

# RESEARCH ON THE CURRENT STATUS AND HISTORY TRANSFORMATION OF HUTONG IN BEIJING IMPERIAL CITY BASED ON GIS TECHNIQUE

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## ABSTRACT:

Hutong is a special cultural heritage of Beijing. This paper research Hutong in the imperial city of Beijing, mainly in 7 typical years from the found of PRC till now, respectively 1949, 1965, 1980, 1990, 2003, 2005 and 2007, produce GIS data of 7 typical years, with accurate geography coordinate and attribute information, including name, built age, demolished age, start location and end location of each Hutong. Famous Hutong GIS data is produced based on Hutong GIS data of 2007, as well as Hutong inside of the protection regions of history and culture GIS data. In order to manage these GIS data efficiently, a spatial database was built, to meet the requirement of search, extract, compare and analyze to historic Hutong data. Further analyze to the transition of Hutong indicates, from 1949 to 2007, Hutong in imperial city has decreased by 55% in the number by 48% in the length. From 2005 to 2007, the decrease trend of Hutong has been held back efficiently, the protection of Hutong direct to a prosperous future.

## 1. INTRODUCTION

Hutong, also be called as alley or lane, is a special cultural heritage of Beijing. From the Yuan, Ming and Qing dynasty till nowadays, Hutong of Beijing imperial city has the history of over 800 years, it born the massive weight of history and culture of China. The research and protection on Hutong has become focus of all circles in Beijing nowadays.

This paper Using Geographical Information Science technique, researching Hutong in Beijing imperial city of 7 typical years from 1949 to 2007, respectively 1949, 1965, 1980, 1990, 2002, 2005 and 2007.

Based on the research above, a transition data of Hutong is produced, it bears the transition from 1949 to 2007, and represents the Hutong of newly built and demolished in each typical year.

During the long history of Hutong, many famous people or events had happened in Hutong, these Hutong bear testimony to that history, so the “famous Hutong” is in the scope of our research. Nowadays, Beijing has setup some protection regions of history and culture, had Hutong inside of the regions been protected very well? This paper shows you the amount and distribution of Hutong inside of these regions.

In order to manage these data efficiently, a spatial database was built, it meets the requirement of search, extract, compare and analyze to historic Hutong data.

Based on the researches above, by comparing the amount and length of Hutong in 7 typical years, we can see the transition tendency of Hutong clearly, the transitional reason were analyzed in this paper.

## 2. METHOD

### 2.1 The Criterion and Scope of Research

Beijing Hutong sprung from the Yuan dynasty, it means a small street between two courtyards, and compose the road system in the imperial city. Nowadays, the concept of Hutong is the same as the Yuan dynasty.

In the Yuan dynasty, the width of street is 25 meter, the back street is 13 meter, and the Hutong is 6~7 meter<sup>[1]</sup>, with the development of society, today's roads are wider than past, so the criterion of our research on the width of Hutong has been changed. The new criterion to define Hutong is as follows: road which has the basic character of alley and hasn't been expanded to avenue, not more than 20 meter wide, hasn't buses passing through, doesn't be included in inhabitant district.

In the Yuan, Ming and Qing dynasty, Hutong mainly located inside of Beijing imperial city, in order to keep the consistency of history, the geographic scope of our research is inside of the imperial city, the scope of the second ring road of Beijing today, the area of which is 62.5 square kilometer.

In order to hold the character of the evolvement and development course of Hutong in 58 years from 1949 to 2007 exactly, we select 7 typical years, respectively 1949 (for People's Republic of China was founded in this year), 1965 (for widely transformation on the name of Hutong has been done in this year), 1980 (the initial stages of reformation and opening of Beijing), 1990 (the widely housebreaking and construction period of Beijing) and the latest three years 2003 ,2005 and 2007 to research.

### 2.2 Basic Data

Substantial researches had been carried out to Hutong of Beijing imperial city by expert on folklore, chorography, architecture,

archeology and layout. This paper used five kind of data to carry out our research:

1) < Chorography of Beijing. Chorography of Surveying and Mapping > [2]

The chorography was produced by the Qing government at 1912, it provides the map of Beijing city with the scale of 1:8500, and we use it to research the history of Hutong in the imperial city.

2) <Beijing History Atlas> [3]

The atlas describes the graph of Hutong before 1947, it keeps the continuity of Hutong well, we use it as the basic graph of Hutong in research.

3) The Digital Linear Graph of 1954, 1965, 1980, 2003

The scale of the DLG of 1954 is 1:5000, the DLG of 1965 and 1980 is 1:10000, and the DLG of 2003 is 1:500. They were mapped by Beijing institute of surveying and mapping (BISM), the location of Hutong is very accurate, and we use it as basic location data to research Hutong in 1949, 1965, 1980 and 2003.

4) < Beijing City Streets Map > [4]

The map was produced from DLG which was surveyed by BISM in 1987, and the scale is 1:14000. The difference between this data and the graph of 1990 is indistinct. We use it as basic graph reference data to research Hutong in 1990.

5) <The Name Record of alleyway in Beijing imperial city > [5,6,7,8]

This record was produced by the government of imperial city in 1965, during this age, Hutong was renamed on a large scale, and it built the relationship between the name and position of Hutong. We use it as basic name data to research Hutong.

Besides these data, we carried out our research using DLG, remote sensing images and toponym data of several typical years, reference books [9] etc.

### 2.3 The Production of Hutong GIS Data [10]

The data composed by Hutong GIS data of seven typical years (1949, 1965, 1980, 1990, 2003, 2005 and 2007), transition of Hutong, famous Hutong and Hutong inside of protection regions of history and culture. The flowchart is as Figure1.

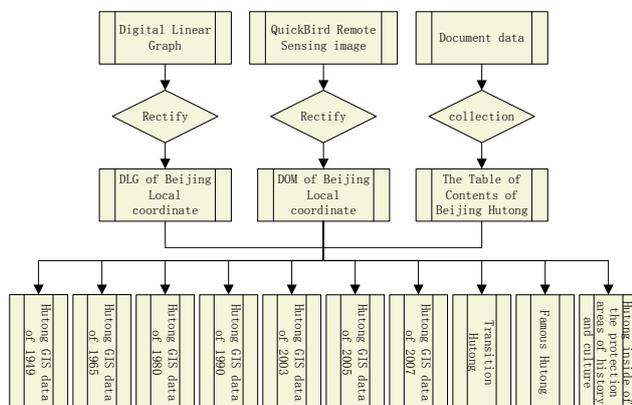


Figure 1. Production of Hutong GIS data

#### 2.3.1 Rectify the basic DLG data

Rectify the DLG of several typical years and that of 1947, 1954, 1965, 1980, 1987 to Beijing local coordinate, the references are DLG of recent years. The software is SuperMap Editor, choose several control points equably distributed on both the DLG to be rectified and the reference, limit the error of rectify to 1 meter.

The rectify result was taken as basic graph data for the production of Hutong GIS data.

#### 2.3.2 Rectify the remote sensing image

We know from the layout institution that there has no newly built Hutong in 2005 and 2007 inside of the empire city. The intention to rectify the remote sensing image is to judge whether there exist Hutong being demolished in 2005 and 2007.

The resolution of QuickBird image is 0.6 meter, which is accurate enough for judge whether the Hutong is demolished. Rectify the QuickBird image of 2005 and 2007 to Beijing local coordinate, the references are DLG of recent years, the software is ERDAS IMAGINE. Choose several control points equably distributed on both the image to be rectified and the reference, limit the error of rectify to 1 meter.

#### 2.3.3 Collect useful attribute data of Hutong

Collect and extract useful data from <The Name Record of alleyway in Beijing imperial city > and other toponym data, to form the table of contents of Beijing Hutong. The result was taken as basic attribute reference for the production of Hutong GIS data, such as Code, Name, width, length, newly built age, demolished age, start location, end location of a Hutong.

Further more, the data named < Map of Protection Regions of History and Culture > is used for producing Hutong GIS data inside of the regions of history and culture.

Write the useful data collected above to the format of Microsoft Access, as follows:

	Name 1949						
	Name 1965						
	Name 1980						
Code	Name 1990	Width	Length	Built age	Demolished age	Start location	End location
	Name 2003						
	Name 2005						
	Name 2007						

Figure 2. Attribute table of Hutong

The attribute of “Code” is unique for each Hutong.

#### 2.3.4 Produce the Hutong GIS data of 7 typical years

The production of Hutong GIS data is comprised of two parts: graph and attribute.

Firstly, produce the Hutong graph of 1949 using the basic data prepared above, and add the “Code” in attribute field; then based on the graph of 1949 and the basic data of 1965, produce Hutong graph of 1965 by add or delete Hutong, keep the consistency of the graph and attribute of “Code”; the method to produce Hutong graph in other typical age are as above. The software is ArcGIS, data format is shapefile.

Based on the Hutong graph of 7 typical years, we assign attribute field using automatic method. By Map Objects<sup>[11]</sup>, the develop tools of ESRI, using the attribute "Code" in Hutong data of shapefile format as a key word, put other attributes in the Hutong data. The attributes are: Code, Name of each typical year, width, length, start position, end position.

### 2.3.5 Produce the Hutong GIS data of transition

Based on Hutong GIS data of 1949, add the newly built Hutong in other 6 typical years. By the developing tools Map Object, on Visual Basic platform, using the attribute "Code" in Hutong data of shapefile format as a key word, put other attributes in the Hutong data, Attribute are: Code, Name of 1949, Name of 1965, Name of 1980, Name of 1990, Name of 2003, Name of 2005, Name of 2007, Width, Length, Built age, Demolished age, Start location, End location. The attributes are different from those of 7 typical years, and reflects the transition of each Hutong very well.

### 2.3.6 Produce the famous Hutong and Hutong inside of the regions of history and culture GIS data

The production of famous Hutong is based on Hutong GIS data of 2007, according to the chorography data, identify which are famous Hutong and produce the GIS data.

Comparing the < Graph of Protection Regions of History and Culture >, and based on Hutong GIS data of 2007, keep the Hutong inside of protection regions of history and culture.

### 2.4 The Foundation of Spatial Database

In this paper, a spatial database<sup>[12]</sup> is founded to manage GIS data of Hutong in Beijing imperial city, which meets the requirement of search, extract, compare and analyze in historic Hutong data. The database is C/S structure. In the service port, use Oracle as database platform and ArcSDE as spatial database engine. In the client port, use ArcGIS as basic platform. The spatial database is developed by Visual Basic to realize data input, edit, search, extract, compare and analyze function based on ArcObject. The GIS database of Hutong in Beijing imperial city managed the Hutong GIS data efficiently.

## 3. RESULTS AND ANALYSIS

### 3.1 The transition of Hutong in Beijing imperial city

In the <Beijing History Atlas>, in Zhizheng age of the Yuan dynasty, the number of Hutong in Beijing imperial city was about 413; in Wanli and Chongzhen age of the Ming dynasty, the number was about 1170; in Qianlong of the Qing dynasty, this number reached 2077.

By statistics to Hutong GIS data of 7 typical years, Hutong in Beijing imperial city was changed tremendously during 58 years from 1949 to 2007. Figure3 show the change, Figure3a is Hutong in 1949, Figure3b is Hutong in 2007, the black line presents street, and the red line represent Hutong.

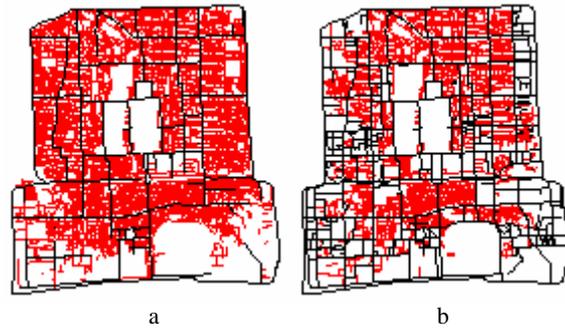


Figure 3. Hutong in 1949 and 2007

#### 1) The transition in number

The number of Hutong in Beijing imperial city was 3073 in 1949, 2382 in 1965, 2290 in 1980, 2242 in 1990, 1559 in 2003, 1384 in 2005 and 1365 in 2007. The statistic figure of the number of Hutong in imperial city is as Figure4.

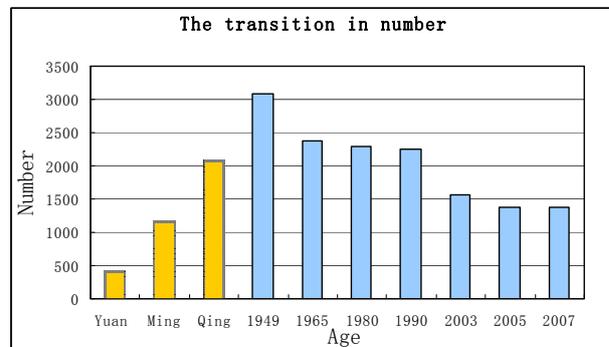


Figure 4. The transition of Hutong in number

Figure4 indicates, Hutong was sprung up in the Yuan dynasty and developed in the Ming and the Qing dynasty. In 1949, the number of Hutong reached the peak. From 1949 to 2007, the number of Hutong decreased by 55% in number. Three periods decrease acutely: from 1949 to 1965, from 1990 to 2003, from 2003 to 2005.

#### 2) The transition in length

The length of Hutong was about 756 km in 1949, in 1965 was 711 km, in 1980 was 689 km, in 1990 was 671 km, in 2003 was 470 km, in 2005 was 402 km, and in 2007 was 395 km. The statistic figure of the transition in length of Hutong is as Figure5.

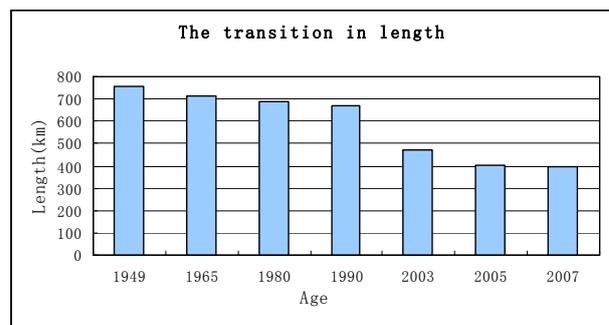


Figure 5. The transition of Hutong in length

Figure5 indicates, the length of Hutong has decreased by 48% from 1949 to 2007. Two periods decreased acutely: from 1990 to 2003 and from 2003 to 2005.

### 3) Hutong of newly built and demolished

At the aspect of newly built Hutong, during 1949-1965, there are 70, during 1965-1980, there are 8, there are no newly built during other period.

At the aspect of demolished Hutong, during 1949-1965, there are 761, during 1965-1980, there are 100, during 1980-1990, there are 48, during 1990-2003, there are 683, during 2003-2005, there are 175, during 2005-2007, there are 19.

Figure6 shows the number of demolished and newly built Hutong between each two typical years.

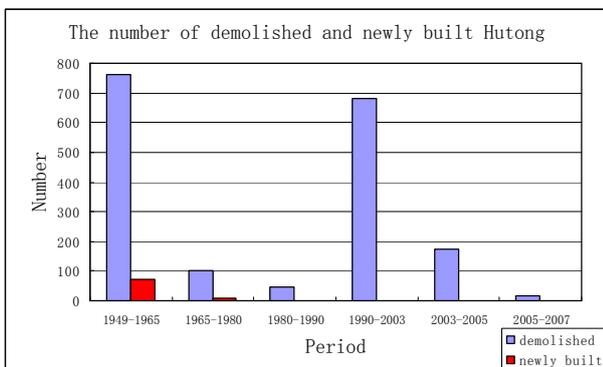


Figure 6. The number of demolished and newly built Hutong  
In Figure6, the number of newly built Hutong is much less than the demolished Hutong. In the case of demolished Hutong, three periods decrease acutely, respectively 1949-1965, 1990-2003 and 2003-2005.

### 4) Analyze to the transition of Hutong

The transition of Hutong from 1949 to 2007 has significant relationship with the transition of Beijing. During 58 years from 1949 to 2007, widely housebreaking and construction has taken place in Beijing, so Hutong had been changed enormously.

From 1949 to 1965, during 16 years, the number of Hutong decreased by 691 (22%), while the length of Hutong only decreased by 45km (6%), these data indicates, most of the transition in this period are rename to Hutong for the case of unite, a few Hutong has been demolished. In fact, in 1965, the government has renamed the Hutong on a large scale.

From 1965 to 1980, both of the number and the length of Hutong keep steadiness. From 1980 to 1990, economic and society reformation is on the initial stages, Hutong keep steadiness, too.

From 1990 to 2003, during 13 years, along with the further reformation of economic and society, a large number of unsafe houses were broken up, the number of Hutong decreased by 683 (30%) acutely, the length decreased by 201km (30%).

From 2003 to 2005, Hutong keep on decreasing, during 2 years, the number of Hutong decreased by 175 (11%), the length decreased by 68km (14%). Some Hutong has demolished partially, that's why the number decreased by 11% while the

length decreased by 14%.

From 2005 to 2007, the number of Hutong decreased by 19 (1%), decreased by 7 km (2%). These numbers are much less than the numbers of Hutong from 2003 to 2005. The decreasing trend had been hold back effectively, due to the appropriately protection to Hutong as cultural heritage by the government of Beijing.

### 3.2 Famous Hutong and Hutong inside of the protection regions of history and culture

#### 1) Famous Hutong

In 2007, the number of famous Hutong is 457, 89 in Dongcheng district, 102 in Xicheng district, 55 in Chongwen district and 212 in Xuanwu district. In Figure7, the blue line represents famous Hutong, the red line represents other Hutong, the black line represents street.



Figure 7. Famous Hutong

#### 2) Hutong inside of the protection regions of history and culture

There are 25 protection regions of history and culture<sup>[13]</sup> in the imperial city in 2001, and more 5 added in 2004. Now, there are 30 regions in the imperial city.

The number of Hutong inside of the region is 743. In Figure8, the yellow regions represent the protection regions, and the purple lines are the outline of the regions, the red line represents Hutong in 2007, and the black line represents the street.

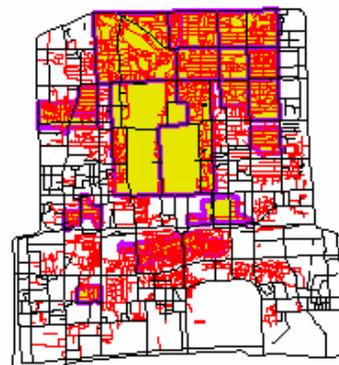


Figure 8. Protection regions of history and culture

The protection regions mainly lie in Dongcheng district and

Xicheng district of imperial city. The number of Hutong only decreased by 7 from 2003 to 2007, this testify the efficiency of the protection regions in protecting Hutong from demolished.

Note: The difference in the number of Hutong between our research and other research is due to the scope of research, the difference on the definition of Hutong.

#### 4. CONCLUSIONS

This paper research Hutong in 7 typical years in Beijing imperial city of 58 years, from the foundation of PRC in 1949 to 2007. We produced the Hutong GIS data of 7 typical years, the transition GIS data, Famous Hutong GIS data and Hutong inside of the protection regions of history and culture GIS data. Besides these, a spatial database was built to manage these data. The result of our research reflected the current status and history transition of Hutong accurately, as follows:

- 1) Hutong in Beijing imperial city had sprung up in the Yuan dynasty, in 1949, the number of Hutong reached the peak. From 1949 to 2007, the number of Hutong decreased by 55%.
- 2) Hutong demolished at two periods, one is 1990-2003, and the other is 2003-2005. Caused by the further reformation of economic and society, and the broken up on a large number of unsafe houses.
- 3) From 2005 to 2007, the decreasing trend of Hutong had been hold back effectively, due to the appropriately protection by the government.
- 4) The number of Hutong inside of the protection regions of history and culture keep steadiness, the protection regions work effectively in Hutong protection.

The result of our research provided reliable GIS data for the protection of Hutong in Beijing imperial city, provides scientific management method for the layout of imperial city, and laid stable foundation for further research. Moreover, the foundation of spatial database is propitious to the public participant in the protection of Hutong, which has society value and application potentiality

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