Study on the Influence of the Accessibility on Evolution of the Urban Regional Center

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Abstract: The urban transport as the city's main artery, is critical to the urban development, this article analyzes the shortcomings of the urban roads or the urban rail transit single accessibility models, and establishes an urban traffic accessibility analysis model based on the combination of the two and based on the central land theory, using the cost grid and network analysis methods taking Chengdu as an example. It also analyze on the impact of the urban traffic in 2010 and 2017 on the accessibility of the urban interior areas before and after the construction of the urban rail transit, according to the distribution characteristics of different regions and the relationship between the urban development trends and the urban traffic accessibility.

1. Research profiles and data sources

The development of the cities is as the result of the interaction of various factors, and the construction of transportation facilities has a profound impact on the development of the cities, according to the perspective of the space flow, enhancing the connectivity between the regions will weaken the physical proximity of the region. A reasonable transportation network will strengthen the flow of spatial elements between the various regions of the cities, and the regional spatial relationship of the city will be re-integrated to form a new urban location. Referring to the central theory, that each region is divided into different levels of the central locations according to the level of the services it provides as the level of the central site itself will provide the different development opportunities for its region and the accessibility of the central and the surrounding regions will affect The flow of various urban elements and the different accessibility will have the different development opportunities.

In recent years, scholars have used the accessibility analysis method to study the spatial impact of transportation facilities. However, the research is aimed at a large area and few studies on the internal accessibility of the city.

Taking Chengdu as a case study, this paper explores the spatial evolution of the urban development opportunities from the perspective of the spatial regional accessibility and provides decision-making reference for the urban space development in Chengdu.

The research area includes all the administrative jurisdictions in Chengdu as the data comes from the portal website of Chengdu People's Government and the statistical annual report of Chengdu Bureau of Statistics and the extraction of Baidu map.

2. Spatial accessibility calculation

2.1 Research methods

According to the principle of providing services of this level, and according to the same level of the central location, the service and impact area of the central location of each level is judged by the cost of time as the accessibility of the area is calculated by calibrating the travel time, and the destination is set as the administrative center of each area.

There are two approaches to the current readability analysis method, one is through network analysis and the other is raster analysis, In this article, a comprehensive analysis method combining the two analytical methods is used to improve the accuracy of the reachability calculation results.

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2.2 Accessibility calculation

The study area is divided into grids, and the size of the grid is set to 15m×15m. The traffic speeds of different modes of transportation are shown in Table 1 below:

Table 1 Speed assignment of different spatial objects

Space target	Highway	Urban road	Land	Water area
Speed design (km/h)	120	60	--	--
Speed calculation (km/h)	100	40	10	5

In the past, the model did not consider the case of the road that can only be connected to the surrounding area through a specific import and export, for this case, the line buffer is set as shown below.

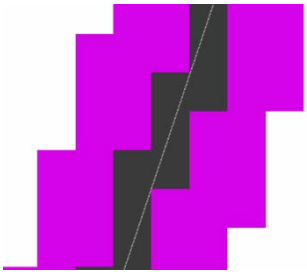

Figure 1 Schematic area of the buffer

3. Determination of the central location of the urban area

3.1 Selection of the Research method

Principal component analysis and cluster analysis methods are used to assess the level of the center, the indicators include total regional GDP (X1), per capital disposable income (X2), fixed asset investment (X3), total retail sales of social consumer goods (X4), number of doctors (X5), population mechanical growth rate (X6), and introduction of foreign investment (X7), the introduction of domestic investment (X8), the total import and export (X9), the applications number of patent (X10).

3.2 Principal component of the statistical indicators

For the KMO test, the closer the KMO test value is to 0, the original variable is not suitable for co-factor analysis, the KMO test values for 2008 and 2017 are 0.714 and 0.711 according to the principle of extracting the principal component and the two principal components are extracted. These two principal components can explain the 83.7% and 82.1% of the original 10 indicators respectively. As shown in the figure below, the two principal components are named for the economic scale and potential development.

Table 2 Rotation factor load matrix

	2010 Year		2017 Year	
Index	Economic scale	Potential Development	Economic scale	Potential Development
X1	0.932	-0.294	0.954	0.022
X2	0.962	0.008	0.946	-0.166
X3	0.797	-0.484	0.844	0.366
X4	0.915	0.077	0.823	-0.481
X5	0.883	0.204	0.744	-0.040
X6	0.542	0.794	0.771	0.371
X7	0.895	0.090	0.864	-0.377
X8	0.801	-0.484	0.631	0.584
X9	0.431	0.079	0.868	-0.348
X10	0.726	0.335	0.578	0.389

3.3 Division of regional central level

The composite scores for each region in Chengdu in 2010 and 2017 are shown in Table 3 below.

Table 3 Comprehensive scores of various regions in Chengdu in 2010 and 2017

	Yearly score	
Region	2010	2017
Wuhou district	2.24	1.41
Longquanyi District	0.09	1.32
Shuangliu District	-0.12	1.25
Qingyang district	1.40	0.93
Jinjiang district	1.14	0.80
Chenghua district	0.79	0.75
Jinniu district	0.82	0.75
Xindu district	0.11	0.26
Wenjiang district	-0.22	0.05
Pidu district	-0.26	-0.15
Qingbaijiang district	-0.43	-0.39
Jintang county	-0.64	-0.57
Xinjin county	-0.57	-0.61
Chongzhou city	-0.48	-0.68
Dujiangyan city	-0.58	-0.73
Pengzhou city	-0.66	-0.75
Jianyang city	-0.56	-0.76
Qionglai city	-0.75	-0.87
Dayi county	-0.42	-0.88
Pujiang county	-0.90	-1.13

Through the Q-type clustering method, the central area of the jurisdiction is divided into levels and the central area levels of 2010 and 2017 are obtained.

In 2010, Chengdu City Level 1 Regional Center is Wuhou District; Grade II Center is Qingyang District, Jinjiang District, Jinniu District and Chenghua District; the third-level central area is Longquanyi District, Shuangliu District, Xindu District, Wenjiang District, Pidu District, Qingbaijiang District, Jintang County, Chongzhou City, Dujiangyan City, Pengzhou City, Jianyang City, Qionglai City, Dayi County, Pujiang County, Xinjin County.

In 2017, the first-level regional center in Chengdu City is Wuhou District, Longquanyi District and Shuangliu District; the second-level central sites are Qingyang District, Jinjiang District, Jinniu District, Chenghua District, Xindu District, Wenjiang District and Pidu District; The third-level centers are Qingbaijiang District, Jintang County, Chongzhou City, Dujiangyan City, Pengzhou City, Jianyang City, Qionglai City, Dayi County, Pujiang County, and Xinjin County.

4. Analysis of the evolution and accessibility of the urban centers

4.1 Evolution of the first-level central area

In 2010, Wuhou District was the first-class center of Chengdu, the scope of its service is represented by the reachable time circle as shown in Figure 2, and the dark brown portion represents the 1-hour travel circle of the first-level center which covers the 1.5% of the total area of the city.

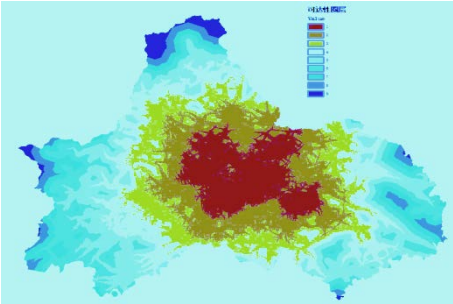

Figure 2 the first-level central travel circle in 2010

In 2017, Shuangliu District, Longquanyi District entered the first-class city center, as shown in Figure 3, the dark brown part indicates that the 1-hour travel is the circle of the first-level central area that covers 6% of the total area of the city.

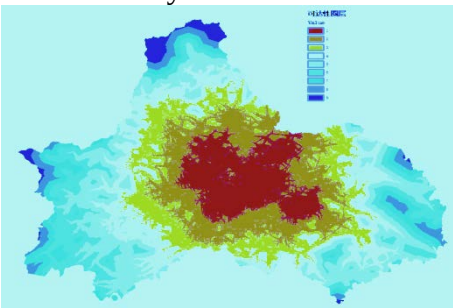

Figure 3 2017 first-level central travel circle

4.2 Evolution of the secondary central area

In 2010, the city's secondary center was located in the downtown Wuhou District, Qingyang District, Jinjiang District, Jinniu District, Chenghua District and the dark brown portion indicates its one-hour travel circle, as shown in Figure 4, covering a range of 3% of the total area of the city.

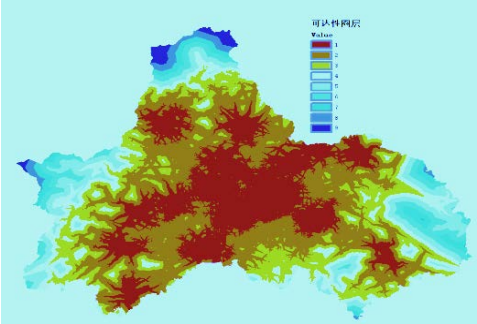

Figure 4 The second-level central travel circle in 2010

In 2017, Shuangliu District, Longquanyi District entered the first-class city center, Xindu District, Wenjiang District, and Pidu District entered the secondary center, and the dark brown portion indicates its one-hour travel circle, as shown in Figure 5, covering the entire city's 12.8% range.

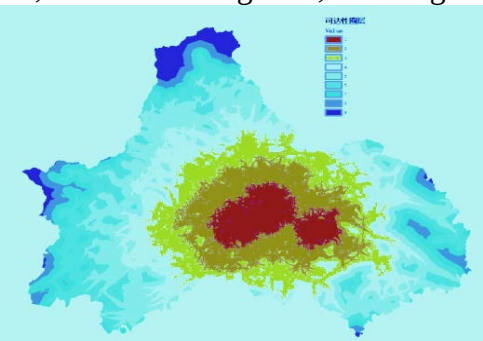

Figure 5 2017 second-level central travel circle

4.3 Evolution of the third-grade central area

In 2010, there were 15 third-level centers in the Chengdu metropolitan area, in 2017, there was also 10 third-level central sites in the Chengdu metropolitan area, which was reduced by five and the Longquanyi District and the Shuangliu District entered the first-level central area. Xindu District, Wenjiang District, and Pidu District enter the secondary center.

The third-level central area is an administrative area with a relative development lag in the urban area and the 1-hour travel circle of the third-level center in 2010 is shown in the dark brown area of Figure 6, covering 12% of the urban area.

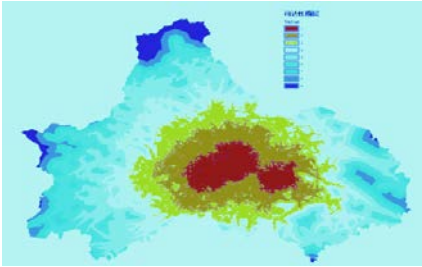

Figure 6 2010 three-level central travel circle

In 2017, the 1-hour travel circle of the third-level center is shown in the dark brown area of Figure 7, covering 30% of the entire city.

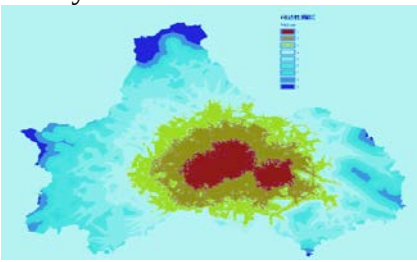

Figure 7 2017 three-level central travel circle

4.4 Impact of urban comprehensive traffic layout on regional development and evolution

In 2010, Chengdu relied on the urban road transportation system to connect every region of the city, the central level of the city showed the obvious characteristics of the administrative divisions and in the urban interior, the policy development opportunities were greater than the urban periphery region.

In 2017, Chengdu's urban transportation system was rich in rail transit and the regional accessibility of the city changed, the change of the accessibility brought about the adjustment of the industrial structure and location function of the level of the urban center began to show the characteristics of traffic dominance.

Based on Figure 2 to Figure 7, the change rate of reachable circle range is introduced to indicate the change of accessibility of Chengdu city in 2010 and 2017 and the specific formula is expressed as follows:

A=S^'/S (1) S^' indicates the area of the 1 hour travel time circle in the center of 2017, and S indicates the area of the 1 hour travel time circle in the city center in 2010, the unit is m2. The A value indicates the level of expansion of the central service area and the changes in the central travel time circle of each level are shown in Table 4 below:

Table 4 Changes in the central travel time circle of each level

Central area	Grade 1	Grade 2	Grade 3
S,	4228894	8126553	12681555
S	995097	1753156	6510303
A	4.24	4.6	1.94

In 2017, all levels of the central travel circle and the service area were expanded, at this time the horizontal and vertical rail transit has been completed and the Shuangliu District on the longitudinal

rail transit line and the Longquanyi District on the horizontal rail transit line are closely connected with the urban center, and benefits from the excellent accessibility which develops rapidly and forms the two city-level central sites. Similarly, due to the connection of the rail transit ring and the ring road to the suburban counties, Xindu District, Wenjiang District and Pidu District have entered the secondary center, these areas have wide jurisdiction and further expand the core space of the city.

5. Conclusion

In the process of economic development, most of the socio-economic factors concentrate in a small number of regional points which are linked by linear transportation facilities to form an axis. These traffic axes have strong economic attraction and cohesiveness to the adjacent areas, and are also the path for the social and economic factors to spread outward, the regional accessibility is directly related to the ease with which regional acceptance points provide services and diffusion to achieve the coordination of the urban development which is necessary to increase the accessibility level of each region compared with the accessibility levels of Chengdu in 2010 and 2017, the accessibility of Chengdu has improved significantly and the regional differences in the accessibility have been narrowed because the improvement of the accessibility promotes the economic and social development among regions and enhances the intensity of spatial interaction, as the backbone of the city's comprehensive transportation system, the urban rail transit has also brought aboutan obvious space-time compression effects which has profoundly affected the regional spatial pattern.

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