9

Environmental Effect of Major Project: Object-Oriented Information Extraction and Schedule-Oriented Monitoring

Zhuowei Hu, Hongqi Liu and Lai Wei
College of Resources Environment and Tourism, Capital Normal University
Key Lab of Resources Environment and GIS, Beijing
Key Lab of 3D Information Acquisition and Application, Ministry of Education,
Key Laboratory of Integrated Disaster Assessment and
Risk Governance of the Ministry of Civil Affairs, Beijing,
China

1. Introduction

With the increase of human activities, ecological security has become a hot topic across the globe. Now the status of ecological security has been influenced by the disturbance of human activities. Since 1990s, there has been many major projects built in China, such as Qinghai-Tibet Railway, the West-East gas transmission, South-North water transfer and the Three Gorges Dam in China. These projects can bring benefits in regional economic development, and affect ecological environment and ecological security. These effects can also influence operation of project security. One of the important issues is to find a balance between the two points for the smooth running of various major projects.

The focus of this article is ecological environment of major project in Beijing. It is dynamically monitored through the change of main project and ancillary project. A method is put forward to integrate multi-source data and information to collaborative analyse. It ensures the continuity of monitoring. During dynamic monitoring of construction, an advanced object-oriented information extraction of remote sensing technology combined with manual visual interpretation to achieve the extraction of target. This method can establish training data set and interpret knowledge database according to the type, spectrum, geometric and texture characteristic of different project type. Meanwhile, the sevaluation indicator system of different periods according to environmental impact assessment requirements needs to be established. Finally, we use the change detection technique to achieve the monitoring and evaluation of process-oriented of project.

2. Theory and implementation

2.1 Research framework

It mainly includes 3 steps in the object-oriented recognition of major projects by remote sensing images: remote sensing information modeling in high-resolution image, object-

oriented information extraction techniques in high-resolution image and accuracy validation and evaluation methods of object-oriented information extraction.

Object-oriented method is not analysis the target by single pixel, but by a collection of pixel in the image. So we can fully take account of some impact factors, such as realation between the object and surrounding environment. Meanwhile, the knowledge base of object characteristics to extract the information from the image is used.

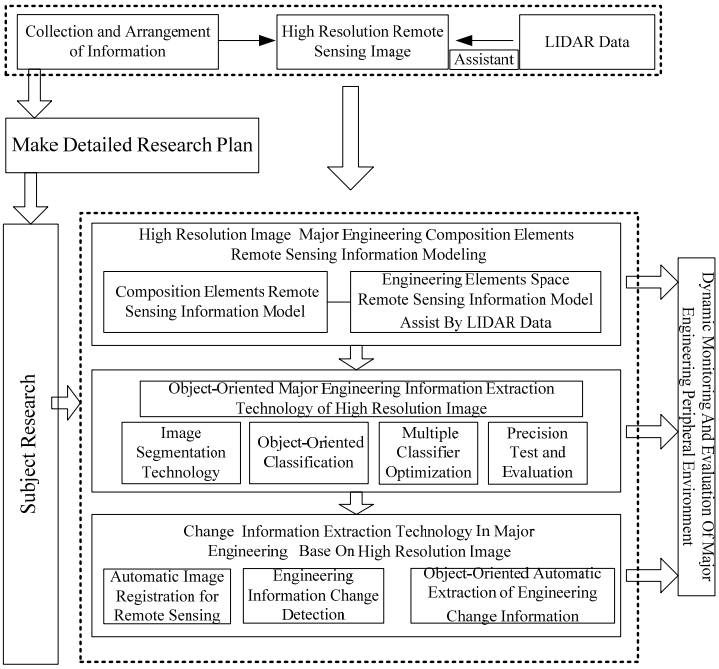


Fig. 1. Information Extraction of Major Project

2.2 Technical route

On the basis of the analysis of the engineering character and the characteristics in the remote sensing images(shape, texture, spectrum), we should combine the actual situations of the major project, choose the right data source, and establish the parameters of the project's construction schedule and indicator system of its surrounding ecological environment; according to those related parameters, the project's characteristics are combined in order to analyse and establish the interpret knowledge database of a project's schedule; and on the support of the database, using the technique of object-oriented to automatic extract the information of characteristic of project schedule and the ecological environment surrounded by project. By combining artificial visual interpretation to modify the extraction results, and through the analysis of the extraction information and the calculation of the monitor index, the project's construction schedule and impact of surrounding ecological environment with semiautomatic and automatic can be monitored finally. Flow Chart of Major Project by Remote Sensing Monitoring is shown in figure 2:

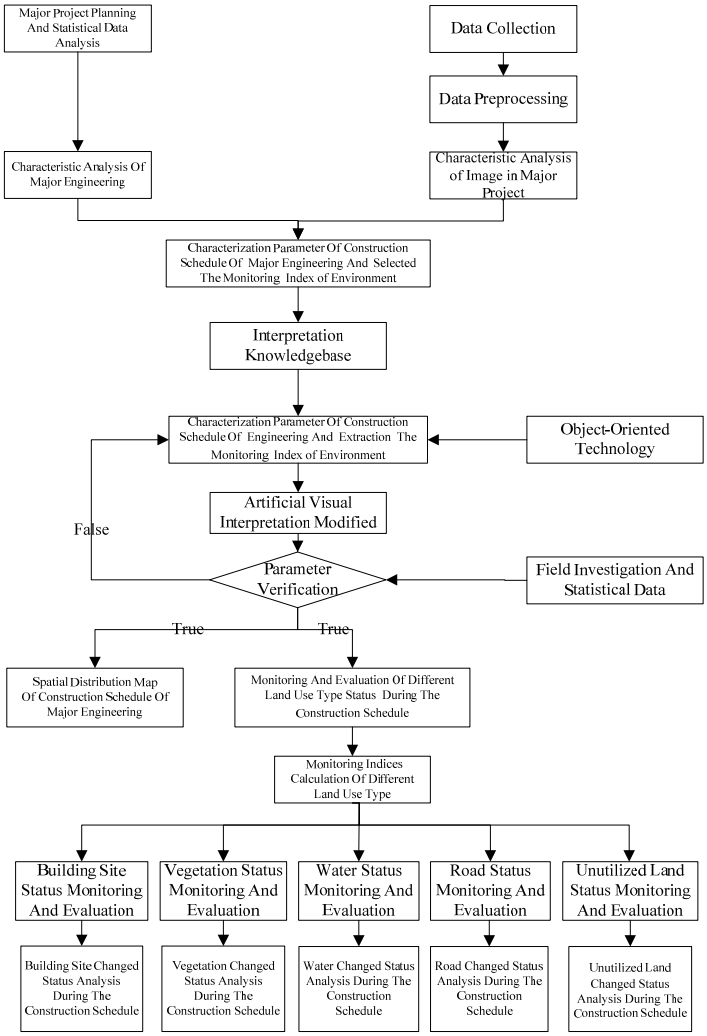


Fig. 2. Flow Chart of Major Project by Remote Sensing Monitoring

2.3 Ecological environment affected by major project and monitoring strategy of remote sensing

Currently, ecological damage caused by major projects of urban construction has been one of the main reasons of environmental degradation, and trends to serious. But the environmental damage and pollution causes mainly non-polluted ecological environmental impact, which is generally destruction of vegetation, destruction of partly landscape, soil erosion, impact of natural resources (land, grasslands, forests, wildlife, etc.), impact of landscape and the impact of interesting areas and so on(nature reserve, monuments, water conservation etc).

Stage	Environmental Problem	Manifestation
Early Stage	Change of Land Cover/Land Useand Decrease of Ecological Function	Requisition, Tree cutting, Green Space Occupied and Regeneration
Medium Stage	Ecological Damage	Animal and Plant Habitat Destruction, Vegetation Reduce, Water Area Reduce, Soil Erosion and So on
Later Stage	Improper Environment Measure	Slope Collapse, Protection Project Failure, Improper Green Way
	Management and Supervision of Environmental Engineering Maintenance	Protective Engineering, Maintenance Management Neglect, Poor Greening, Sabotage and So on

Table 1. The environmental problems existed in major projects of construction

Major construction projects include: point (sations, terminals and airports), polyline (Lines, pipelines and routes) and polygon (sadium area and project area). No matter which type of project, its object includes two types: the main project and ancillary project. Main project is the construction object of the project in accordance with project planning, Such as the Beijing South Railway Station main building, etc; Ancillary project means engineering facilities which plan in order to improve or supplement the principal design features and construction, such as the station square, bus station, road and etc. Its major impact on the ecological environment refers to the problems arising by cnstruction of access roads and camps. Therefore, during the schedule of construction, it is necessary to not only consider the influence to the ecological environment by the main project, but also consider the adverse effects on the surrounding environment by the ancillary project. As a result, engineering sidewalk alignment should avoid living areas as possible, sewage discharged into the sewage tank, and sidewalk trees and grass in order to greening, although it can increase the investment, it improves the construction environment.

The life cycle of major project construction mainly includes 4 stages: investigation, design, construction and operation. They are completely different periods of stage. So it should be monitoring and evaluation by stage, and discussing the impact on the ecological environment in various stages of the life cycle. Then the method of monitoring and evaluation content is then put forward. During the monitoring and evaluation, In addition to focusing on the eco-environmental impact, analysis should focus on the direct impact of the construction period and the corresponding environmental protection measures. At the same time, some aspects of design are ignored, such as the choice of site, line selection) and the management of the operation period. In particular, the land use regeneration after project construction cannot be ignored.

2.3.1 Investigation stage

Surrounding eco-environmental monitoring of investigation stage mainly include the environmental impact of ecological sensitive areas (nature Reserve, Scenic Area and wetlands etc), engineering spoil area and the topographic gradient of project along etc.

During the feasibility study of the investigation stage, environmental protection department should make environmental impact report. This can be confirmed through the key point of environmental protection and measures during various design stages, and make the appropriate engineering design.

For the main project, alignment should avoid the nature reserve, scenic area and wetlands etc. And it should collect local landscape characteristic and the planning information of the region.

2.3.2 Design stage

The design of the route should be according to the characteristics of project and the environmental geological condition of the project then take appropriate measures for ecological and environmental protection in order to prevent new pollution and ecological destruction, and protect resources and natural environment that human beings depend on.

For the main project, construction of spoil field must consider the ecological characteristic of the region, take appropriate and effective protective measure, and prevent further soil erosion. In ecological vulnerable region, major projects must follow the principle that avoid as possible, the construction site, sandstone yard must be considered repeatedly, in order to damage the vegetables as little as possible.

2.3.3 Construction stage

Major project during the construction stage is more complex and difficult. There are many issues to be considered; above all eco-environmental protection. The ecological environment affected by construction of major project is multifaceted, such as land resources and water pollution, chang of flora and fauna community and important impact on the ecosystem.

2.3.4 Operation stage

Ecological environment in operation stage of project mainly include 2 parts: Positive effects and negative effects.

1. Positive effect

The project has 2 main positive effects. On the one hand, the temporary construction area will be planting grass and tree for ecological restoration or rehabilitation after the construction. On the other hand, project construction department will implement a comprehensive virescence project according to design specifications and requirements.

2. Negative effect

The project has 2 main negative effects too. On the one hand, the facilities and activity of project can change or disturb the environment of animal habitat. Because the project can changes the animal channel and activity area. On the other hand, the enterance of a lot of people and vehicles can destroy local vegetation. This effect can reduce the biodiversity community, and change the vertical structure of communities. Long-term effect, it may lead to the cessation of community succession and even retrograde succession.

2.4 Analysis of project schedule characteristic

Case of research in this article is Beijing-Tianjin Inter-city Highspeed Railway. It is a major transportation project.

Beijing-Tianjin Inter-city Highspeed Railway is a typical project of polyline, whose railway station is a typical project of point, and the surranding area of the railway station's ancillary facilities, including the railway station square, parking place, bus stop, etc, are a typical project of polygon. This kind of project is very easy to aggravate the development of geologic hazard problems, such as landslide, soil erosion, and even affect the safety of traspoting itself and the influence on the whole benefit.

Land use during construction include: permanent sites, temporary sites and unused land. Permanent land use refers to the area of roadbed, stations, bridges, tunnels and ancillary projects of transportation engineering. Temporary land refers to vehicle transport road, materials field, access roads of construction and area of construction during the period of construction. Unused land refers to the places which are being used in a certain period due to project planning, demolition, land acquisition or other construction reasons. But such land is not being used for permanent and temporary usage temporarily.

2.4.1 Data collection and scheduleing

According to this research needs, and the demonstrate application needs, we collect multi-source remote sensing data, and the engineering relevant statistical and planning data. Through data standardization and data scheduleing technologies, we deal with the collecting remote sensing data, in order to meet the inquirement of information extraction and monitoring applications.

We choose "BJ-1" satellite remote sensing data as primary data, and other multi-source remote sensing data as auxiliary to monitor the prior period, the middle and the last period. The data acquisition is as follows:

1. BJ-1 data

Considering the project's monitored phase and the small satellite launch services period, select satellite data of the project mid-and late-phase, as the following table 2:

Spatial extent	Type	Spatial resolution	Time	Use
Beijing region (Beijing South Railway Station)	BJ-1 multi-spectral	32m	Oct 2007	Data fusion
	BJ-1 Pan	4m	Oct 2007	Data fusion, Information extraction
	BJ-1 multi-spectral	32m	Sep 2008	Data fusion
	BJ-1 Pan	4m	Sep 2008	Data fusion, Information extraction

Table 2. BJ-1" satellite data information

2. Auxiliary data

Ancillary data provide references for the precise alignment of the different periods or different time to these satellite images, and they are benefit to train the image selection of classification schedule and verify the results, in addition, they can greatly reduce the amount of outside work, save time and money, and also very important to ensure that we can complet the project with high quality and on time.

We need to collect the necessary supporting data according to Beijing South Railway Station's construction followed by the table 3.

Data type	Spatial resolution or scale	Type	Time	Use
SPOT	2.5m	multi-spectral	May 2007	Assisted information extraction
QuickBird	0.6m	multi-spectral	May 2007	Assisted information extraction

Table 3. Auxiliary data

2.4.2 Standardized rules for data

1. Plane coordinate system

Datum: 1954 Beijing coordinate system
Projection: Gauss - Kruger projection
Striping mode: 6 ^{o}

2. Height coordinate system

1956 Huanghai Height Datum
When topograhic maps are Xi'an 1980 coordinates system and 1985 National Height Datum coordinates, we should convert the datum to Beijing 1954 coordinate system and the 1956 Huanghai Height Datum,1:25 million and 1:10 million scale is 6 ^{o} zoning.

3. Data Prescheduleing

Using remote sensing geographic information system software, such as ENVI and ARCGIS, to do geometric correction and image fusion.
Work steps: control point selection, correction, registration, image fusion.

2.5 Establish engineering schedule characterization of target system

In the construction schedule, we will inevitably take and split the farm land. Thus, we use these two ways to monitor the project's progress: first, through the area change of the project itself to reflect; second, through the monitor of the construction associated with the ancillary works and the surrounding land-use change to reflect.

Different time periods have diverse characteristics in remote sensing image, thus there will be different project type (main project, ancillary project), may lead to different projects exhibit the same characteristics, as they are from artificial cement structures, but, the same

project type may show different characteristics, as they have different progress (different cement hardened, different stages of progress), which gave a lot of confusing interference factors to the monitor progress.

So we need to build the engineering schedule of index system, combined the extract information from remote sensing images with monitor progress project.

2.5.1 Before the construction

As the project land acquisition, demolition, there will be a large continuing area of unused land or land that covered with a little vegetation, at the same time, as the project officer's presence, there will be appear construction wall, simple workshops and other architectural temporary site. Although there are construction activities, but they are not the main content to be monitored.

2.5.2 In the construction

Main building construction area is increasing, while the relavent ancillary construction is continued to be improved, a large number of temporary construction sites appeared (referring to road transport vehicles during the construction, materials, field, basement, construction of access roads, construction sites and barracks and other accounting ground). Unused land area is reduced. At the same time, as the project fill and cut directly destroys vegetation, changing the original shape, stacking a large number of spoil, and poor terrain conditions also produce soil erosion.

2.5.3 After completion

The project main building is no longer increase. A large number of temporary land and unused land will be substituted by ancillary works and ecological restoration project.

In summary, the remote sensing monitor character indicators of major projects in urban construction showed in the table 4 below.

Index	The meaning of indicators	Included in class	Monitoring methods
The main project site	South Station is the main project construction site. Through its area change to directly reflect the progress	Built-up areas	Object-oriented information retrieval and artificial visual interpretation and change detection techniques
Ancillary site works	Except the main project, supporting projects. Including engineering around the Plaza, road, bus stations and other engineering and construction areas	Built-up areas, road	Object-oriented information retrieval and artificial visual interpretation and change detection techniques

Index	The meaning of indicators	Included in class	Monitoring methods
Unused land	Project land acquisition, demolition. It through the different stage changes react the progress. One important indicator of completion.	Grassland, Woodland, Built-up areas	Object-oriented information retrieval and artificial visual interpretation and change detection techniques
Temporary sites	Refers to the period of motor transport road construction, materials field, base, construction of access roads, construction sites and barracks and other area. One important indicator of completion.	Built-up areas	Object-oriented information retrieval and artificial visual interpretation and change detection techniques

Table 4. Type of landuse

Thus, Beijing South Railway Station transportation project study area land use / land cover classification index system is in the following table 5.

Index	The meaning of indicators	Monitoring methods
Built-up areas	Including South Station main project of building land, land for ancillary works (works around the Plaza, road, bus stations and other projects) and unused land and other built-up area of land	Object-oriented information extraction technology
Road	The linear structures for temporary or permanent transportation function.	Object-oriented information extraction technology
Grassland	Refers to the growth of herbaceous plants, more than 5% coverage of the various types of grass, including animal husbandry, grassland and shrub dominated canopy density below 10% of the woodland grass.	Object-oriented information extraction technology
Woodland	Refers to the growth of trees, shrubs, bamboo and other forest land. Including woodland, shrub land, woodland and other woodlands.	Object-oriented information extraction technology
Water	Refers to the natural terrestrial waters and water-conservancy projects, including canals, reservoirs, ponds, coastal land and beaches.	Object-oriented information extraction technology

Table 5. Beijing South Railway Station landuse classification indicators

2.6 Establishment of interpret knowledge database

Interpret knowledge generalized various remote sensing characteristic during different stages of project, these include: hue, brightness, shape, texture, and spectrum. It provides

assisted support for major project schedule and extraction of surrounding ecological environment information. Extraction of major project use artificial and object-oriented methods. So interpret knowledge database has been built for these methods of information extraction.

Basic idea: We need to analyse the image characteristics from different data sources and consider the composition, structure and environment of major project, according to different characteristics of information in remote sensing image, the element's common features are studied during different time in high-resolution remote sensing image, such as geometric features, texture features, spectral information, spatial characteristics and characteristics. Then the remote sensing information database which is suitable to BJ-1, QuickBird, IKONOS and SPOT data should be constructed. The construction schedule is shown in Figure 3.

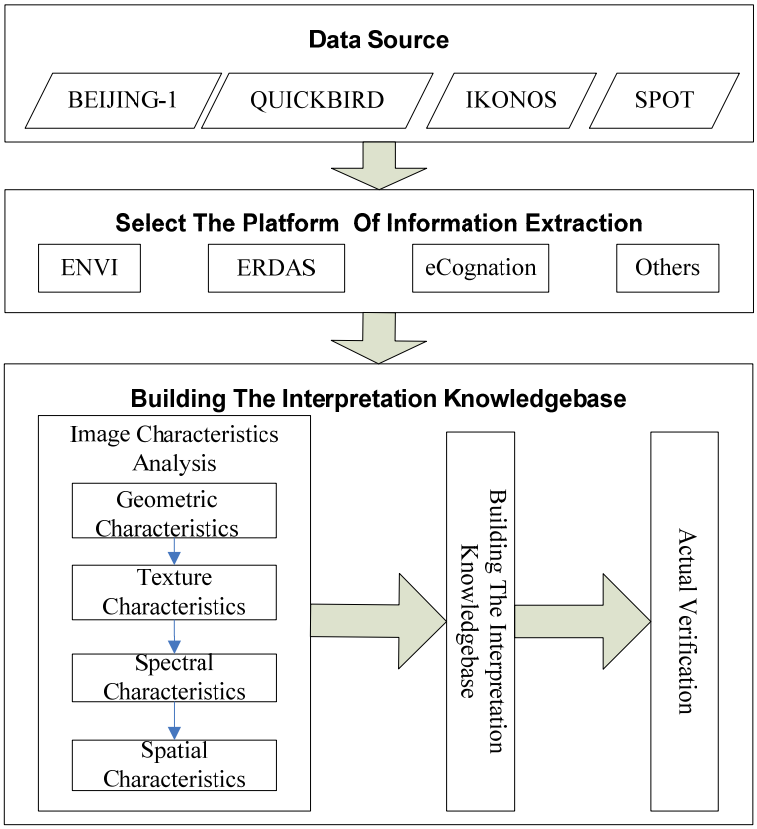


Fig. 3. Flow chart of interpret knowledge database of major project

As data source is different, the interpret knowledge database is different as well. This research is building interpret knowledge database focused on BJ-1, SPOT, QuickBird and TM data.

Interpretation marks for example shown in the following table 6.

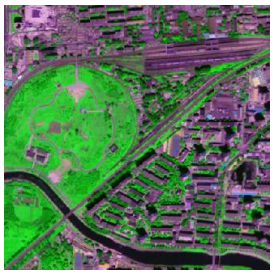
Type	The main project site of Beijing South Railway Station		
Image characteristic	Shape	Specific shape and external clearly boundary	
	Hue	Purple or bright white	
	Texture	Rough structure in mid-term project, uniformity structure in post project	
Image type	BJ-1 4m fusion image, Quickbird multispectral image		
Sample Image	 2005 year Quickbird (Before the construction) No texture	 2007 year BJ-1 (In the construction) Rough texture	 2008 year BJ-1 (After the construction) Uniformity texture
Description of interpretation	According to shape, hue and surrounding strong contrast of main project and ancillary project		

Table 6. Interpretation marks of main project

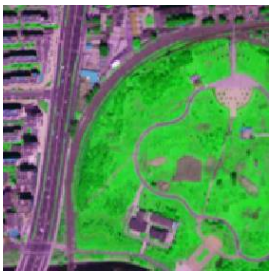
Type	Square, road and bus stop around the Beijing South Railway Station		
Image characteristic	Shape	Clearly geometric feature, regular shape	
	Hue	Green, red and bright white	
	Texture	Uniformity structure of image texture	
Image type	BJ-1 4m fusion image, Quickbird multispectral image		
Sample Image	 2005 year Quickbird (Before the construction)	 2007 year BJ-1 (In the construction)	 2008 year BJ-1 (After the construction)
Description of interpretation	According to shape, hue to interpret		

Table 7. Interpretation marks of ancillary project

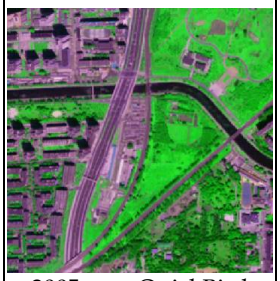
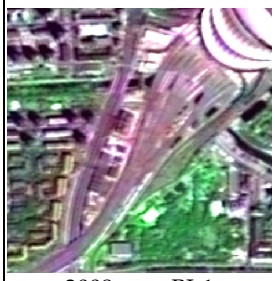
Type	Unused land		
Image characteristic	Shape	Irregular geometry and obscure boundary	
	Hue	Purple gray and dark color	
	Texture	Rough texture	
Image type	BJ-1 4m fusion image, Quickbird and SPOT multispectral image		
Sample Image	 2005 year QuickBird (Before the construction)	 2007 year SPOT (In the construction)	 2008 year BJ-1 (After the construction)
Description of interpretation	Irregular shape and textture surrounding by engineering land, building land and the edge of vegetation		

Table 8. Interpretation marks of unused land

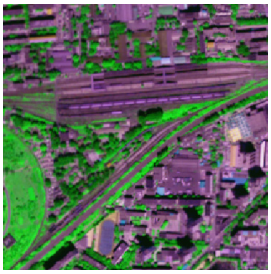
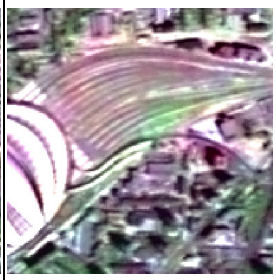
Type	Road of transportation, materials field, base and barrack		
Image characteristi	Shape	Irregular geometry and obscure boundary	
	Hue	Purple gray and dark color	
	texture	Rough texture	
Image type	BJ-1 4m fusion image, Quickbird multispectral image		
Sample Image	 2005 year Quickbird (Before the construction)	 2007 year BJ-1 (In the construction)	 2008 year BJ-1 (After the construction)
Description of interpretation	Irregular shape, distribution in edge of the main project and similar hue with engineering land		

Table 9. Interpretation marks of temporary land

2.7 Indicators extraction of project schedule characteristic

A remote sensing technology was used in order to extract the indicators of project schedule characteristic directly from the remote sensing image. Thus, we put forward an indicator extraction method of object-oriented project schedule and visual interpretation of artificial intervene. This method mainly uses remote sensing technology to extract the information of land-use and land-cover.

This method mainly includes two steps: 1. Monitoring indicator extraction of land-use and land-cover based on object-oriented technology. 2. Indicator extraction of major project schedule by human intervention. The key technical route is shown in Figure.

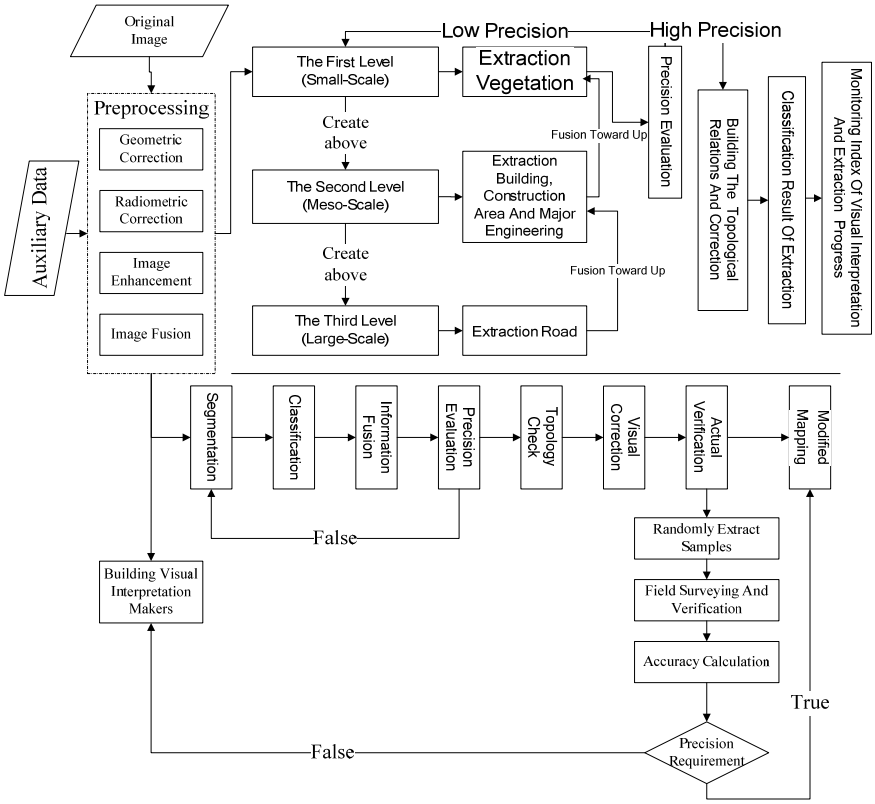


Fig. 4. Flow chart of the information extraction of major project

In this technical route, object-oriented information extraction is the key link. The study is based on the pixel's spectrum, shape and texture characteristics within the range of engineering research, compose to a single image object with all the similar characteristics of the pixels, and then, according to each object's spectrum and spatial characteristics, classify image object of the study area, extract the surface land use/covers information of engineering research area. The information extraction method procedure is as follows.

Based on this method procedure, we choose a mature object-oriented information extraction software package to extract the surface land use/land cover information; Then, we choose a mature GIS software platform to do more artificial work, such as merging and classification, to realize the extraction of the projects' progress characterization parameter.

2.7.1 Software platform choice

We take Ecognition software for example. Its object-oriented classification method basically has two kinds: the most neighboring method and member function method.

1. The nearest method.

It is similar to the supervid classification method, and we must choose samples to do image classification.

Advantages: operation is easy and intuitive, it does not need to summarize and distinguish these all kinds of rules, and it can quickly handle class hierarchy relationship;

Disadvantages: limiting the number of object information used in classification, for example, if the information is too much. It will affect the speed of classification, increase the information redundancy, and even can not use the context very well. The classification schedule is as the diagram shows.

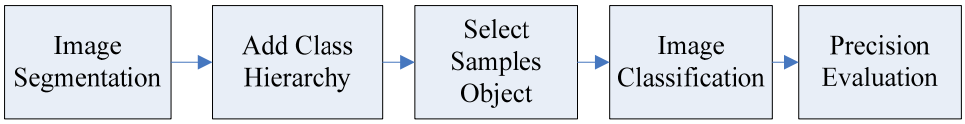


Fig. 5. Flow chart of the nearest method

2. Member function method.

It describes the class feature through membership (also called member function). Membership function is a fuzzy expression, it is a simple method which is used to convert any characteristic value to the range of [0, 1]. Use possibility to describe the belonging degree of the object to the class. The belonging value is usually between 0 and 1, 1 as completely belong to this category, and 0 as not. The size of the belonging value depends on the category description degree of the researching object.

This subject mainly use member function method to extract 2005 and 2007 QuickBird and SPOT data's object-oriented information of Beijing south railway station; After extraction of the classification, we can extract the progress of characterization parameter in a mature GIS software platform.

2.7.2 Project schedule characteristic extraction of Beijing South Railway Station in 2005

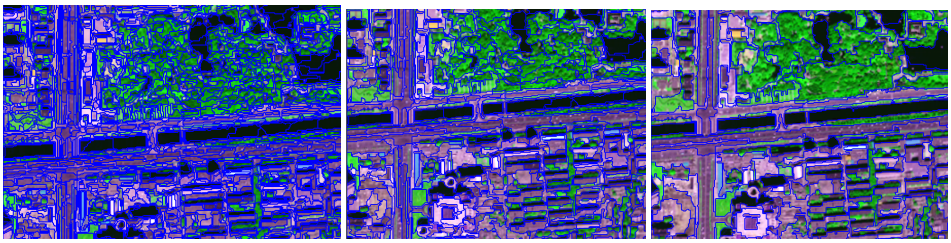
The data source is Quickbird image in 2005.Project schedule characteristic extraction of Beijing South Railway Station in 2005 is mainly includes 2 parts. One is land-use/land-cover information extraction by object-oriented of project study area in 2005. The other is project schedule characteristic extraction by human intervention.

1. Land-use/land-cover information extraction by object-oriented of project study area in 2005

Step 1. Image segmentation

The choice of split-scale size affects the size of the object to the image, named that it affects the accuracy of the information extraction. At the same time, the different split-scale can also make the different size and number of the object's polygon of the project. Through trial and error, we can obtain the appropriate division scale and its parameters of all levels, As follows:

The effect of different segmentation scale is shown in figure:



(a) Level1scale 10 (b) Level2 scale 20 (c) Level3 scale 50

Fig. 6. The effect of the three layers segmentation

Step 2. Classification

First of all,we introduce three abstract base class (lay1, lay2, lay3), using the single value in the hierarchy to define the relationship of inheritance to level1, level2 and level3 respectively, so that each class can inheritance a layer of the object.After the definition of inheritance, make the three classes associated with the three splited layers. Then extact the hierarchical information. To extact roads and water in the level3 (large scale), vegetation and building area in level2 (Mesoscale), and the vegetation will be further broken down into woodland and grassland in level1.

After lay3 inherited level3, it was associated with level3. On the base of lay3, using the length above 300 and the mean value of level3 between 100 and 200 to extract the road.Through observing the result of the classification, we found that there were non-road objects classified as road category, we use the tool “manual” provided by Ecognition to amend it.

Using the brightness which is below 50 and the standard deviation below 15 to extract water.This classification method also extract the shadow.Through trial and error, we have found tha there is no better way to completely remove the shadow. Therefore, we use the artificial intervention to remove the shadow. Through the relationshiop of opposite, make the other unclassified object extracted into other classes.

On the base of lay2, road 2 inherited the lay3's ,water 2 inherited the lay3's.On the base of the unclassied objects,using the brightness which was above 41 and the ratio of the layer2 was above 0.37 to extract the vegetation.Through the relationshiop of opposite,make the other unclassified object extracted into Built-up areas[2].

On the base of lay1, road 1 inherited lay2's, water1 inherited lay2's, vegetation 1 inherited lay2's, build-up 1 inherited lay2's. On the base of vegetation[1],using the standard deviation which was above 13.5 to extract the woodland,and through the relationship of oppsite,extracted the grassland in the land which was not woodland.

The extraction results are shown in table 11 and figure 8:

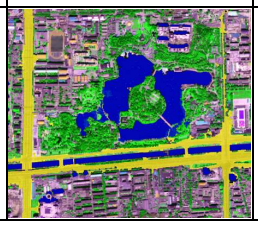
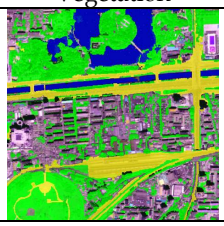
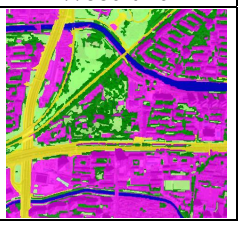
Extraction of Road	Extraction of Water	Extraction of Vegetation	Extraction of Woodland
			

Table 10. Extraction Result

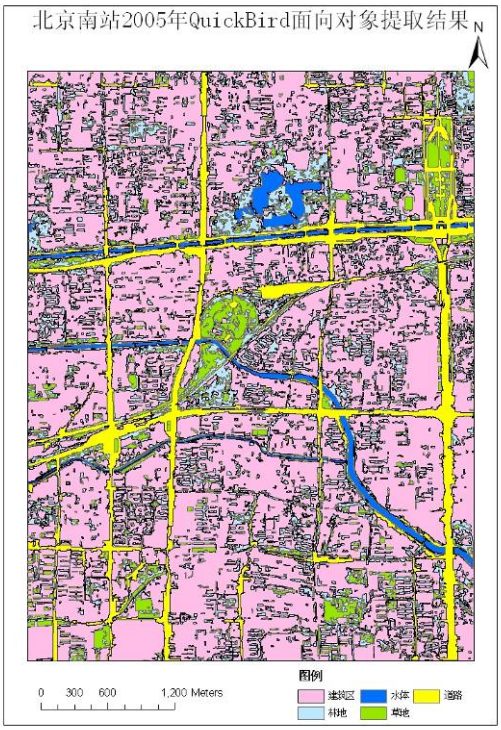


Fig. 7. Extraction result of Beijing South Railway Station by object-oriented in 2005

Step 3. Accuracy Assessment

We use pre-defined area tests the classification result. It is shown in figure 9.

Error Matrix based on Samples

User Class \ Sa...	道路[1]	水体[1]	建筑区[1]	林地[1]	草地[1]	Sum
Confusion Matrix						
道路[1]	29	0	1	0	0	30
水体[1]	0	21	0	0	0	21
建筑区[1]	0	0	20	2	0	22
林地[1]	1	0	0	10	0	11
草地[1]	0	0	0	11	12	23
unclassified	0	0	0	0	0	0
Sum	30	21	21	23	12	
Accuracy						
Producer	0.9666667	1	0.9523810	0.4347826	1	
User	0.9666667	1	0.909	0.909	0.5217391	
Hellden	0.9666667	1	0.9302326	0.5882353	0.6857143	
Short	0.9354839	1	0.8695652	0.4166667	0.5217391	
KIA Per Class	0.9536797	1	0.94	0.37	1	
Totals						
Overall Accuracy	**0.8598131**					
KIA	**0.824**					

reduce expand Close

Fig. 8. Accuracy assessment result

Overall Accuracy is 0.8598131.KIA is 0.824.

2. Project schedule characteristic extraction by human intervention in 2005

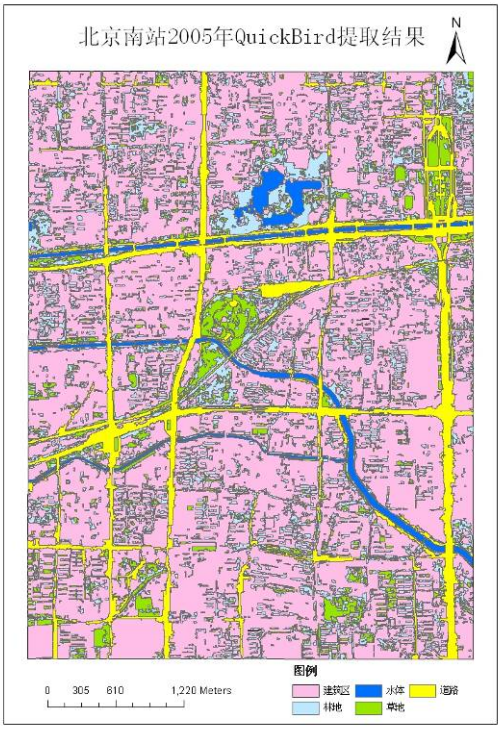


Fig. 9. Extraction result by human intervention

Project schedule characteristic	Surface feature	Time	Area（km2）
Main project land	Building	None	0
Ancillary project land	Building	None	0
Unused land	Grassland, Woodland and Building	None	0
Temporary land	Building	None	0

Table 11. Project schedule characteristic in 2005

Then we use the method of artificial visual interpretation to extract the project schedule characteristic from BJ-1 image in 2007 and 2008.

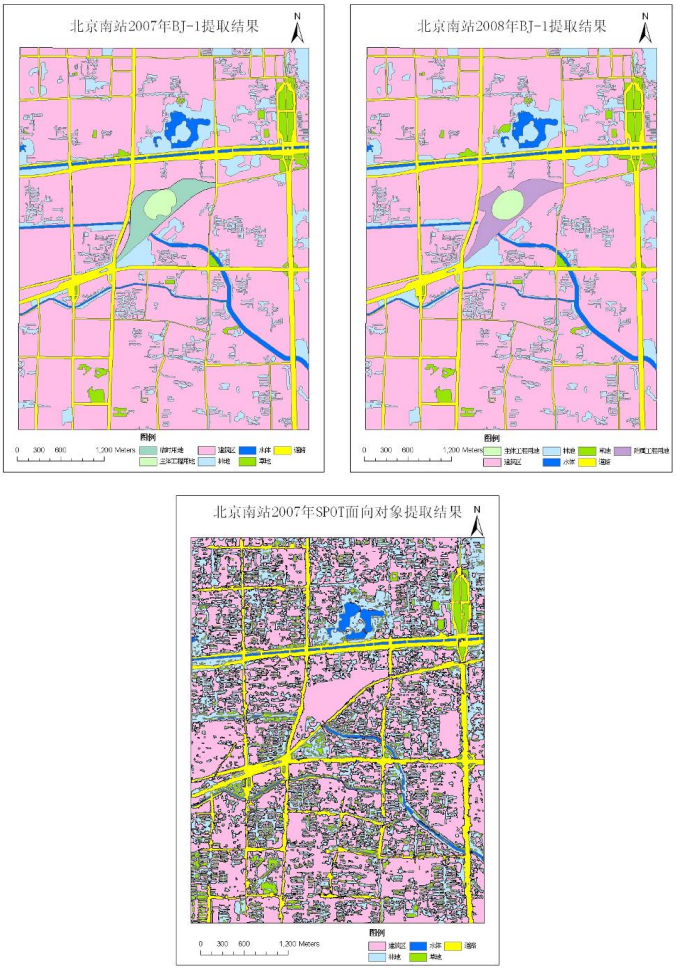


Fig. 10. Extraction result of Beijing South Railway Station by object-oriented in 2007

2.7.3 Progress analysis

Through the analysis and calculation with the parameters of the project, such as area, proportion and area changes from different stages, to achieve the process monitoring of the projects.

1. Main project

Main project land Proportion =Main project land area/All area×100%

Time	Main project area	All area	proportion
2005	0	21.0338	0
2007 May	0.0718	21.0338	0.34%
2007 Oct	0.1309	21.0338	0.62%
2008	0.1392	21.0338	0.66%

Table 12. Main project land area and proportion from 2005 to 2008

(a)2005 (b)2007 May (c)2007 Oct (d) 2008

Fig. 11. Extraction result from 2005 to 2008

The main project is the main building area of Beijing South Railway Station. Through its area changes, it can directly reflect the process of the project.The project did not start in 2005. Its area was 0. To May 2007 of the project mid-term, the areas of main project were 0.0718km2. The area of main project was 0.1309 Oct 2007. It goes to 0.1392 in 2008.

2. Ancillary project

Ancillary project land Proportion =Ancillary project land area/All area×100%

Time	Ancillary project land area	All area	Proportion
2005	0	21.0338	0
2007 May	0	21.0338	0
2007 Oct	0	21.0338	0
2008	0.3488	21.0338	1.66%

Table 13. Ancillary project land area and proportion from 2005 to 2008

Fig. 12. Extraction result of ancillary project in 2008

Ancillary project is addition to the main project. It includes the square around main project, roads, bus stops and so on. The area of ancillary project is 0 in 2005. The area of ancillary project is also 0 till Oct 2007. In 2008, the deadline of project, the area is 0.3488 km2, 1.66% of total research area.

3. Temporary land

Temporay land Proportion =Temporary land area/All area×100%

Time	Temporary land area	All area	Proportion
2005	0	21.0338	0
2007 May	0.3263	21.0338	1.55%
2007 Oct	0.3585	21.0338	1.70%
2008	0	21.0338	0

Table 14. Temporary land area and proportion from 2005 to 2008

(a) Extraction result in 2007 May (b) Extraction result in 2007 Oct

Fig. 13. Extraction result of temporary land in 2007

Temporary land is the landuse of truck roads, base and so on during the project period. The area of temporary land is 0 in 2005, pre-project stage; the area of temporary land is 0.3263 km2, 1.55% of total research area in May, 2007. The area increased by 0.3585 km2, 1.70% of total research. In 2008, the deadline of project, there are no temporary land. It is the symbol of project completion.

4. Unused land

Unused land Proportion =Unused land area/All area×100%

Time	Unused land area	All area	proportion
2005	0	21.0338	0
2007 May	0.0632	21.0338	0.30%
2007 Oct	0	21.0338	0
2008	0	21.0338	0

Table 15. Unused land area and proportion from 2005 to 2008

Fig. 14. Extraction result of unused land in 2007 May

Unused land is one of the key symbols of project completion. The area of unused land is 0 in 2005, pre-project stage; the area of temporary land is 0.0632 km2, 0.3% of total research area in May, 2007. There are not temporary lands in deadline of project. It symbolizes the project completion.

2.8 Accuracy verification

Accuracy verification mainly consists of the determination of investigation mission, research method, accuracy assessment method and the revision of result.

2.8.1 Determination of the investigation mission

Obtaining samples are needed for building the interpretation marks of BJ-1 satellite.

Make sure that the accuracy and the precision of assessment classification for the construction condition patch of the transportation project. It includes design of field

surveyed route, determination of field sampling points, determination of indefinite patch, validity, type, location of the definite and variable patchs. They add the missing patch which are monitored by remote sensing, ensuring the reliability of the remote sensing monitoring results.

The verification mainly towards the monitoring results of Beijing South Station Project's construction schedule. The finished project condition of the year 2008 is chosen to be tested in field.

2.8.2 Investigation methods

There are 3 forms of field investigation:checking with maps、consulting and field verification. It begins with checking the information of variable patchs、index elements according to the map of present condition of land utilization and some other auxilliary materials; it requires consulting for patchs which are hard to ascertain; finally, the field verification is used for those indefinite patchs.

According to the monitoring results, both typical and indefinite areas of the project's schedule representative indices are chosen to set the sampling points. Finally, we get 17 sampling points. There are 2 main part of the project's verified points; 6 accessory project's verified points; 3 roads verified points; 1 grassland verified point; 3 construction land verified points. Field verified points cover the regions around.

In the schedule of implementing, each observation points should be located accurately by GPS, the project's construction progress、the start time、the state of landuse and other general materials should be recorded, digital camera is used to take at least 2~4 photos from each directions for different routes. According to the information collection results of different project's construction points, they are compared with the interpretive results and then verifying the accuracy of the extracted information in the important project areas and their surroundings.

2.8.3 The results of investigation

According to the record of sampling points' general materials in different project construction land, their distribution and schedule conditions are to be realized.

It is via field investigation to verify the accuracy of transportation projects' interpretive work. Both setting sampling points by GPS and recording their landuse types are necessary. And then they are compared with the interpretive results. The ratios of right ones and whole sampling points are exactly the verified accuracy results. The GPS and searial numbers are marked in the field verified map; the latter is ranked in the time sequence of verified routes.

The field relative recorded materials of Beijing South Station project are compared with the interpretive results, and then it comes to the accuracy assessment of Olympic venues' construction results.

The relative recorded materials through field investigation are compared with the interpretive results; the ratio of landuse typys which are consistent with the interpretive ones and whole sampling points is exactly the verified accuracy result. It is 74.19%.

Type	GPS Point	Measured area(m2)	Map area(m2)	Verify accuracy(%)	Error proportion(%)
Major project land	1, 7	137578	139157	0.989	0.011
Ancillary project land	5, 6, 9, 11, 13, 14	3546	3344.65	1.060	0.060
Road	12	1568	1529.87	1.025	0.025
Greenland	2	23880	0	0	0
Building	17	21406	20698.949	1.034	0.034

Table 16. Accuracy verification of Beijing South Railway Station

2.8.4 Revised results

The field relative recorded materials of Beijing South Station project are compared with the interpretive results, and then it comes to the accuracy assessment of Olympic venues' construction results.

The interpretive results are revised by field verified report. The Specific schedulees are shown in the figure 16.

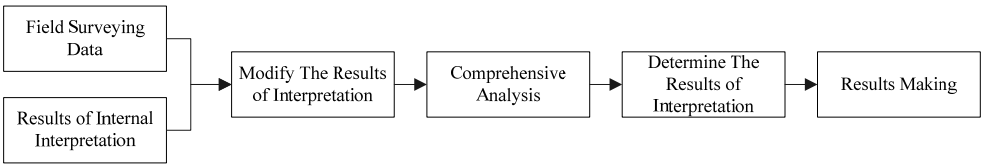


Fig. 16. Flow chart of revised interpret result

3. Summary

Evaluation of ecosystem has always been debated since last 60s. As a multiple system with nature, society, and economy, ecosystem impacted by multiple factors shows its complexity and nondeterminacy. This will bring a plenty of problems when we evaluate ecosystem comprehensively.

1. Among previous researches of ecosystem, the boundary between evaluation of environment assessment and ecosystem assessment was obscured, or mechanically combination of methods of different types in different ranges with different theoretical foundations is named as Eco environment method, which makes it difficult to improve and develop the eco environment method. To some degree, the credibility of ecological environment evaluation is decreased, which affects the conduct of sustainable development strategy.
2. Index systems of evaluating ecosystem should be perfected, and different scales of evaluation unit should be in different systems. Evaluation of ecosystem cannot exist without index system. In researches which are in different situations or inducted by different researchers, distribution of weight are in a large range, therefore this will lead to different results of evaluation.

3. Quantitative evaluation models of ecosystem should be improved. The current evaluation model of ecosystem is static models which focus on structure, function and status of ecosystem rather than the change procedure. Because of importance of ecosystem management, dynamic evaluation models of ecosystem are quite crucial work for the future.
4. Methods of evaluating ecosystem should be developed. Following the development of dynamic models, the problems we face are more complex and comprehensive. And research methods trend to quantitative with globalization and long- term of research object. Therefore, traditional statistics methods are not able to complete these kinds of tasks, and we need new technique to support evaluation of ecosystem.
5. Methods of obtaining data should be improved. In previous evaluation, some indices data were obtained through average of areas which reduced reliability of data and affected evaluation results negatively.

4. References

Howard L. Climate of London deduced from meteorological observation .London: Harvey and Darton, 1833, .

Lo, CP, Quattrochi, DA, Luvall, JC. Application of high-resolution thermal infrared remote sensing and GIS to assess the urban heat island effect .Int J Remote Sens, 1997,18, 18 :287~304 .

Snyder W C, Wan. BRDF Models to Predict Spectral Refle- ctance and Emissivity in the Thermal Infrared .IEEE Transactions on Geoscience and Remote Sensing, 1998,36, 36 :214~225 .

Oke TR. City Size and the Urban Heat Island .AtmosphericEnvironment, 1976,7, 7 :769—779.

O'Neill, R. V., Gardner, R. H., Milne, B. T., Turner, M. G., Jackson, B., Kolasa, J., Pickett, S. T. A. Heterogeneity and spatial hierarchies .Ecological heterogeneity. New York: Springer-Verlag, 1991, :85~96 .

Wang K, Wang J, Wang P C, et al. Different Influences of Ur-banization on Surface Characteristics from MODIS:A Case Studyfor Beijing Metropolitan[J] .Journal of Geophysical Research, 2007,112, 112 (d22) :1-12 .