

# Chapter 15

## A Planning Support System for Retrieving Planning Alternatives of Historical Conservation Areas from Spatial Data Using GIS

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### Introduction

Urban conservation has drastically changed in theory, in practice, and even its basic definition, over the past 50 years. The definition of urban conservation is not limited to the scope of human society, which has continued to evolve since the 1931 Athens Charter. Historical towns and urban areas, as well as their natural landscapes and residential environments, are also included as subjects of urban conservation. In China, urban conservation is currently of interest to urban designers and city administrators, who are concerned with providing a historical urban identity as well as an authentic urban identity. The historical conservation areas in Beijing have become the most congested areas due to the lack of effective planning control and management, and these areas have gradually become warrens, which have been settled by numerous migrant laborers.

Local researchers and planners in the field of urban policy and urban sociology have expressed interest in conserving historical urban identity. The complexity of this field stems from both the theoretical and practical development of urban planning and management. In order to advance conservation planning in Beijing, a new method is necessary in order for discussions to take place between these different disciplines. In addition, a new ordinance issued by the Beijing Municipal

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Government in 2003 described a new planning framework in historical conservation areas with restoration planning through public participation. In this chapter, the relevant concepts reflecting the contribution of the present research, which are comprehensive planning approaches including new supplementary ordinances of the bylaw system, a solution for complicated relationships regarding real estate titles, conservation standards, and restoration planning in urban planning and design, are discussed.

This chapter focused on policy reorientation of the restoration plan in the historical conservation areas in Beijing, China, and explores how to effectively support participatory planning from a viewpoint of promoting the implementation of conservation planning. The geographic information system (GIS), the decision-making model, and the visualization tool are recognized as the three core modules used for planning support, because historical conservation planning includes the spatial analysis of related datasets, retrieving planning measures based on planning policies and guidelines, and the visualization of various planning alternatives. Accordingly, this research will benefit from the application of the planning support system (PSS).

In recent years, the PSS has attracted extensive attention as the latest form of computer-aided planning system (Klosterman 1997; Brail and Klosterman 2001; Geertman and Stillwell 2004). The concept of the PSS was initially proposed by Harris (1960). Several books for the PSS have been edited in recent years (Brail and Klosterman 2001; Geertman and Stillwell 2003; Brail 2008; Geertman and Stillwell 2009). The PSS has been mainly applied in spatial plans (Kammeier 1999; Geneletti 2008), urban environment improvement plans (Edamura and Tsuchida 1999), industrial location choices (Kammeier 1999), and land use plans (Klosterman 1999). In the integrated conservation and development programs, participatory approaches have been used to engage local people in protected area management and conservation actions. Wang et al. (2007) proposed a decision support model for estimating the historical buildings conservation budget. In addition, Shen and Kawakami (2010) developed an online visualization tool for Internet-based local townscape design in Japan, and citizens can access this tool for planning participation. However, there are few PSSs for historical conservation planning from a comprehensive viewpoint of conservation planning policy and related design guideline.

Here, the concept of a multidisciplinary approach for finding an appropriate solution of enforceable restoration planning is proposed in this chapter in the form of the PSS, which includes several tools. In order to investigate how to carry out restoration planning from the viewpoint of promoting public participation that has been stipulated in a new ordinance of the Beijing Municipal Government, the conservation planning policies and guidelines for plan implementation can be transcribed as scenarios consistent with the existing urban bylaw system in Beijing. For this task, GIS is used to setup a database of historical conservation areas with attribute information, including statistical survey data and data on architectural style, preservation state, real estate information, and planning control indicators. Scenarios of planning implementation are configured according to urban bylaws so

that conservation plans have legal basis and become practicable. Moreover, the survey data of each courtyard house restored in the GIS database and the conservation standards established by urban planners should be employed to run a reasoning process using GIS customized program in order that the planning measures for each courtyard house can be stored as attributes of GIS features in a database. Furthermore, VR data are created based on the CAD and GIS database for arguments as to how to gain consensus in the restoration planning and design of courtyard houses between stakeholders.

## **Relative Planning Regulations of Urban Conservation and Property Ownership in Beijing**

As metropolises, some capital cities establish huge social political engines and have the power to enact complex bylaw systems based on the national legal system. On the other hand, various studies have investigated urban conservation systems of historical urban districts and traditional houses throughout the world. In the context of these bylaw systems, the importance of the conservation of physical characteristics is emphasized, along with cultural, social, and economic aspects (Townshend and Pendlebury 1999; Ipekoglu 2006; Ahmed and Salah 2001; Jim 2005). Ericson (2006) evaluated the strengths and weaknesses of the participatory approach used in an applied research program conducted in three Ejido communities in the Calakmul Biosphere Reserve on the Yucatan, Peninsula of Mexico. Table 15.1 shows the local bylaws of Beijing regarding urban conservation that can be applied to cultural properties and historical conservation areas. Control regulations, construction supervision, and building management are all addressed in the bylaws in Beijing.

However, starting from 1949, preservation planning was not implemented smoothly due to confusion with respect to real estate management. From 1949 to 1980, private properties were gradually made into public properties as a result of procurement under the publicly owned housing policy under the Chinese socialism regime. All land parcels in urban areas were nationalized, and the titles of buildings were signed over to the government. Since the 1980s, policy reforms in China have stated that government-owned buildings should be returned to their original proprietors. Thus, confusion regarding the original proprietors has emerged because of missing information and documents of previous title.

On the other hand, local administrative provisions regarding conservation and renovation affairs of historical conservation areas (enacted, November 18, 2003) illustrate Beijing's policy reorientation of the restoration plan in historical conservation areas and consider how to perform restoration planning while promoting public participation. Thus, local government should cultivate the sense of identity of stakeholders in conservation planning so that stakeholders can take the initiative in solving planning problems in the conservation process. However, confusion in

**Table 15.1** Local bylaws in Beijing regarding historical conservation areas

| Relative regulations                                                                                                                                                 | Types of local bylaws                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Local administrative provision regarding the preservation of cultural properties in Beijing (enacted June 23, 1987, revised October 16, 1997)                        | Regulation of the Congress of People's Deputies in Beijing |
| Local administrative provision regarding preservation areas of cultural properties and planning controls in Beijing (enacted November 13, 1987)                      | Bylaw of the Beijing Municipal Government                  |
| Local administrative provision regarding the construction supervision of cultural properties (enacted November 13, 1987)                                             | Bylaw of the Beijing Municipal Government                  |
| Strategies regarding the refinement and management of traditional building in cultural property areas in Beijing (enacted July 31, 1989)                             | Bylaw of the Beijing Municipal Government                  |
| Verdict regarding planning action of the 25 historical conservation areas in Beijing (enacted February 1, 2002)                                                      | Bylaw of the Beijing Municipal Government                  |
| Local administrative provision regarding conservation and refinement affairs of historical conservation areas (enacted, November 18, 2003)                           | Bylaw of the Beijing Municipal Government                  |
| Ordinance regarding the historic culture city of Beijing (preliminary regulation) (enacted, March 1, 2004)                                                           | Bylaw of the Beijing Municipal Government                  |
| Local administrative provision regarding the purchase of courtyard houses by companies and legal persons in historical conservation areas of Beijing (April 1, 2004) | Bylaw of the Beijing Municipal Government                  |

real estate management caused by the transformation of property ownership in urban areas influenced the primary role of residents who are confused regarding their property building rights.

In addition, there are too many renters who are immigrant laborers from regions outside the Beijing metropolitan area. Their existence has resulted in the overpopulation of historical cultural areas. As such, their relocation to other residential areas is indispensability for the realization of urban conservation in the inner city in Beijing. Therefore, the enablement requirements for conservation plan implementation are ownership-based conservation planning and decrease in population through the movement of immigrant families.

## Conservation Plan Based on the New Ordinance of Conservation Standards of Beijing

Due to government-owned buildings being returned to their original proprietors, the conservation plan should be changed to an ownership-based plan. Residents of traditional buildings follow the instructions of conservators in the conservation process. Thus, the conservation efforts of residents require financial assistance from the government. In other words, a subsidy system should be established in Beijing.

Nevertheless, if the population of immigrant families in traditional houses increases and the living conditions in the conservation areas are not sufficient, then residents will not be able to implement ambitious plans to continue living in historical conservation areas. The present situation makes it difficult for residents to make a living in the conservation areas of Beijing relative to in other residential areas of Beijing. Thus, the implementation of a conservation plan will require a great deal of effort, even though the subsidy system that supports residents in conserving traditional houses can be introduced in historical conservation areas.

As a practical matter, if the Beijing authorities carry out historical conservation as described in the new ordinance while taking public involvement into account, the residents of conservation areas will be responsible for implementing the conservation plan. The scenario for ownership-based conservation should take planning implementation into account. In this scenario, conservation standards designed by urban planners and designers are used as preconditions in the decision process.

Moreover, the relocation of residents in historical areas is also a precondition of implementation of the conservation plan. Therefore, the process illustrated in Fig. 15.1 shows who should first be relocated from the historical areas. Next, the process is to determine planning alternatives for traditional houses and who should be the reasonable party for the restoration of traditional buildings and the landscaping of conservation areas. Herein, the term “landscaping” means that, in the



Fig. 15.1 Decision tree reflecting planning policies in Beijing historical areas

conservation areas, existing traditional style buildings should be restored and new buildings should be constructed in accordance with the traditional style.

First, the bifurcation at the beginning of Fig. 15.1 is related to whether the house is a culturally valuable property and is used as a cultural property. If this is not the case, and if the house is not situated along a planned road, the building is in good condition, the courtyard house is used as a private residence, and the planned use is also as a private residence, then the residents can continue living in the traditional buildings because there is no need to demolish their houses. In such cases, if the courtyard house is privately owned, then the courtyard will be supported through the subsidy system. However, if the courtyard house is publicly owned, then the government is responsible for the restoration or reconstruction of the courtyard house.

Second, if the residents should vacate the traditional courtyard houses, there are several cases to be considered. If the courtyard house is designated as a cultural property, then ownership should be transferred to the public, even though the house is privately owned. If the courtyard is not a highly valued cultural property, and if the house is situated along a planned road, if the house is not in good condition and is currently being used as a private residence, whereas the planned use is not as a private residence, then the residents cannot continue to live in the house because the house must be demolished. In this case, the courtyard house should be rebuilt and will not be an original traditional building continuously. If the total area of adjacent courtyard houses in neighbor to be dismantling is larger than 4 ha, then the site will be defined as a redevelopment area because of a related regulation in the local bylaws of Beijing (Enacted, 18.11.2003, as shown in Table 15.1). Otherwise, the buildings will be rebuilt in the conservation areas. If the buildings are privately owned, then the owners will be asked to maintain the traditional architectural style upon reconstruction.

## Planning Support Using GIS to Retrieve Planning Alternatives

For this chapter, the study area was chosen from among the 25 historical conservation areas in Beijing. Figure 15.2 shows the location of the study area, which is a typical area including government and municipality-designated cultural properties, selected traditional buildings, and new buildings that should be renewed and built in the traditional style. This area also faces planning issues such as complicated real estate ownership and high population density, as mentioned above. Table 15.2 briefly summarizes this area.

In this area, approximately one third of the courtyard houses have been returned to the original owners. Figure 15.3 shows the ownership distribution of the historical cultural area. The actual planning is implemented by the house inhabitants of the courtyard houses, who may be individuals, the government, or companies. Figure 15.4 shows recent photographs of the buildings in the study area.



**Fig. 15.2** Location of the case study area

**Table 15.2** Overview of the study area

|                                        |                        |
|----------------------------------------|------------------------|
| Historical conservation project area   | 70.38 ha               |
| Length from east to west               | 1,400 m                |
| Total floor area of all buildings      | 499,480 m <sup>2</sup> |
| Number of traditional courtyard houses | 1,120                  |
| Residents (households)                 | 24,030 (9970)          |

As described above, Fig. 15.1 presents a decision tree based on local policies regarding real estate management, urban planning and design, and conservation standards designated in the local bylaw system, which is a comprehensive planning approach. The GIS is used to facilitate the decision process described in this decision tree, which is shown as Fig. 15.5. In Beijing, survey data and planning drawing were edited in Excel format and CAD format, which are converted into a GIS database as dbf files and shape files. A rule-based tool is developed as an if-then customized planning support system using VBA of ARCOBJECT. In this if-then decision tool, the planning alternatives, namely, the planning measures of each courtyard house, can be deduced based on spatial features and their GIS data attributes.



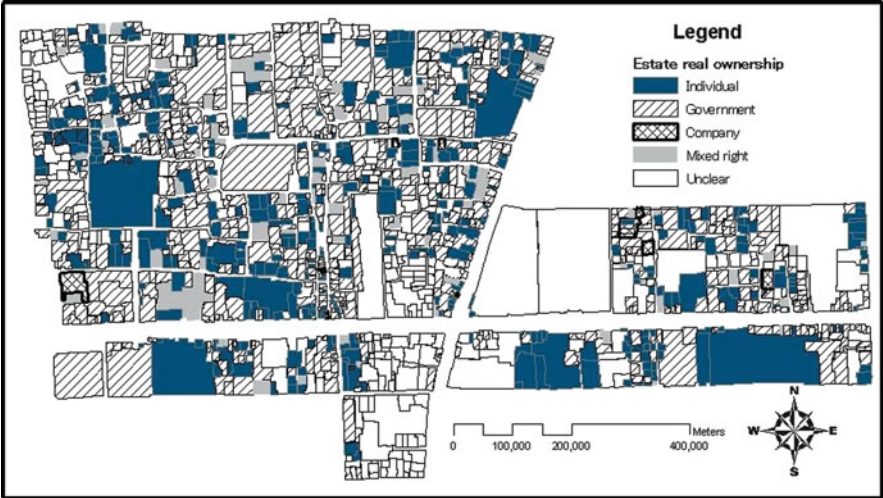


Fig. 15.3 Ownership distribution map of the study area



Fig. 15.4 Extension or reconstruction of buildings occupied by immigrant families



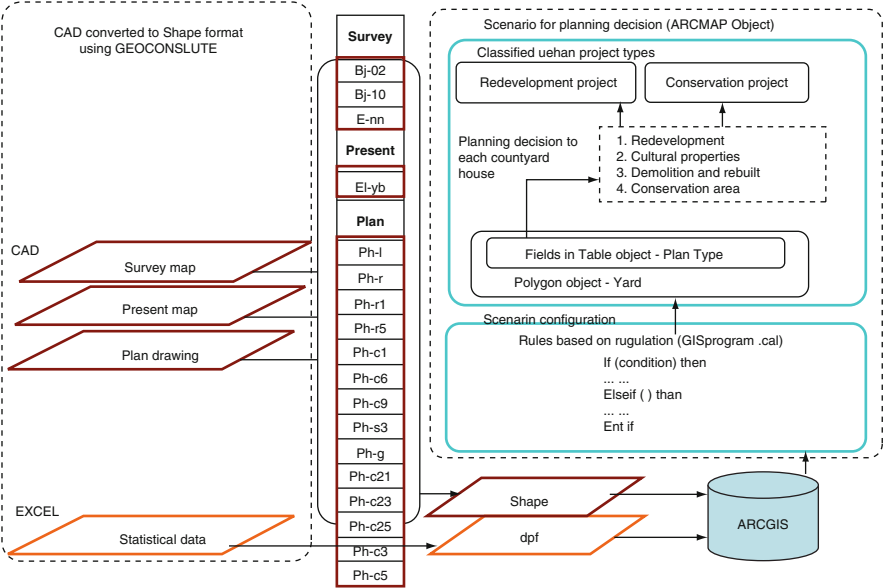


Fig. 15.5 System framework of the proposed tool for generating planning alternatives

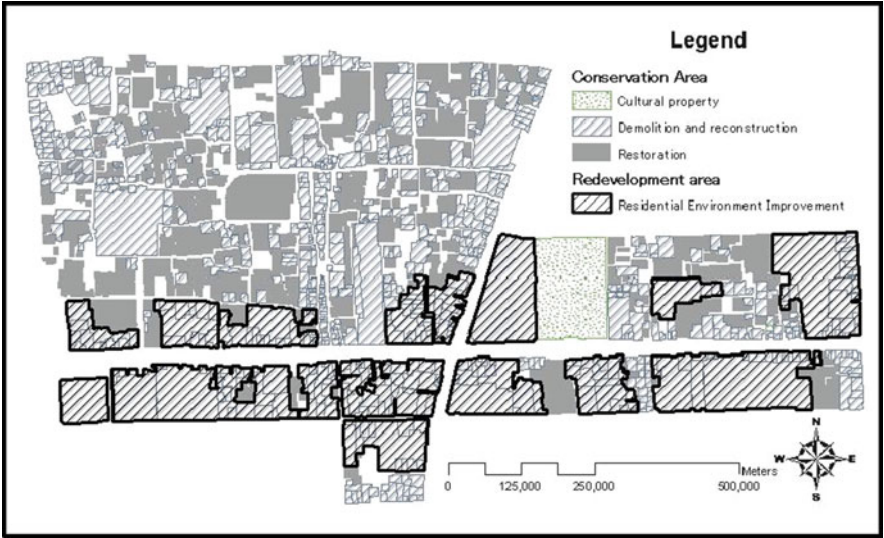
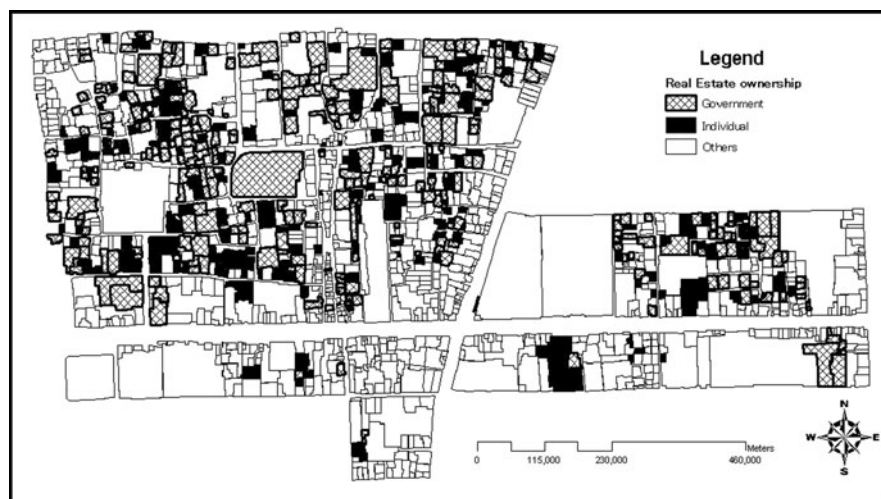


Fig. 15.6 Results of planning measures

Figure 15.6 shows the results of planning alternatives of courtyard houses generated by the proposed tool, which includes the four alternatives: residential environment improvement in redevelopment areas, cultural property, demolition and reconstruction and restoration in conservation areas. The local government in



**Fig. 15.7** Distribution of courtyard houses identified as restoration targets

China supports cultural property preservation through public finance. Moreover, the government-owned courtyard houses should be restored or rebuilt by the government, which will not be included among the targets of a possible subsidy system. The privately owned courtyard houses in conservation areas require financial support from the local government for restoration or reconstruction. All of the buildings in redevelopment areas will be demolished and rebuilt in traditional architectural style, but no financial support will be provided through public finance.

Figure 15.7 shows the courtyard houses identified as restoration targets retrieved from the entire area. In the figure, the black polygons are privately owned courtyard houses, and the hatched pattern polygons are government-owned courtyard houses. The other courtyard houses are landscaping targets that should be rebuilt in the traditional architectural style.

## Alternatives of Housing Environment Improvement for Restoration Targets Using VR

For openly providing planning information on the conservation area over the Internet, we develop a visualization tool with which to visualize design alternatives using VRML based on planning standards issued by local planning authorities for the public to determine possible design alternatives for a courtyard house. In order to obtain a consensus with respect to housing environment improvement, the number of houses that should be removed and planning budgets should be considered among stakeholders. However, all possible alternatives can be visualized through different building forms. Thus, we suggest a design tool that can simulate

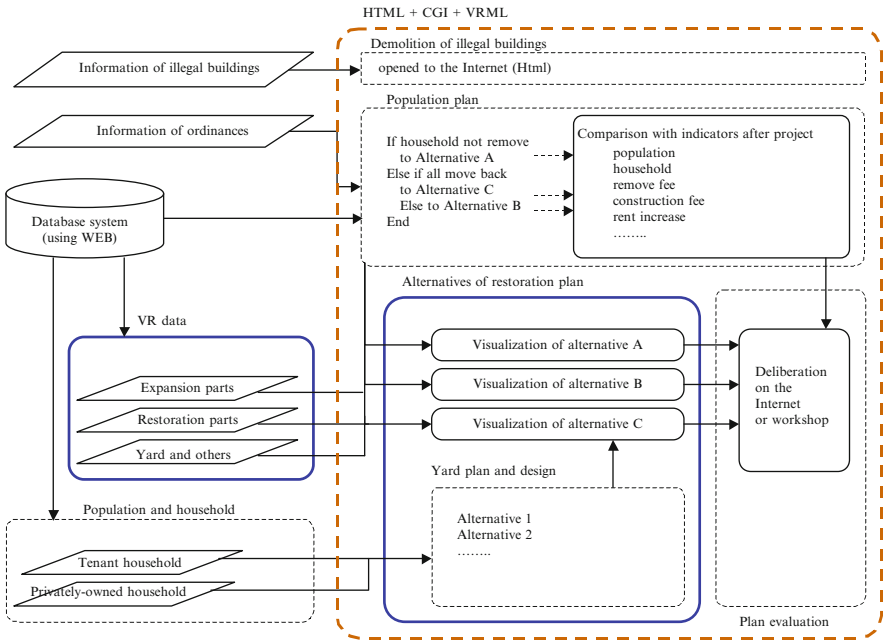


Fig. 15.8 System framework of our tool for visualizing alternatives

these planning alternatives and their possible building forms using VRML for discussion and evaluation, which can also be provided openly to the public over the Internet. Users include residents, experts, and administration officers.

In practice, after the restoration targets are determined using the GIS tool, the planning alternatives for each restored courtyard house should be considered on a case-by-case basis. For the possible future public participation, we examine how to use the proposed visualization tool to represent the alternatives.

Figure 15.8 shows the system framework of this visualization tool, which is developed as a web application for stakeholders to access using the Internet. This system is expected to be helpful for stakeholders to obtain a better understanding of the objectives of the housing environment improvement in the conservation area according to a planning implementation process in “Verdict regarding planning action of the 25 historical conservation areas in Beijing (Enacted 1.2.2002)”, which includes the following steps:

1. Demolition of illegal buildings,
2. Population planning,
3. Alternative restoration plans, and
4. Plan evaluation.

As shown in Fig. 15.5, the VR data set for representation alternatives is prepared in a web database and can be selected by users to represent design alternatives with planning information as well. In the first planning process, namely, the demolition

of illegal buildings, the illegal buildings that should be demolished are made known to the public. For population planning, the system is developed as a tool for presenting alternative and relative indicators based on the decisions of the stakeholders. The alternative restoration plans can be visualized using VRML to share a virtual world and related planning information between stakeholders. Finally, an evaluation of the plan is prepared in order to collect the opinions of stakeholders.

Figure 15.9 shows the interface of the population plan. The web contents in the left-hand frame show the planning process and are linked to the right-hand frames, which show the alternatives in a planning drawing and a visualized VR world.

A typical courtyard house has been prepared for the purpose of educating the stakeholders. First, buildings in the courtyard house without a construction permit should be demolished: the positions of these illegal buildings are indicated on the homepage along with information on the floor area and the number of residents. The residents of the illegal houses are renters. When the housing environment improvement project is carried out, the renters must decide whether to move or to pay increased rental fees.

As a result of overpopulation, population adjustment is necessary. Population planning must be conducted according to the housing standard of “residential floor area per person” enacted in the ordinance in historical preservation areas, which is at least 10 m<sup>2</sup> per person. In order to explain the objective of the housing environment improvement project, the visualization tool should coordinate different population planning needs with different alternative building forms. Finally, stakeholders should attempt to make decisions on planning alternatives through plan evaluation. Figures 15.9 and 15.10 show the three alternatives prepared using the system, and Table 15.3 shows some of the indicators for each alternative.

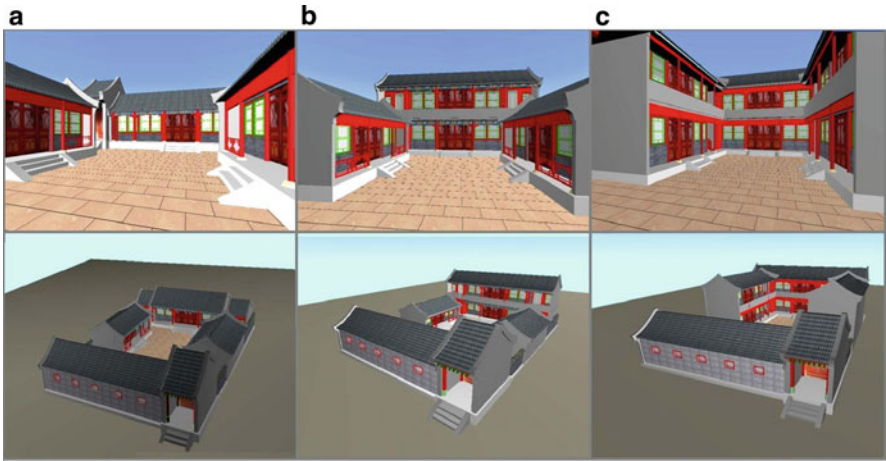
As with the described planning process, the fundamental component of the proposed tool is for representing the alternative plans using VRML to propose a population plan to address the high population density of the preservation area. The primary goal of the proposed tool is to allow stakeholders to understand the situation and the choices available to them.

## Conclusions

The economic reforms of the past few decades have physically transformed China's cities. Private ownership of real estate has gradually increased after the decline of the socialist ownership policy that began in 1949, and the transformation of property ownership in the urban area has influenced the system of urban development. This chapter has focused on the policy reorientation of the restoration plan in the historical conservation areas in Beijing, China, which considers how to carry out restoration planning from the viewpoint of promoting public participation, which has been stipulated in a new ordinance by the Beijing municipal government in 2003.



Fig. 15.9 Representing the population plan using the visualization tool: (a) Alternative plan A. (b) Alternative plan B. (c) Alternative plan C



**Fig. 15.10** Alternative plans (a) A-Restoration. (b) B-Expansion I. (c) C-Expansion II

**Table 15.3** Alternatives plans

|                                           | Alternative A | Alternative B | Alternative C   |
|-------------------------------------------|---------------|---------------|-----------------|
| Scenario                                  | Restoration   | Expansion I   | Expansion II    |
| Expansion of houses                       | None          | One building  | Three buildings |
| Leave the house intact                    |               |               |                 |
| Privately owned house                     | 4             | 4             | 7               |
| Tenant house                              | 0             | 2             | 3               |
| Remove house                              |               |               |                 |
| Privately owned house                     | 3             | 3             | 0               |
| Tenant house                              | 0             | 1             | 0               |
| Residential floor space (m <sup>2</sup> ) | 337.3         | 475.5         | 922.1           |

For the restoration of historical conservation areas in accordance with the policy of public participation, a subsidy grant system for restoration that is supported by public expenditure is necessary. Therefore, a comprehensive approach is proposed in order to find a solution for a complex relation among real estate ownership, conservation standards, and restoration planning in the conservation area.

As a result of this research, the possibility of introduce a decision tool and a visualization tool to support the conservation plan is clarified. A decision tool using GIS is used to integrate urban policy with respect to real estate management and urban design and planning, through which the conservation plan can be changed to a practicable ownership-based plan.

In the proposed system, we used ARCGIS, VR to support the conservation plan in Beijing. We succeeded in data integration using GIS and data conversion software, experts in local urban planning can explore planning policies using the GIS tool based on if-then rules reflecting local planning ordinances. Residents can learn about restoration plan alternatives for courtyard houses through VR simulation.



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