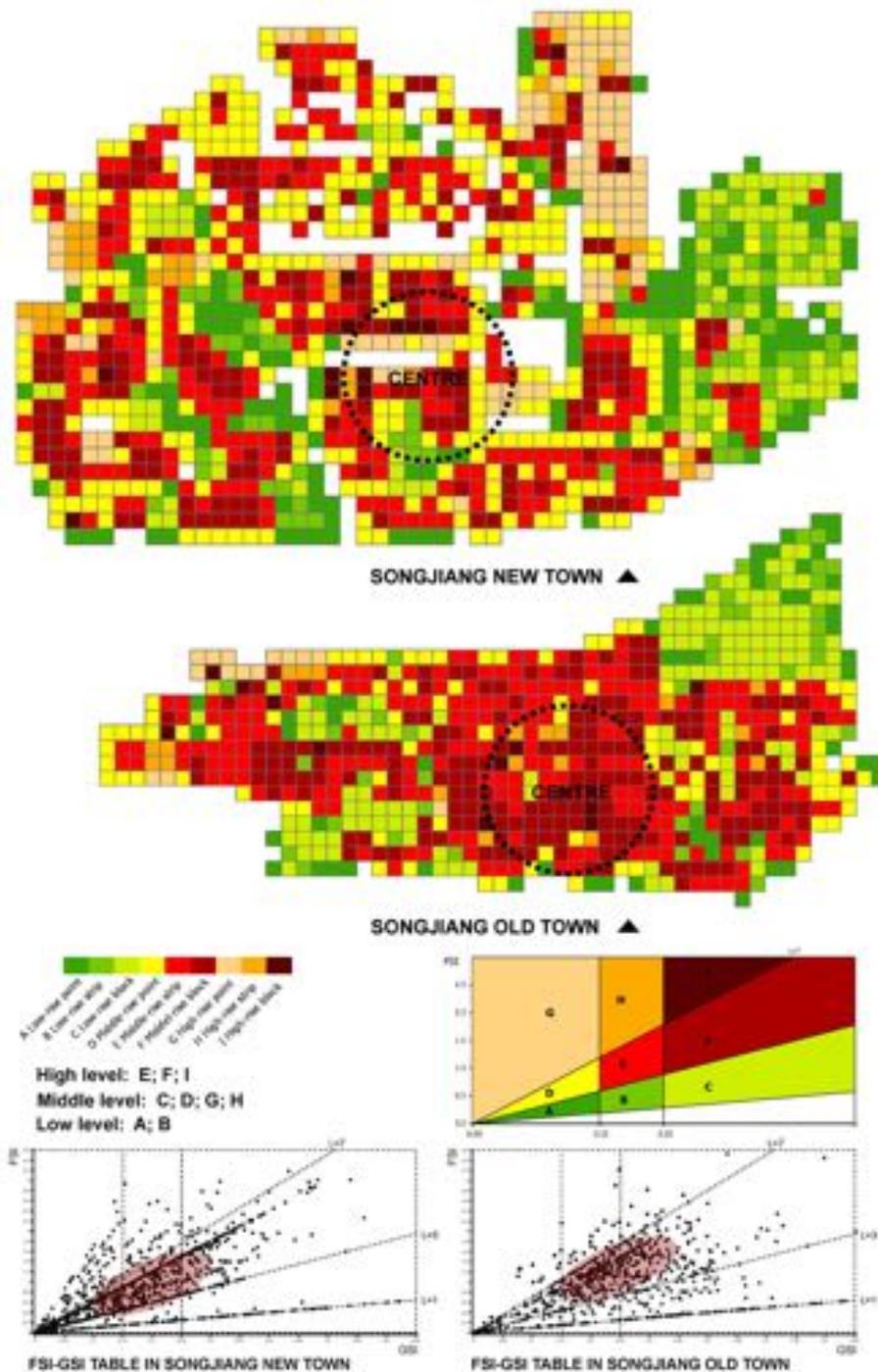


Figure 5. The comparison of density and building types between Songjiang new and old town through spacematrix.

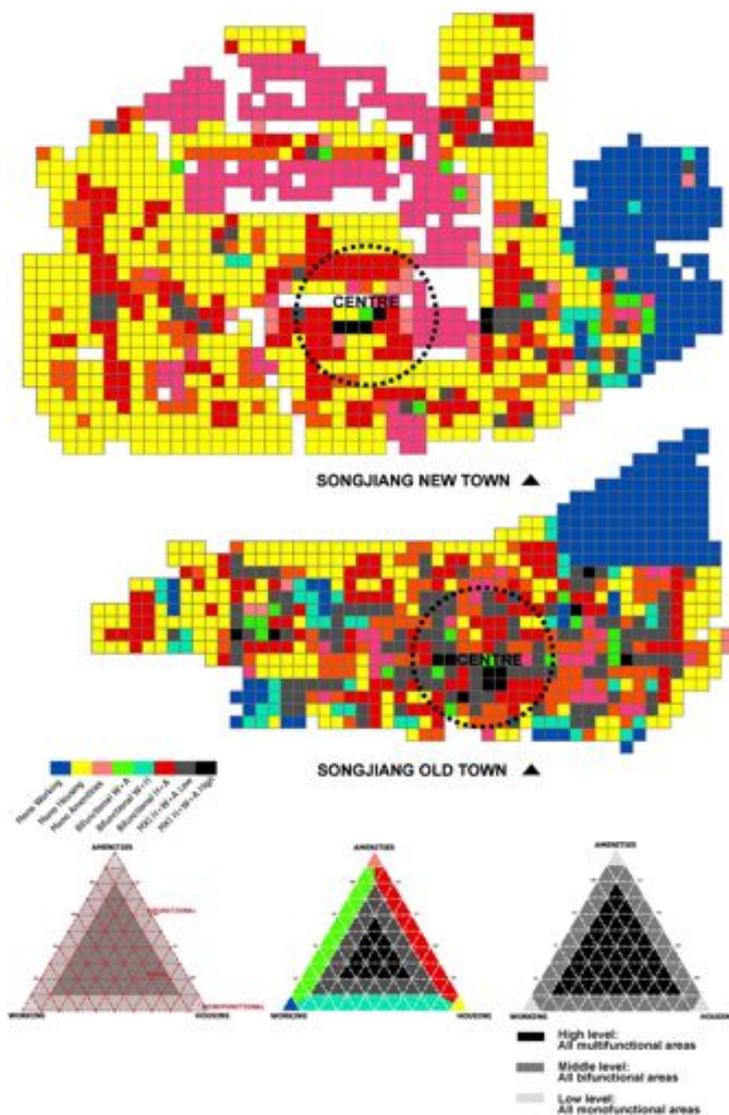


Figure 6. The comparison of land use mix between Songjiang new and old town with the use of MXI.

5. Applying MXI to compare the degree of land use mix between Songjiang new and old town

The mixed use index (MXI) was developed by van den Hoek (2008, 2009) to measure various degrees of multi functionality of land use. The MXI model deals with the degree of functional mix in a quantitative manner in terms of the percentage of dwellings, working places, and amenities, measured in building spaces. The function Housing includes various buildings for residential living, such as apartments, condominiums, and town houses. The function Working implies places of occupation such as offices, factories, and laboratories. The function Amenities implies all kinds of commercial facilities such as shopping and retail, societal facilities such as schools and universities, and leisure facilities such as sporting venues, cinemas, concerts, and museums. Figure 6 shows a triangle matrix on how these three functions can be correlated and divided into high, middle, and low values of multi functionality. The three corners of the triangle represent one single function, which are either 100 per cent amenities, 100 per cent dwellings, or 100 per cent working places.

An area consisting of three functions (with each function occupying a minimum amount of ten per cent) is regarded as a multi functional area, which may have a highly positive influence on the degree of urbanity. This area receives a high value and is marked in grey or black. An area consisting of two functions is a bi functional area, and therefore receives a middle value. An area that only has one function is a mono functional area and therefore receives a low value.

As a product of long-term evolution, Songjiang Old Town consequently has a higher function mixture than the quickly developed Songjiang New Town. As Figure 6 demonstrates, a higher number of black and grey cells can be found in the old town than in the new town. However, several highly mixed cells still can be found in Songjiang New Town's centre. It therefore seems that the planners recognized the importance of land use mix. Nonetheless, this strategy was only implemented in several blocks of the central areas, which actually degrades the overall centre into several building complexes with mixed functions. Mono functional residential neighborhoods are still

dominant in the new town. They are built according to zoning restrictions with a separation of functions. In contrast, a strong functional mix structure is shown in the entirety of the old town, not only concentrated in its historical centre but extending throughout. It is the high mix rate and wider distribution of functional mix areas that contribute to a high degree of urbanity in the old town, but are lacking in the new town.

6. Combining various spatial properties to visualizing the differences between Songjiang new and old town

The spatial integration values, density values, and land use mix values are analyzed separately at first. Since the research method used in this paper based on the framework of cells, therefore, it is possible to combine various spatial properties together can yield a comprehensive understanding of all of the urban morphological differences between the new and old towns. The three spatial analyses mentioned above defined values as belonging to high, middle, and low levels. Based on these values, it is possible to classify various types of urban morphological developments into seven categories.

The seven categories are ranked from low to high value, and from suburban to low-urban, as well as various in-between areas including middle-urban and highly-urban areas (Figure 7). The high or low value of categories should, to a certain extent, coincide with the degree of urbanity because spatial properties represent urban morphological developments. For instance, the suburban category consists of urban areas containing two or three low values and one middle value in all measurements. Thus, this area is labeled as an area with a low degree of urban development.

The new town demonstrates a much lower degree of urban morphological development than the old town, which reflects the limited number of middle-urban and highly-urban cells. While 19.8 per cent of cells belong to the high level of development in the old town, only 8.4 per cent do so in the new town. The lower morphological development reflects poor socio-economic performance and a lower degree of urbanity.

Furthermore, the geometric distribution of middle-urban and highly-urban cells also reveals some interesting findings. Most highly-urban and middle-urban cells of Songjiang New Town are located along the main roads. They tend to scatter over a large area rather than concentrate in the centre. In contrast, a spatial structure with a high degree of urbanity consisting of highly-urban and middle-urban cells can be seen in the old town. The vital urban centre also can be found in this highly urbanized structure. Therefore, the main spatial differences between Songjiang's new and old towns can be identified as the aggregating of vital town centres and the development of highly urbanized spatial structures.

Moreover, Ye and van Nes (2012)'s research in a set of Dutch new towns prove that the spatial transformation towards more vital town centres and urbanized spatial structures does exist in the development of new towns. Although new towns tend to show a more networked structure rather than follow the corresponding old towns' mono-centric structure, the overall trend is similar. Therefore, it is possible to conclude that aggregating vital town centres and developing highly urbanized spatial structure are the two spatial goals for developing new towns with high urbanity. Principles learned from old towns –

where the street network integration is high at various levels of scale, where there are active frontages between buildings and streets, and where there is a multi-functional land use – need to be applied in new towns.

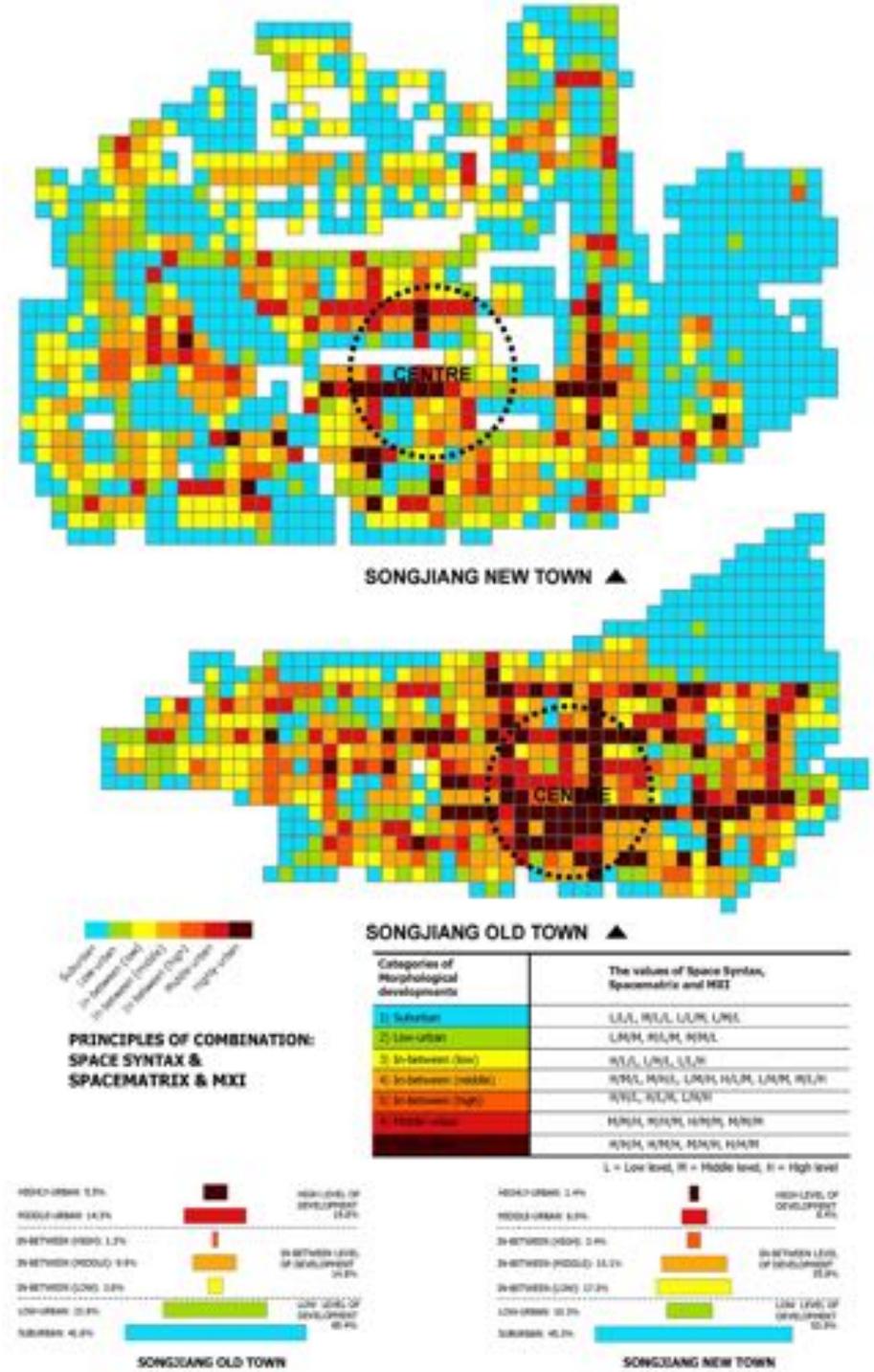


Figure 7. Comparison of general urban morphological differences between Songjiang new and old town through space syntax, spacematrix, and MXI.

7. Conclusions and challenges for regenerating poorly functioning new towns

The first spatial flaw of Songjiang New Town is a poorly inter-connected street network at several levels of scale. The demonstrated spatial features in building density and functional mixture also have a negative impact on promoting a high degree of urbanity. The so-called town centre in the new town is nothing more than a pedestrian-unfriendly building complex with an inward oriented shopping mall and dwellings turned away from streets. The identified spatial flaws of Songjiang New Town are as follow:

1. As regards the street structure, the high number of cul-de-sac streets contributes to a poor degree of spatial integration on the street network which creates fragmented and disconnected neighborhoods. The design of the street structure of Songjiang New Town is influenced by the principles of the inward oriented neighborhood unit pattern. The focus is on providing fluent vehicle transportation and to avoiding through traffic for internal streets, rather than providing a pedestrian-friendly environment.
2. As regards building density and building types, the high-rise point building type has replaced the middle rise strip and block type in the new towns. This leads to a decrease of interactive spaces between buildings and streets.
3. As regards the degree of land use mixture, the strict zoning rules and the enclosed residential neighborhood unit developing pattern contributes to mono-functional urban areas with a separation of dwelling, working, commercial, and leisure activities.

Certain traditional principles of the neighborhood unit, including “placing arterial streets along the perimeter,” “designing internal streets using a hierarchy,” and “restricting local shopping areas to the perimeter” (Perry, 1929:25-44) are clearly proven as obstacles to creating lively urban areas. Seemingly, the current planning system and urban design practices based on the enclosed neighborhood unit idea restrict possible social and economic interactions in the urban streets.

The problems of Songjiang New Town show that there is a need to suggest new guidelines for steering the development of other new towns which are current being planned or under construction across China. The focus needs to be put on developing vital urban centres that provide a spatial structure with a high degree of urbanity. Achieving those two goals requires improvements in the following three directions (Figure 8): enhancing the inter-connectivity of the street network, enhancing the space for interaction between buildings and streets, and encouraging a high mixture of urban functions.

The first step is to re-link the cul-de-sac road structures inside the large-scale urban blocks to replace the internal streets with a hierarchy. This creates smaller urban blocks with a higher degree of inter-accessibility provided by a network street pattern. This suggestion corresponds with the proposals of the New Urbanism School for creating vital urban areas (Bookout, 1992; Congress for the New Urbanism, 1996; Katz et al., 1994).

The second step is to encourage the transformation of the building mass from point and stripe types of buildings towards block types of buildings. Several high-density Chinese new towns suffer from a low degree of urbanity because

they tend to utilize point and stripe types of building which limits the possibilities for social interactions between buildings and streets.

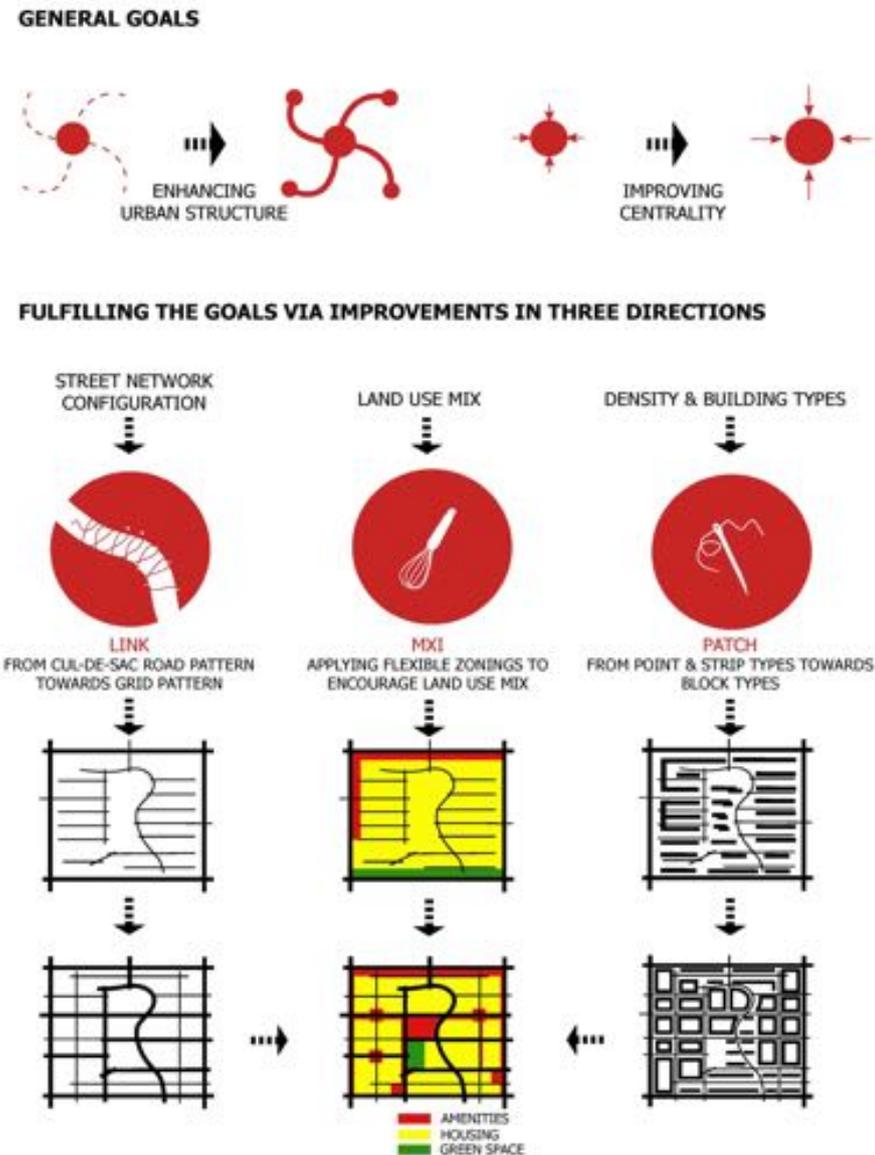


Figure 8. Some spatial principles promoting a high degree of urbanity in new towns.

The third step is to encourage a diverse land use mix. This requires flexible planning rules and zoning regulations to facilitate a high degree of multifunctionality throughout the entire town. Flexible governance can help functional changes over time, which is also important to promote land use mix. The traditional neighbourhood unit principle of restricting commercial areas to the perimeter for creating quiet living areas should be revised.

As the results of this inquiry show, the method applied is useful for visualizing and quantifying spatial properties of the built environment in terms of the degree of street network integration, density of buildings, and functionality. For urban morphologists, the proposed method contributes to add quantitative considerations into traditional qualitative morphological analyses, which

corresponds with morphologists' calling in recent years. For urban designers, it is able to assist design practices in diagnosing existed spatial flaws and making scenario testing of future design plans. Meanwhile, some restrictions also exist. As a method based on grids rather than blocks, the potential of high-resolution analysis is restricted and modifiable areal unit problem (MAUP) is emerged inevitably. This situation will lead to certain misunderstandings and require a careful selection on grid size. As a method only focusing on spatial variables, its results need to be considered together with socio-economic counterparts before a final conclusion is given.

To conclude, a revision of certain principles relating to the residential neighborhood unit pattern is needed. Principles proposed during an industrial age hardly meet the demands of a contemporary urban context. Moreover, a genuine understanding of the role of various spatial drivers is useful in planning the next generation of new towns. As this research shows, interdependencies exist between street network configuration, density and building types, and the degree of land use mix. Further exploration is needed to quantify the relations between these three spatial properties and to understand urban transformations over time. As Hillier (2006) asserted, cities have their own evolving logic. Interpreting it requires at least an understanding of how various spatial parameters affect a town's socio-economic performance.

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Notes

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