

## RESEARCH ON EVALUATION METHOD OF REAL ESTATE REGISTRATION DATA QUALITY

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### ABSTRACT:

In recent years, China has promulgated the "Civil Code of the People's Republic of China", "Implementation Rules of the Provisional Regulations on Real Estate Registration" and other laws and regulations, which have protected citizens' rights and obligations in real estate from the legal system. It shows that the quality of real estate registration data is very important. At present, there is no set of standards for evaluating the quality of real estate registration data. This article sorts out the production process of real estate registration data and focuses on the four stages of production: digitization results, field surveys and surveying and mapping results, group building results, integration and association. As a result, the main points of real estate registration data quality control were put forward, and a quality evaluation model was developed. Taking Beijing's real estate registration historical archives integrated data quality inspection as an application case, it shows that the quality evaluation model has been successfully applied to actual projects, ensuring the quality of Beijing real estate registration data. It also provides a reference for the next step in China's quality control of the unified registration of natural resources confirmation.

### 1. INTRODUCTION

Real estate refers to fixed objects such as land, sea areas, houses, and forests. Real estate registration refers to the registration of land, sea areas, buildings, and structures as a whole of real estate on the basis of land and sea areas. For the public, it mainly refers to real estate and land. In May 2020, the "Civil Code of the People's Republic of China" was implemented, and the real estate registration clauses in it further protect everyone's property rights and guarantee the safety of transactions. The quality of real estate registration data is directly related to the interests of an institution, organization, or right holder. Therefore, how to do a good job in real estate registration data quality control is a topic worthy of research and discussion. Currently, there are many articles introducing real estate data production, For example, (Zheng et al. 2015) discussed how to realize the association of house attribute data and house spatial data, and realize the association of house and land based on house spatial data and land data. (Chen, Z.Y., 2019) introduced the integration of real estate surveying and mapping results. However, there is less research on the quality control of real estate data. There are only a few introductions, such as (Ye, et al. 2019) which introduces the key points and inspection content of quality control in the production stage of real estate data integration, (Tong et al. 2002) discusses the quality control of land and real estate basic geographic information system data collection and database construction, and puts forward some quality control methods and measures. But these articles did not clarify the results of each stage of production, and did not make a quality evaluation of the inspection content.

This paper introduces the production process based on real estate registration data, and explains that the real estate registration data results mainly include four parts: digitization results, field surveys and surveying and mapping results, group building results, and integration related results. Through the

study of the characteristics of the four types of results, the inspection process, sampling method, inspection content and method, and quality evaluation model are described. Then, based on the inspection results of the integration of Beijing real estate registration historical archives, the main quality problems in the real estate registration work are analyzed to prove that the quality evaluation model is feasible. China's unified natural resource right confirmation and real estate registration will soon be integrated under one platform, so this quality evaluation model provides a reference for the unified data quality inspection of natural resource right confirmation.

### 2. REAL ESTATE REGISTRATION DATA RESULTS

According to the process of real estate registration data integration, the real estate registration results specifically include four aspects: digitization results, field surveys and surveying and mapping results, group building results, and integration related results. The production process of real estate registration integration is shown in Table 1.

Serial number	Real estate registration integration results	
1	Digitization results	
2	Field survey and surveying and mapping results	Field survey results
3	Group building results	Field surveying and mapping results
4	Integration of related results	Building results
		Land results
		Housing registration business connection
		Land registration business connection
		House and land data association

**Table 1.** Real estate registration integration results.

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## 2.1 Digitization Results

Digitization results refer to the scanning and digitization of paper archives, entering the right holder, house and land attribute data, and establishing file digitization and paper files to associate the right holder, house and cadastral data.

## 2.2 Field Survey and Surveying and Mapping Results

Field survey and surveying and mapping results refer to the use of GPS-RTK, total station field collection and other technical means for field surveying and mapping, using polar coordinates and forward intersection methods to perform surveys to form a cadastral map. At the same time, investigate the basic attribute information of the house, including building number, location, number of floors, area, etc. The purpose of surveying and mapping is to ensure that the measured houses and land match the satellite remote sensing images.

## 2.3 Group Building Results

The result of group building is that in the geographic information system, the data of each house is integrated into the building to which it belongs, and then the building and the land space coordinates in the cadastral management information system are matched and positioned. Combined with the location, a unique real estate registration unit number is formed. The system includes house graphics, house attribute information contained in the graphics, and satellite imagery.

## 2.4 Integrate Related Results

Integrated association refers to the establishment of a logical relationship between real estate unit data and archives by combing through real estate registration data. The attribute information includes the district/county where the building is located, street, house number, house number, right holder, house area, etc.

# 3. QUALITY EVALUATION MODEL

## 3.1 Inspection Process

The inspection process includes several stages: sampling, overall survey, detailed inspection, result quality evaluation, and preparation of inspection reports. Through pilot projects in some districts of Beijing, it has been shown that the process is executable. (Figure 1.)

### 3.1.1 Sampling

Sampling is based on administrative divisions, and samples are randomly selected in proportion to stratification. The sample should be evenly distributed, covering every production unit, taking into account the situation of single-family and multi-family, etc., to ensure that the sample achieves spatial coverage of the entire measurement area.

### 3.1.2 Overall Survey

Check the batch results as a whole. The main contents of the inspection include: the consistency of the quantity of each result; the completeness of the documentation; the completeness and readability of the electronic data results; The correctness of the spatial reference system of geographic information data.

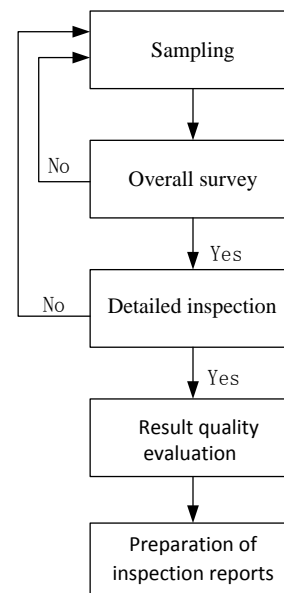


Figure 1. Real estate registration integration inspection process.

### 3.1.3 Sample Detailed Inspection

(1) Contents and methods of digitization results inspection: The quality inspection of digital results mainly adopts manual visual data comparison and inspection methods, which are checked with scanned files. The objects of digital achievement inspection are all types of real estate registration data, and the inspection content includes image quality and data entry. (Table 2.)

(2) Contents and methods of field survey and surveying and mapping results inspection: Field survey and surveying and mapping results quality inspection The internal inspection mainly adopts the method of consulting records, reference data analysis, and internal inspection. The field inspection mainly adopts methods such as on-site accuracy inspection and field verification. The main inspection contents include spatial reference system, location accuracy, and attributes. Accuracy, field photos and attachment quality, etc. (Table 3.)

Among them, the calculation formula of the position error:

$$M = \pm \sqrt{\frac{\sum_{i=1}^n \Delta_i^2}{2n}}, \quad (1)$$

where  $M$ —The error in the result  
 $n$ —the total number of detection points (edges)  
 $\Delta$ —The difference between the measured value and the true value.

Mathematical accuracy assessment method:

$$M_0 = \pm \sqrt{m_1^2 + m_2^2}, \quad (2)$$

where  $M_0$ —The absolute value of allowable median error;  
 $m_1$ —The error in the result required by the specification or technical document;  
 $m_2$ —error in detection.

Quality element	Code	proportion	quality sub-element	Check points	Check content
Picture quality	1	0.5	Clarity	picture	Whether the scanning results are complete, without errors or omissions; the image is clear, the color is real, there are no spots or dead pixels, and the picture is not rotated
Data Entry	2	0.5	Correctness	Reference entry	The entered business data and field content are consistent with the picture, without errors or omissions

**Table 2.** Contents and methods of digitization results inspection.

Quality element	Code	proportion	quality sub-element	Check points	Check content
Spatial reference system	1	0.2	Geodetic datum	coordinate system	Check that the coordinate system meets the requirements
Position accuracy	2	0.3	Plane position	Error in plane position	Whether the error in the absolute position of the house exceeds the limit
				Relative position error	Whether the error in the relative position exceeds the limit
Attribute precision	3	0.3	Correctness	House graphics	Whether the house graphics match the actual shape of the house
				Attribute item	Whether the attribute items are filled in correctly
Field photo	4	0.1	Completeness	Public Security Blue Label Photo or Building Name	Whether the attribute items are filled in completely
					Completeness
Attachment quality	5	0.1	Completeness	Housing basic information survey form; technical report; instrument verification certificate, etc.	The photos shall show the surrounding situation and specific information of the building
					Correctness

**Table 3.** Contents and methods of field survey and surveying and mapping results inspection.

Mathematical accuracy is calculated according to the provisions of Table 4 using the method of segmented linear interpolation; when multiple mathematical accuracy scores, single mathematical accuracy scores are greater than 60 points, take the arithmetic average or weighted average.

(3) Contents and methods of checking the results of group building: The inspection content of the group building results includes the spatial coordinate system, the spatial matching degree and the data attributes. (Table 5.)

Mathematical precision value	Quality score
$0 \leq M \leq (1/3) * M_0$	$S = 100$
$(1/3) * M_0 < M \leq (1/2) * M_0$	$90 \leq S < 100$
$(1/2) * M_0 < M \leq (3/4) * M_0$	$75 \leq S < 90$
$(3/4) * M_0 < M \leq M_0$	$60 \leq S < 75$
M—Absolute value of error in results; S—Quality score	

**Table 4.** Mathematical accuracy scoring standards.

(4) The quality inspection of integrated related results mainly uses data analysis and other methods to check the logical consistency, completeness, repeatability, and number of figures related to the registration business, data and archive results. (Table 6.)

### 3.2 Quality Evaluation

#### 3.2.1 Error and Omission Assessment

Error and omission assessment methods are adopted for archive digitization results, group building results, and integration related results. Field surveying and mapping results are evaluated according to (Zeng, et al. 2009).

(1) Standards for deducting points for quality of results. (Table 7.)

$a_3$ —Number of errors and omissions in category D;  
 $t$ —Adjustment factor.

Quality element	Code	proportion	quality sub-element	Check points	Check content
Spatial coordinate system	1	0.3	consistency	House space coordinate system, land space coordinate system	Whether the house space coordinate system and the land space coordinate system are consistent
Spatial matching	2	0.3	suitability	Natural Building Space Pixel and Zong Map Element	Whether the matching degree of natural building space primitives and land space is consistent with the requirements of each district
Data attributes	3	0.4	Correctness	Logic Building List	The correctness of the number of households in the logical building
			Normative	House code, building code	Whether the house code and building code meet the national standards
			Uniqueness	House code, building code	Whether the house code and building code are duplicated; the uniqueness of the business and the uniqueness of the logical building

**Table 5.** Contents and methods of checking the results of group building.

Quality element	Code	proportion	quality sub-element	Check points	Check content
Logical consistency	1	0.2	Logic of business data	Business sequence	Check whether the business sequence of each household is correct
			Logic of time	sequentially	Check whether the business time series of each household is correct
			Quantity	Number of results	Check whether the number of submitted results meets the requirements
Completeness	2	0.3	information	Business information	Check whether the business information of each household is complete
			recording	Business record	Check whether the business records of each household are missing
			link	Unlinked housing business inspection	Check whether each business has a situation where the business is not connected to the house
Repeatability	3	0.2	recording	Record repeatability	Check whether the business records of each household are duplicated
Graphics and data association	4	0.3	business	Duplicate business check	Property repeatability check
			accuracy	connection relation	Check whether the relationship between each household's picture and business data is accurate

**Table 6.** Integrate related results inspection content and methods.

(2) The scoring method of quality sub-element is carried out according to formula (3).

$$S_2 = 100 - [a_1 * (12/t) + a_2 * (4/t) + a_3 * (1/t)]$$

, (3)

where  $S_2$ —The score value of the quality sub-element;  
 $a_1$ —Number of Type B errors and omissions;  
 $a_2$ —The number of errors and omissions in category C;

(3) The quality element scoring method shall be carried out according to formula (4).

$$S_1 = \sum_{i=1}^n (S_{2i} * p_i), \quad (4)$$

where  $S_1$ —Quality element score value;  
 $S_{2i}$ —The score value of the i-th quality sub-element in the quality element;

$p_i$ —the weight of the  $i$ -th mass sub-element in the mass element;  
 $n$ —the number of mass sub-elements contained in the mass element.

Type of error	Missing Type Code	Deduction standard	Remarks
Serious mistakes	A	42 points	Serious errors and omissions that caused the results to be unusable
Multiple mistakes	B	12/t points	Serious errors and omissions that affect the normal use of results
Second mistake	C	4/t points	Heavier errors and omissions that affect the normal use of results
Mistakes	D	1/t points	Minor errors and omissions that affect the normal use of results

Note:  $t$  refers to the adjustment coefficient, which is set according to the needs of the project, and the general value is 1.

**Table 7.** Types of errors and omissions and deduction criteria

(4) The quality of unit results is scored according to formula (5).

$$S = \sum_{i=1}^n (S_{i1} * p_i), \quad (5)$$

where  $S$  — unit achievement score value;  
 $S_{i1}$  — The score value of the  $i$ -th quality element;  
 $p_i$  — the weight of the  $i$ -th quality element;  
 $n$  — the number of quality elements contained in the unit result.

### 3.2.2 Unit Achievement Quality Assessment

The quality evaluation of unit achievement is based on the unit achievement quality score to evaluate the quality grade, which is divided into four grades: excellent grade, good grade, qualified product, and unqualified product. The general inspection only assesses two levels of qualified and unqualified products, and the detailed inspection assesses four levels of quality. ( Table 8.)

Quality score	quality level
90 points $\leq S \leq$ 100 points	Premium grade
75 points $\leq S <$ 90 points	Good grade
60 points $\leq S <$ 75 points	Qualified product
The proportion of gross errors in the position accuracy or mathematical accuracy check is greater than 5% Unqualified quality elements	unqualified products

**Table 8.** Unit achievement quality assessment grade.

### 3.2.3 Batch Result Quality Judgment

The batch result quality judgment determines the quality grade of the batch result through the judgment conditions. The quality grade is divided into two levels: qualified batch and unqualified batch. (Table 9.)

quality level	Judgment condition
Batch qualified	No non-conformance items or Class A errors or omissions were found in the general inspection, and no unqualified unit results were found in the detailed inspection The general survey found non-conformance items or class A errors or omissions, or found unqualified unit results during the detailed inspection, or failed to submit technical documents (such as design documents, technical summary, quality inspection reports of each district, etc.) and informative documents (such as List etc.)
Batch unqualified	In the production process, the use of measuring instruments that have not been metrologically verified or are unqualified There is a phenomenon of forgery or a major deviation in the technical route

**Table 9.** Quality judgment conditions of batch results.

## 4. QUALITY INSPECTION OF INTEGRATION RESULTS OF BEIJING REAL ESTATE REGISTRATION HISTORICAL ARCHIVES

In the past few years, Beijing has carried out data integration of real estate registration historical archives in 16 districts of the city. Through the implementation of real estate data integration and paper file sorting, the previously dispersed registration business data, spatial data and archive data will be unified and integrated into the new real estate registration information management system (Wang, W.,Y,2018). Due to the huge amount of data, the sample size of each district has hundreds of thousands, and some have tens of thousands of volumes. A large number of quality inspectors invested by the quality inspection department come to do quality inspection work at the same time.

The main issues that affect the quality of the inspection of the results of the integration of the historical archives of real estate registration in Beijing are: the scanned documents and pictures of the digital results should not be rotated or deformed. The scanned copy of the same property cannot be missing. When entering data, it should be noted that the entered information is consistent with the scanned information. Field survey and surveying and mapping results should be noted that the information in the field survey should not be filled in error, especially information such as the area of the house and the floor. The photos taken in the field cannot be blurred and can reflect the information of the building. It should be noted that the corresponding building under the same property is unique. The parcel corresponding to each building is also unique. The number of houses in a building is fixed and cannot be redundant or omitted. Integrating related results should pay attention to complete real estate business records to form a complete transaction timeline. The problems detected were fed back to the production unit, and the production unit revised the data that did not meet the requirements, ensuring the quality of the overall project results.

## 5. CONCLUSION

Using the research results of this article, through the Beijing real estate registration historical archive data integration inspection project, the quality of the results was objectively and scientifically evaluated. It proves that the quality evaluation model is suitable for the inspection of real estate registration results. Provide experience and reference for the production and quality inspection of real estate registration. Guarantee the reliability, accuracy and completeness of real estate registration. Through the research on the quality inspection of real estate registration data, the following experience and experience have been obtained.

### 5.1 Sampling Form Innovation

According to the setting of conditions such as cottages, buildings, production units, and housing locations, stratified and proportional random sampling to ensure uniform sample distribution.

### 5.2 Innovation of Inspection Content

Although real estate registration data has the results of surveying and mapping, it is fundamentally different from traditional surveying and mapping quality inspection. The inspection content and inspection methods set up according to the characteristics of different achievements meet the requirements for the quality of real estate registration data.

### 5.3 Develop Tools for Automated Inspection

Since most of the inspection methods are based on manual visual interpretation, the amount of labor and time consumed is huge. The next step is to carry out research on automated inspections on this basis in order to improve the speed and efficiency of inspections.

In 2018, the basic platform for real estate registration information management achieved a nationwide network, and China's real estate registration system has entered a stage of full operation. Real estate registration serves the government's decision-making as well as the people. The real estate registration work under the natural resource system has laid a solid foundation for the development of natural resource right confirmation and registration work. The real estate registration quality inspection method and quality evaluation model of the article provide ideas and reference for the inspection of the unified confirmation and registration of natural resources, and provide effective support for government departments to carry out research based on the integrated data in the future.

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