Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-technology Integration

Shunji Du and Qian He,China

Key words: urban renewal,basic data survey,UAV remote sensing,informationization surveying and mapping

SUMMARY

At present, China's big cities are undergoing vigorous development and construction, especially since the 21st century, the area and social capacity is becoming more and more big, leading to a certain degree of "urban diseases" such as residential environment congestion, traffic jams and urban waterlogging. Therefore, in recent years, local governments are vigorously promoting urban renewal, especially for surrounding old villages or industrial backward areas can be rebuilt without increasing the land area, but it can realize multi-regional development, improve living environment and improve urban quality.

In the process of urban renewal, basic data survey is the basic work that needs to be carried out in the early stage of the project. It is necessary to fully investigate the current situation data of population, housing, land, cultural relics and other current data in the renewal area, so as to carry out scientific renewal planning and implementation. In order to ensure data quality and work efficiency, we have adopted a series of surveying and mapping technology.

We adopt mobile phone programming to realize real estate information collection and area automatic calculation,utilize unmanned aerial vehicle (UAV) and 3D laser scanning technology to establish a real 3D model of the reconstructed area and building, and use FME to achieve quality inspection and database construction.A village spatial information mapping and modeling production system with integrated technology has been built,which can quickly and accurately obtain geospatial data.Through several actual projects test and the verification by independent third-party testing agency, it shows that the measurement results of this method meet the requirements of the relevant specifications of the real estate and urban renewal survey, improve efficiency and diversity of results,and can provide important data support for design renewal planning, cultural relic protection and illegal land use monitoring.

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration (10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-technology Integration

Shunji Du and Qian He,China

1. THE INTRODUCTION

Since the implementation of the reform and opening-up policy, China has experienced remarkable urban construction and social development.With the continuous expansion of the urban area, many traditional villages and handicraft industrial areas have gradually been surrounded by the city,leaving a large number of "three old" areas in the urban area, namely, old factories, old towns and old villages.On the other hand, China's big cities implement strict construction land control policies. The contradiction between the booming demand of cities and the lack of construction space is growing day by day, and the development mode relying on land expansion is difficult to sustain. In this context, revitalizing existing land and renewing the total amount through urban renewal is an important strategy for sustainable development of cities.

The basic data survey and investigation is an important basic work in the early stage of urban renewal and reconstruction.Its purpose is to find out the scale and attributes of various resources such as houses, population, and land that already exist, it's the basis for later planning and compensation scheme. The truth and accuracy of the survey results are related to the scientificity, feasibility, and rationality of urban renewal projects design, and are of great significance to the orderly promotion of urban renewal.

2. CONTENT AND PROCESS OF BASIC DATA SURVEY

According to the "Measures for the Investigation and Management of Urban Renewal Basic Data in Guangzhou"[Xiong,2019],the project needs to investigate the current data of land, housing, population, economy, industry, cultural relics, ancient trees, public facilities within the renewal scope through the combination of government departments' shared data and surveying and mapping.The traditional operation mode is to conduct attribute surveys after field surveying, that is, to measure 1: 500 digital maps as working base maps, and then carry out attribute survey of industry, cultural relics, houses, etc., forming many tables, maps, documents and database results.In order to ensure the accuracy and seriousness of the data,The data is first sent to all relevant functional departments for review, the investigating unit shall modify and improve it according to the review opinions and then publicizes them, and finally the government entrusts a third organization to conduct supervision for the overall quality inspection.The detailed flow chart is shown in Figure 1.
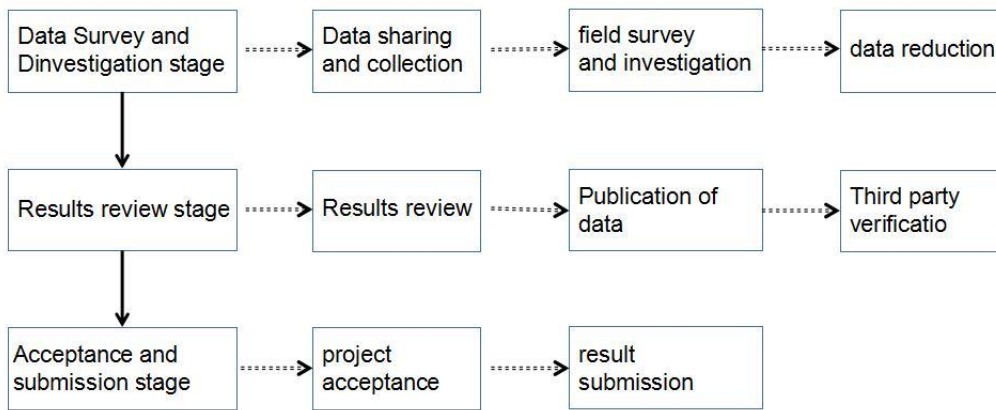
Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration (10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020

Fig 1. flow chart of city update basic data survey

3. KEY TECHNOLOGIES OF THE INVESTIGATION SYSTEM

3.1 Mobile survey software based on Android system

In addition to measuring the area of buildings, the urban renewal Survey needs to obtain property information such as the identity of the house owner, property right registration and so on, so as to make compensation and resettlement accordingly. Therefore, in the process of surveying, it is necessary to take photos of each house, resulting in thousands of photos of an investigation project. In order to effectively take and manage the photos, we developed mobile survey software based on Android system.

The software can manage the user's access rights, avoid modifying the original data, and meet the confidentiality requirements. At the same time, by clicking the "survey sketch", "doorplate", "status photo", "certificate photo" button, you can take photos by category and save them automatically. In addition, through automatic character recognition and QR code scanning, the address can be automatically entered. Get rid of the manual arrangement of massive photos and improves the accuracy, completeness and orderliness of information collection.
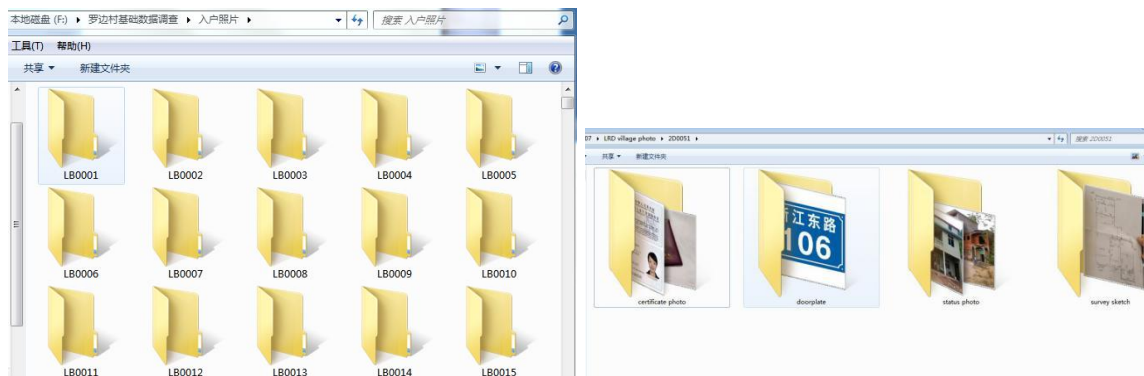

Fig 2.Photos are automatically classified and saved

3.2 Data processing system based on AutoCAD and FME platform

According to the requirements, each house needs to provide a diagram and a detailed list of the real estate area, plot the side length and the building area of each floor, and register relevant property information such as construction time. Based on AutoCAD platform, we developed a real estate data processing system with Visual LISP technology[Liu,2017]. After drawing the outline of the house, the building layers and structure types of each part are entered through the system. Then, the system can automatically calculate the building area of each part according to the building area calculation specifications, mark the dimensions in batches, and export the area list in batches. At the same time, it has the function of data inspection, which can check and mark the common errors such as missing and wrong filling, greatly improving the work efficiency.
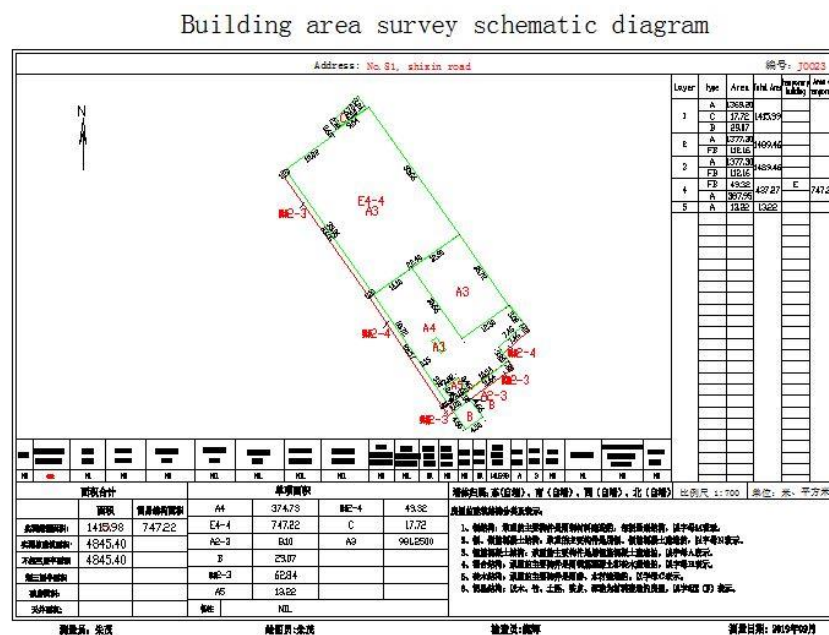

Fig 3. Calculation system of real estate area

FME (feature manipulation engine) supports the operation and transformation among GIS, CAD, BIM, point cloud, table, grid, database and other data. We have defined several workbench templates, which are mainly used for quality inspection and data storage[Chen,2019]. For example, through FME to extract the information in the house area detail table and cooperate with the house distribution map, you can check the completeness and consistency of the data, or use FME to calculate the graphical data and analyze the table results for errors. Beside, a data template that meets the needs of urban renewal was customized. Through previous data analysis and inspection, appropriate FME converter parameters were called for

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration (10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020

various data characteristics, and the data was logically combined to form an orderly data flow to build a database.
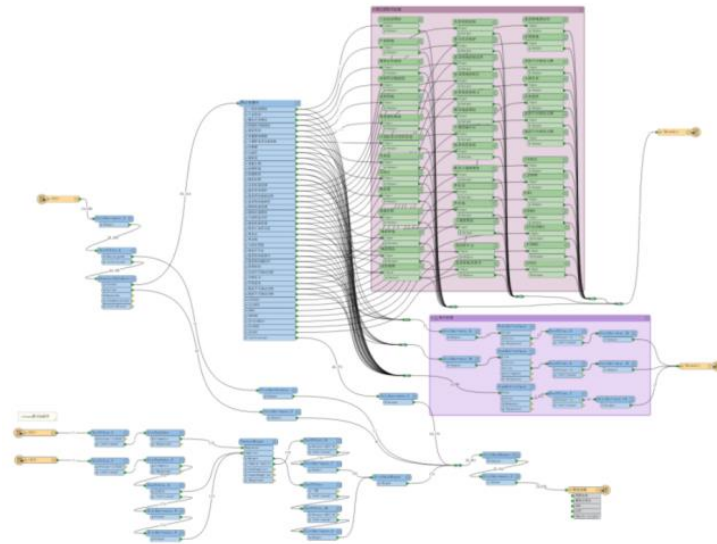

Fig 4. Schematic diagram of FME data processing module

3.3 3D technology of tilt photography based on UAV

We use multi-rotor UAV to carry out tilt photogrammetry to obtain high-precision real-life 3D models of the renewal area, which can measure the side length and height of the house, and provide clear orthophoto images to assist the administrative approval[Xu,2018,Zhou,2016]. For historical buildings such as the ancestral hall inside the old village, due to the fuzzy texture or component details of the UAV 3D model, we use the ground 3D laser scanner (RIEGL VZ400) to supplement the point cloud, and combined with the photos taken by the digital camera to build a more detailed model, which effectively serves the protection of cultural relics. The flow chart is shown in the following figure.

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration (10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
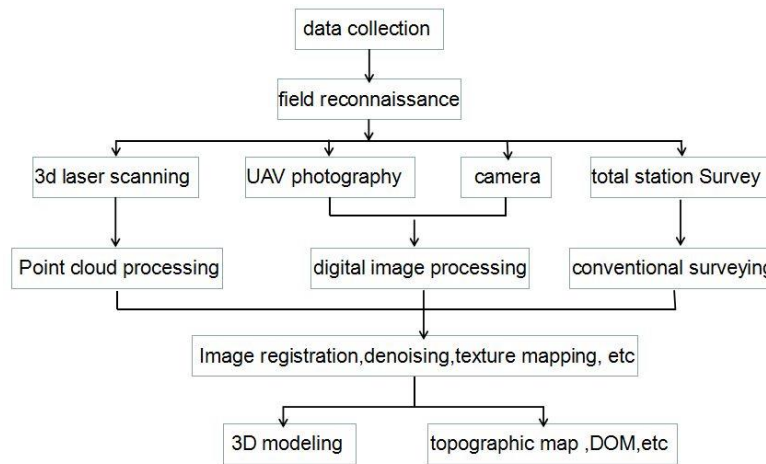Amsterdam, the Netherlands, 10–14 May 2020

Fig 5.Establishment of real scene 3d model system

3.4 Example analysis and accuracy verification

We selected a key old village in Guangzhou for verification. The specific project scale is shown in the table below:

Table 1. Project scale

Survey area	Population involved	Number of villagers' houses	Gross floor area	Quantity of historical relics
1.9 Km2	6234	4126	1.85 million ㎡	5

This project uses rotorcraft for low-altitude data collection, and uses multiple takeoffs and landings to complete tilt photogrammetry data collection. The ContextCapture software is used to process the tilt aerial image to produce real-world 3D model and DOM. At the same time, Laser range finder and total station are used to measure the length and corner of the house for accuracy check. The equipment used in the project is shown in the table below.

Table 2. The equipment used in the project

Device type	Equipment model
aircraft	Harwar, 4-axis 8-rotor uav
Aerial system	Tilt digital aerial camera (5 lenses)
Total station	Topcon OS-102
Laser rangefinder	Leica D210

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration (10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020

| Graphics workstation | Linux;128 gb of memory;GeoFroce GTX 1080T graphics card |

In order to detect the accuracy of the results, 545 feature points were randomly collected by the total station, and compared with the coordinates collected by the model. The mean square error of the plane position is ±0.027m, which is less than the requirement of ±0.05m by the specification. The error distribution is shown in the table below.

Table 3. Error distribution interval

error of mean square(m_0) interval	Number of check points	proportion
$m_0 \leq 1\sigma$	452	82.9%
$1\sigma < m_0 \leq 2\sigma$	88	16.2%
$m_0 > 2\sigma$	5	0.9%

4. THE CONCLUSION

In addition to urban renewal, The spatial information surveying production system based on multi-technology integration, has been applied to different fields such as land acquisition and relocation measurement, historical buildings and cultural relics survey, and illegal land (building) monitoring. However, the degree of data fusion produced by various technologies is not enough. At present, we is further exploring and considering the combination of big data management systems to integrate traditional surveying and mapping data, three-dimensional models, planning and design, administrative approval and other kinds of spatial and social attribute data, all the data are integrated into one map, achieving the goal of only one mapping and output according to any demand, and improving data service capabilities.

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration (10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020

REFERENCES

[1] Xiong H,Du S.2019.Practice and Thinking on Basic Data Investigation of Urban Renewal.Beijing.Beijing Surveying and Mapping,33(04):480-483.

[2] Liu G,Zhang X.2017.Visual LISP Programming In Municipal Pipeline Surveying Application.Wuhan.Urban Geotechnical Investigation & Surveying,3:141-144.

[3] Chen i,Huang W.2019.Automatic Storage of Urban Update Basic Data Based on FME.Wuhan.Geospatial Information,17(07):57-59+99+10.

[4] Xu S,Huang X,et al.2018.Oblique Photogrammetric Technique Applied in Surveying and Mapping Large-scale Topographic Map.Beijing.Bulletin of Surveying and Mapping,02:111-115

[5] Zhou X,Meng X, et al.2016.A method for urban real 3D model building based on oblique photogrammetry.Beijing.Science of Surveying and Mapping,41(09):159-163

BIOGRAPHICAL NOTES

I am ShunjiDu, Male, graduated from wuhan university with a master's degree.I am a Registered Surveyor of China and currently working in Guangzhou Urban Planning&Design Survey Research Institute(GZPI),mainly engaged in urban renewal survey and deformation monitoring related work.

CONTACTS

Title Given name and family name:ShunjiDu

Institution:Guangzhou Urban Planning&Design Survey Research Institute

Address:No.10 JianSheErMa road, yuexiu district, city, guangdong province, PRC

City:guangzhou

COUNTRY:The People's Republic of China

Tel. +86 18620693685

Email:799986131@qq.com

Web site: None

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration (10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020

Basic Data Survey and Investigation of Urban Renewal and Reconstruction Based on Multi-Technology Integration
(10545)
Shunji Du and Qian He (China, PR)

FIG Working Week 2020
Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020