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''DEVELOPMENT OF EVALUATION MODEL FOR INTENSIVE LAND USE IN URBAN CENTERS''

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ABSTRACT

Starting with exploration from the angle of urban spaces, this research was conducted by analyzing the functional areas—urban centers with the foremost highlighted contradictions in terms of intensive land use so as to develop an evaluation model for intensive land use in urban centers. supported quantitative research methods, and taking under consideration three aspects of intensive use, i.e., buildings, lands and traffic in addition as multiple evaluation factors, this paper conducted the research horizontally by means of quantitative and comparative studies on each individual factor, developed the evaluation model for intensive land use in urban centers, and analyzed the driving forces of intensive land use from the aspects of buildings, land use, roads, etc.

Keyword: Evaluation of land for infrastructure development, urban land evaluation.

1. Introduction

With the rapid development of tertiary industry in China since the 1980s, the roles of cities have gradually been transformed into distribution and repair centers. Both living service and productive service industries have successively been clustered in urban centers, rendering this sort of agglomeration in each city a brand-new status in terms of both scale and extent. Mutually of the nonrenewable resources, land in urban centers is faced with increasing pressures having emerged from those dimensions of space, traffic and landscaping, etc. Only by means of applying the intensive mode of land use to a greater extent will or not it's possible to implement its central service functions. Therefore, it's the metropolis that imposes the best demand toward land use in higher density.

However, in most cities of China nowadays, intensive land use in central areas is insuf-

ficient, with significant waste of space. On one hand, non-public facilities are laid get in lower density, occupying substantial urban lands, with extensive use of space and lower space revenue; on the opposite hand, public facilities aren't constructed in an exceedingly sufficiently intensive way. Low-rise public buildings occupy extensive lands, making it impossible to require full advantage of land value in urban centers. of these problems, together with other issues, like excessive area of street blocks, lack of urban branch systems, poor management and organization, etc. have impeded the implementation of public service function of urban centers (Wang, 2009).

This paper developed a search analyzing the functional areas—urban centers with the foremost highlighted contradictions in terms of intensive land use—in order to construct an evaluation model from such dimensions as spatial forms, structural elements and repair functions, elaborated, with respect to land use, deep reasons of intensive land use at medium–micro -level, and explored the particular pivot points of areas with central functions for intensive development strategy.

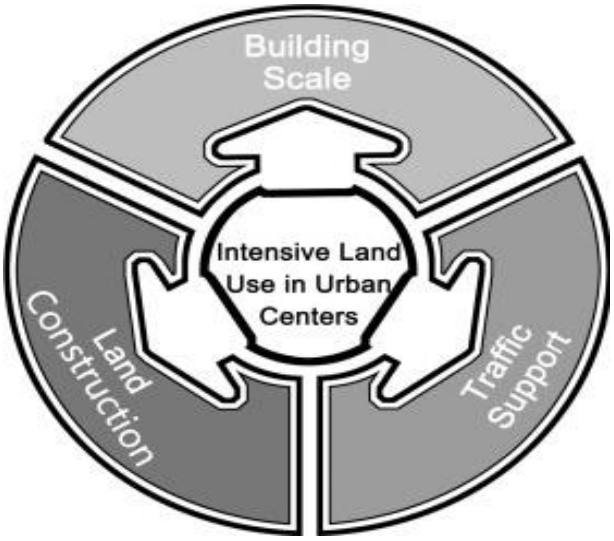
2. Impact factors of intensive land use in urban centers.

Urban center is that the core area of urban development, of which compact spatial forms present intensive land use within the whole area. In considering evaluation index system on intensive land use in urban centers, this paper began with the exploration of the core problems of land use from the angle of spaces, deduced the impact factors associated with the event and construction of land in urban centers, and created the evaluation index system on intensive land use in urban centers by incorporating interactions of these impact factors. Space research is at the middle of the study on intensive land use in urban centers. The indices for evaluating intensive degree of spaces carry with it the subsequent three aspects.

2.1. Intensive scale of buildings in urban centers.

Building spaces implementing public functions include various spaces undertaking urban industrial functions within urban centers, which satisfy the necessities of the evolu-

tion of the styles of urban public spaces. They also act as material carriers for the event of industry. We may say that, to a particular extent, the intensive development of urban centers depends on high degree of clustering of building spaces with public functions. Furthermore, in selecting appropriate mode of urban land use, because of their different intrinsic attributes, functional spaces show different development trends, which are represented as spaces of building entities in numerous forms within urban centers. (Figure 1).



(Figure 1).

Figure 1. Structural chart of things for intensive land use in urban centers.

2.2. Intensive construction of land in urban centers.

Urban land is that the fundamental element of intensive land use in central areas yet because the source of clustering of varied sorts of material spaces. Moreover, urban land may be divided into supporting land and construction land, both of which have impacts on intensive land use. The distribution of supporting lands indicates the link between non-development lands, like greenbelt and water surface, etc., and therefore the overall spatial styles of central areas, while construction land has an impression on the forms and utilization efficiency of spaces with public functions.

2.3. Intensive traffic support in urban centers.

The intensive operation of spaces in urban centers relies on the efficiency of the structure of their road traffic network. Road traffic acts as a form of spatial support framework, orienting land expansion and development in urban centers. On the one hand, optimum accessibility facilitates the intensive development of urban centers and promotes intensification of spatial forms; on the opposite hand, as non-construction space in urban centers, road traffic could be a negative factor for intensive land use (Li et al., 2010).

3. Construction of index system for intensive land use in urban centers.

The following three factors of intensive land use in urban centers are further developed, namely buildings, lands and traffic. Related impact factors, like specific functional spaces of buildings, land subdivisions for business operation, proportion of street frontage, and ingroup clustering in urban centers, etc., are considered moreover. during this way, the indices of nine correlations are obtained so as to construct the index system for intensive land use in urban centers (Figure 2).

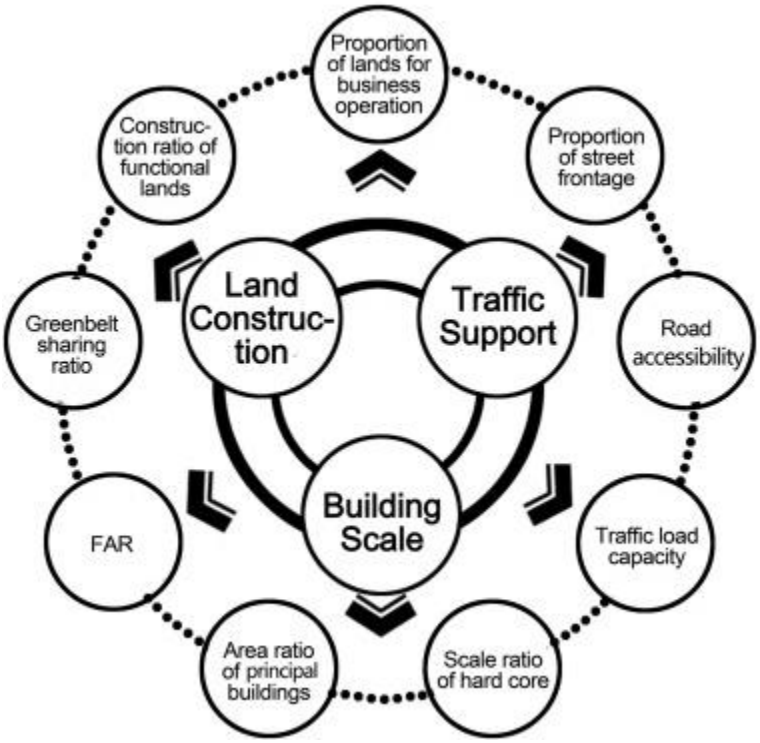


Figure 2. Construction of index system for intensive land use in urban centers.

3.1. Area ratio of principal buildings (A1)

In nature, the realm ratio of large-scale functional buildings represents the degree of spatial clustering of urban functions, indicating predominant trends of the event of urban functions in an city.

From the angle of intensive land use, the first ratio of functional spaces directly influences the evolution of spatial forms in urban centers, ensures effective implementation of leading functional spaces, and acts as a particular index for measuring the weather of functional spaces.

3.2. Construction ratio of functional lands (A2)

The restriction of the development ratio of lands with public functions on intensive land use has two-fold meaning. One refers to the dimensions of lands for developing the functional spaces of contemporary industry on the amount of street blocks. It relates to the world of the road block occupied by the entity of every functional space and indicates the use status of the lands available for construction in urban centers. the opposite relates to the development scope of lands making direct contributions to the event of urban centers, including urban lands which enhance operating efficiency of central areas, like land for road traffic. It also represents utilization efficiency of lands in urban centers. Therefore, land construction ratio is an index for measuring the weather of development.

3.3. Road accessibility (A3)

Road accessibility could be a specific factor of restriction on road traffic factors in urban centers, indicating the road area and also the number of straight road segments. Here, the amount of straight road segments implies the efficiency of traffic flow on the bottom.

Road accessibility index is defined as,

$$K = (\sum_{i=1}^{n} m_i / A) = M / A,$$

K is that the accessibility index of road network in city. A the realm of roads in urban center, mi the straight road segments at node I and M the entire road segments of

network in city With the identical area of land, the more the straight road segments, the smoother the traffic flow of motorcars. Road area indicates the reasonable utilization degree of overall road network within urban centers. In similar conditions, the more the road area, the greater the proportion of overall road network in terms of land use within the whole central area. This ratio implies that, given the world ratio of a road network with high efficiency, the more the straight road segments, the upper the efficiency of the road network structure as a full.

3.4. FAR (floor area ratio) (B1)

FAR is that the most blatant factor for measuring intensive degree of land use in urban centers. The FAR of urban centers indicates the general status of land use of spatial entities in those areas. Therefore, the FAR of urban centers depends on the interplay of the land for construction and therefore the buildings within those regions. FAR value represents land use in urban centers indirectly. However, because of the difference between land use mode for landscaping and land use mode for construction in urban centers, the features of the 2 different urban centers are usually represented under one same FAR value. Thus, FAR is biased towards building implications.

3.5. Traffic load capacity (B2)

In a broad sense, traffic load capacity represents intensive degree of land use and functional spaces in urban centers. Firstly, the entire area of driveways in urban centers indicates the scale of motorcar traffic, which becomes the muse of intensive traffic development. Secondly, the event of functional spaces in urban centers depends on the elemental basis established by traffic and other supporting facilities. Traffic load capacity indicates the operating efficiency of road traffic in urban centers, and is a vital index of intensive traffic land use in urban centers.

3.6. Proportion of street frontage (B3)

Proportion of street frontage is a very important index in measuring economic benefit

which has occurred in urban centers. It will be elaborated from two aspects. the primary relates to the interfaces of street blocks. In urban centers, the more the interfaces of street blocks created along traffic road network, the more the opportunities for service operations. they'll provide more services for other spaces with central functions created by entry and exit traffic. Therefore, street frontage shall be calculated as area per driveway of segments longer than 8 m in our analysis. The second aspect relates to road area. Where less road area creates more street frontages, it means more direct contributions of road utilization with high efficiency to economic benefits of urban centers.

3.7. Scale ratio of coterie (C1)

Hard core is that the clustering of functional spaces in urban centers of additional high density, with its scope defined as building area of functional spaces in urban centers accounting for 90% of the whole area. The size of clique may be a unique characteristic of the event of urban centers. the dimensions ratio of in group has two aspects of meanings. the primary aspect is that the proportion of the dimensions of legal right in in group areas, which indicates the degree of clustering within the coterie under the land use mode of urban centers. The second aspect is that the proportion between the building area of camp area and also the area of urban centers, which suggests the general characteristic of the dimensions of spatial clustering of the pack and acts because the yardstick for comparison of various clique areas in urban centers. Therefore, during this research, the proportion of building area in clique is adopted for both analysis and calculation.

3.8. Proportion of lands for business operation (C2)

The characteristics of lands in urban centers are diversified. However, they might be classified into only two types in step with the methods of land leasing. a method of land leasing is conducted by means of market competition, while the opposite is by means of transfer. The latter is generally applied to the sort of lands that provide supporting services for those lands acquired by the previous method. In urban

centers, it's mostly the lands for business operation that implement the function of central services and build primary economic benefits. Thus, during this study on intensive land use, the lands used for business operation are calculated inclusively, including the lands used for retail business, banking and insurance, business consulting, hospitality, entertainments, etc. the realm ratio of the lands for business operation to the lands for construction in urban centers is thought to be the
use efficiency of lands for business operation furthermore because the index of intensive land operation.

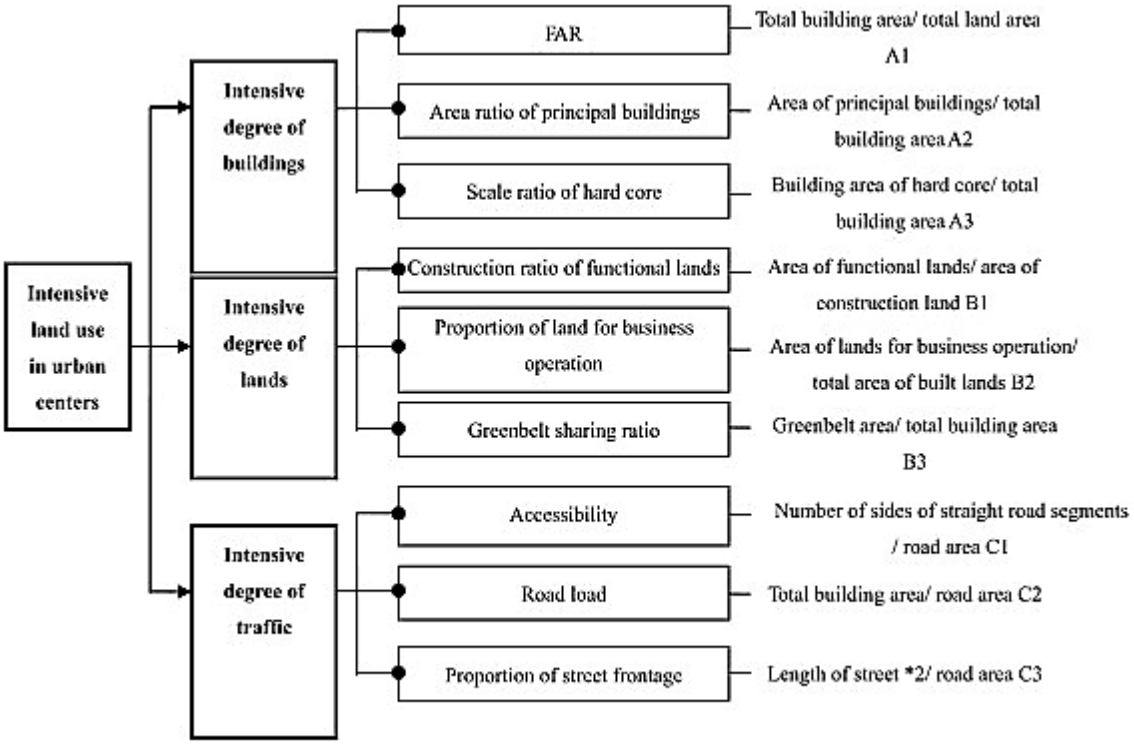
3.9. Greenbelt sharing ratio (C3)

Greenbelt sharing ratio indicates the degree of landscape clustering in urban centers. On one hand, the world of lands for landscaping is inextricably associated with the particular quality developed in urban centers; on the opposite hand, the layout of buildings in urban centers imposes specific demands on landscaping. Therefore, greenbelt sharing ratio denotes the world of lands for landscaping shared by per unit building area. Furthermore, different greenbelt sharing rates imply different construction modes of urban centers, like clustering and development of buildings with central functions with penetration of massive lands for lands caping, or otherwise, the low-density coverage of buildings with reduction of lands for landscaping.

4. Construction evaluation model for intensive land use in urban centers

Based on the above analysis, this paper constructed the general framework of evaluation indices on intensive land use in urban centers, which consists of three status levels, namely intensive degree of buildings, intensive degree of lands, and intensive degree of traffic. Each status level is further softened into three element levels and

given its weight. In turn, the index system of intensive land use is subdivided into nine specific indices (Figure 3), which can be quantified by means of both methods of the AHP evaluation model supported by entropy technology and therefore the qualitative index quantification supported by expert scoring. The “classification interval-valued” quantification of indices is also calculated by means of fuzzy membership function (Yang and Wu, 2006). Figure 3. Overall framework of evaluation indices on intensive land use in urban centers. After the calculation and analysis of the three basic levels, namely intensive degree of buildings, intensive degree of lands and intensive degree of traffic, the evaluation process of index system on intensive land use in urban centers is developed. The evaluation results on intensive land use in urban centers are obtained by means of information calculation and summarization of nine indices.



5. Application and discussion

Based on the evaluations on intensive land use in urban centers presented in literature at domestic and international levels, we discover that land use in each city has

certain development characteristics and should be generally classified into the subsequent four sorts of intensive development by means of information analysis.

5.1. Multi-mode of intensive use in urban centers (spindle shaped)

The multi-mode of intensive use is featured by two of the three basic levels (buildings, lands and traffic) of intensive use which show the characteristics of intensification, while the remaining level is underused, i.e., not showing proper intensification. for example, two urban centers—the Central Area and Tsim Sha Tsui in port, China—have distinct advantages in terms of intensive degree of buildings and intensive degree of lands. However, they're at a mediate level in terms of intensive degree of traffic. Another example, the Central District of Jianghan Road, Wuhan, is well-reputed for its intensive degree of traffic further as intensive degree of lands. However, in terms of intensive degree of buildings, it shows mediate level with the spindle shape within the structural chart. In all, these urban centers are intensified in land use as an entire with distinct characteristics. Therefore such mode of intensive use is very supported in specific evaluation system for intensive land use in urban centers, far and away setting the pace for the evaluation results on intensive land use of the other urban centers.

5.2. Single mode of intensive use mode in urban centers (dashed-line-shaped).

The single mode of intensive use indicates that urban centers don't develop comprehensively intensified land use in some regions. Instead, in terms of a selected index, it develops extremely high degree of intensiveness. Except that a pair of indices of intensive use are at average level, other indices are all below average on the evaluation list. Such urban centers usually concentrate on the event of a selected index. Compared with the development mode of other urban centers, such mode of land use may have many constraints breaching the development goal of urban centers. In practice, this mode leads to excessive land use for specific purpose with inconvenience for traffic network, for instance. Therefore, the only mode of intensive use has disadvantages for development (Wang and Shao, 2008).

5.3. Balanced mode of intensive use in urban centers (polygon-shaped).

The balanced mode of intensive use is usually adopted because the land use mode by most urban centers. This mode shows neither prominent single index of intensive land use, nor too many restricted indices. Instead, this mode of land use presents balanced intensive degree, with emphasis on each aspect. Under this balanced mode of intensive use, each index is comparatively on a mean level, with a polygon structure shown within the structural chart. Take People's Square in Shanghai as an example. The structural chart of this mode of intensive use is presented as a rectangle, with its center of gravity placed on the a part of intensive use of buildings. The direction of development particularly highlighted during this balanced mode of intensive use is to stay the prominent advantage for further intensiveness of land use in such sorts of urban centers. In other directions, such urban centers will attempt to realize sustained development so as to evolve to the advantaged direction of development. Another example of Beijing Road, an metropolis of Guangzhou, shows that the advantage in direction of intensive use of land are going to be valuable for the renewal of this municipality in an organic manner, resulting in specializing in the event of intensive use of buildings and intensive use of traffic during this metropolis.

5.4. Low degree mode of intensive use mode in urban centers (shuttle-shaped).

The shuttle-shaped mode of intensive use indicates that urban centers are normally poor-reputed on the nine indices of intensive land use, with a shuttle-shaped structure presented within the structural chart. The shuttle-shaped mode of intensive use is featured by “the advantaged indices aren't strong while the disadvantaged indices are extremely weak”. Such urban centers are at mediate level of intensive use of land and fail to appreciate effectively the intensive use in terms of buildings and traffic because of the restrictions of historical and topographical conditions (Zhu et al., 2009).

6. Conclusion.

Given the important roles of intensive land use in terms of service functions in urban centers, the evaluation model of intensive land use for urban centers was construct-

ed so as to adapt to the present development with high intensity. Quantitative definition of the scopes of urban centers is conducted and such evaluation factors as spatial form, structural element and repair function are introduced. This model is often applied with the support of GIS and with typical central areas in cities of high density in East Asian region as research objects.

With relevance the driving factors for intensive land use in central areas, our model considers only the foremost fundamental elements which are positively correlated with evaluation results. However, it's laid foundation for future research for its eurytopicity. Supported the differences presented in evaluation data, it's possible to debate the particular functions of driving factors for intensive land use. As for the driving mechanisms of intensive land use, it's necessary to further discuss the methods to get the optimum evaluation result under market driving mechanism, policy driving mechanism, geographically driving mechanism and their combined operations (Figure 4). the stress in future work are on the way to develop the established evaluation model of intensive land use for urban centers into regulating and control tools in conceptual design and construction management.

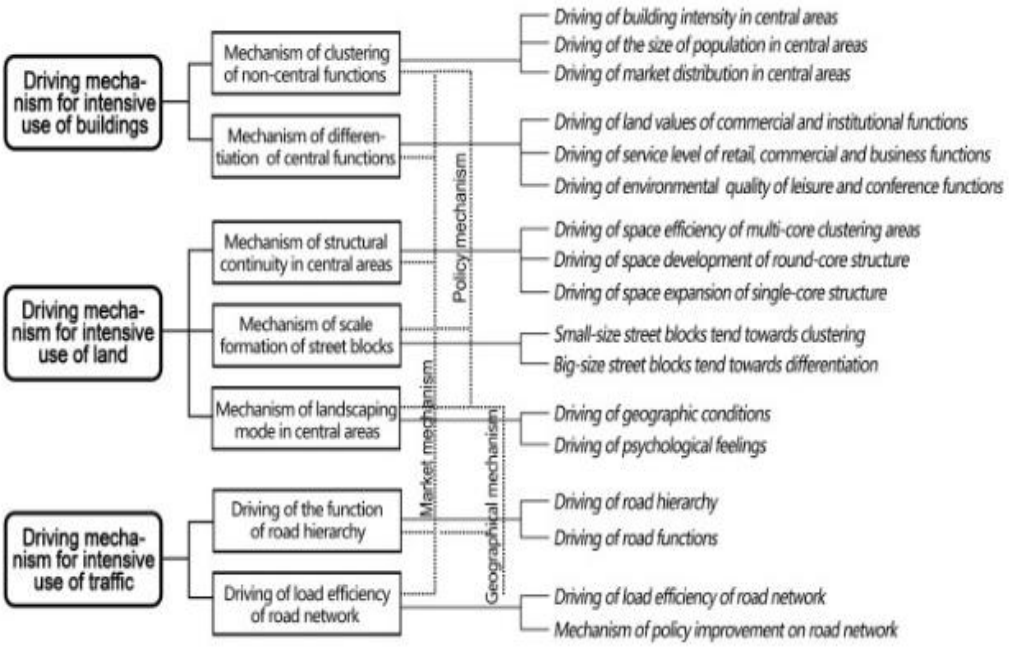


Figure 4. Driving mechanism for intensive land use in urban centers.

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