Study on Visualization of Townscape Rules Using VRML for Public Involvement

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Abstract

The importance of a visualization tool to improve public participation is becoming increasingly recognized within the urban planning and design community. The effective application of such a visualization tool in this context, however, remains relatively under explored. Based on a case study in which townscape rules were drawn up as a result of consensus through the landscape improvement committee of Nanao city, Japan, this paper discusses the potential and limitations of a visualization tool in improving public involvement for the purpose of reaching consensus on townscape rules at a district level. In addition, this paper reveals the need for a knowledge-based database system linking with VRML objects for powering a visualization tool to provide necessary information to assist in decision-making.

Keywords: visualization tool; townscape rule; district plan; VRML (Virtual Reality Modeling Language)

1. Introduction

In recent years, with the spread of the Internet and development of computer technology, various types of spatial multimedia including text, video, photography and virtual reality, WebGIS are employed for public participation in planning by helping stakeholders to acquire a better understanding of the planning and design process (Michael J. Shiffer, 2001; Daniel Bulmer, 2001; Moon, T. H., 2003). With respect to the visualization of planning and design requirements of stakeholders in public involvement, planning and visualization tools (T. Zamenopoulos and K.Alexiou, 2003) for human or artificial design agents in a distributed network can be utilized to generate coordinated design. These tools are helpful for making decisions in the planning-design process. Research concerning the applicability of spatial multimedia and visualization tools in urban planning and design has recently been conducted around the world.

Concerning the visualization of planning and design for public participation, the technological possibilities for each user to build his/her own space and communicate in a virtual city have been proven to be achievable through the Alphaworld Project (Smith, A. and Dodge, M. *et al.* 1998). The Alphaworld Project was not a real construction project but a pure virtual world without any design regimes, so it can be considered as an initial step for practice in urban planning and design.

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In attempting to use the virtual reality technology in practice, the Ryoanji Project (Okabe, A. and Sato, T. *et al.*, 1999) was carried out to examine cooperative possibilities for remote design while sharing the same VRML world. This project was developed as a designing game for assigning the positioning of stones in a Japanese garden.

In practice, Andy Smith (Hudson-Smith, A. and Evans *et al.*, 2002) of University College London discussed a visualization tool for generating alternatives for public participants in the Woodberry regeneration project. A public park visualization tool was introduced as an on-line design collaboration system (Shen, Z. J. and Kawakami, M., 2003) for collecting participants' designs on the Internet environment. In this system participants can make new ground surfaces, and arrange the design or select elements on the planning site in the VRML world. Visualization of planning and design alternatives is proposed to assist in bottom-up decision-making as a tool for representing different land use scenarios (C. Pettit and A. Nelson *et al.*, 2004) in public involvement. However, the visualization tools differ between projects such as PP-SDSS for public housing (Jack Barton and Jim Plume *et al.*, 2005), townscape design (Oharu, H. and Arima, T. *et al.*, 2001) and so on.

Though there are many research projects in the context of possibilities for using a visualization tool, few are used in the context of verification in planning practice. As mentioned above, Pettit prepared several scenarios using a VRML world, which is accompanied by a visualization tool that is embedded in a VRML scene for locating design elements respectively, similar to Shen's work of a Public Park. However, the researches are still focusing on system development, and how to use visualization tools to improve planning decisions is a task for future study. A research report

(N. Matsumoto and T. Utsunomiya, 2004) focused on the effectiveness of 3D walkthrough animation using VRML and argued that even though visualization encouraged participants to express concrete opinions and requests, visualization can also mislead stakeholders if there is a lack of accuracy in conveying the current condition or planning and design. Therefore, 3D walkthrough animation incorporating local features or planning and design should be formulated as far as possible. Furthermore, another project (Tanoue, Y. and Arima, T., 2005) conducted experimentally was a verification of a visualization tool and concluded that using the tool at an early stage in the workshop might fix the citizens' image. This is because the representation of the virtual world is too realistic to simulate the real condition, such as changes in the actual building, which might be offending to the owners.

How to use the visualization tool and how to make it effective? These are important topics concerning the popularization of VRML technology in public involvement. This paper presents our research on these topics.

A visualization tool is after all auxiliary to traditional methods and cannot replace all of them. For example, field survey is necessary regardless of whether or not a new visualization tool is employed in the workshop. There are also research reports (Shinobe, 2005) concerning traditional methods including field survey, questionnaire, vote and other means that focus on the effectiveness of learning and gaining consensus.

With regard to making proposals in a traditional planning committee for public participation in Japan, participants can represent their concepts by preparing documents, drawing illustrations and carrying out experiments with a model prepared by a working group based on text, draft drawings or model materials. However, if only the draft drawings and documents are utilized, the degree of consensus that can be reached during the deliberation process might be limited to some extent, because the participants would have to imagine the entire plan and make their decisions based on each rule that might be only a fragment of the whole. Even though a new visualization tool is employed, the draft drawings and documents are also available as basic information of the plan alternatives, which can also be prepared as HTML documents via http service on the Internet. However, traditional planning committees can only be held at prescribed times and places.

The real model (H. Shimura and S. Satoh, 2001) is used as a tangible and visible entity for sharing images with committee members and a CCD camera is utilized to check the real model on TV in order that committee members can access the model from viewpoints such as human scale. However, TV and camera devices are tools to share common images through a real model, which need a permanent space for exhibition and storage and model materials need to be replaced if different alternatives need to be shown in the same space.

With the spread of the Internet, electronic media (Michael J. Shiffer, 2001, M. Matsubara and N. Matsumoto, 1991), such as photography and film are employed for visualizing the current situation and planning alternatives. These tools are basically available on the Internet; however, they fall short in terms of interactive access requirements for users. Virtual reality using CAVE (R. Gotting and J. Newton *et al.*, 2004) is expensive for public participation, however it is a good virtual immerse tool for visualizing planning alternatives.

For deliberation, it is possible to formulate a common image using VRML technology in committee meetings in order to obtain a better understanding of the proposed plan and eliminate any misunderstanding. In exploring the VRML world, not only the image of respective separated design elements is visually perceptible but also consensual validation and inter-calibration between different design elements is confirmable for deliberation. The VRML world can be distributed on the Internet environment via an http service, and participants can explore from the web without spatial and temporal limitations.

As described above, there are both new possibilities and challenges in using VRML for improving public participation in a planning committee through visualization. This paper attempts to analyze the effectiveness of using a visualization tool for proposing a plan and design within townscape rules and promoting a level of consensus between stakeholders. The term townscape rule is a planning and design regulation regarding buildings, street furniture and their land parcels for promoting townscape at a district level, which is called the Machidukuri-rule in Japan. In order to complement the committee agenda, the tool is developed as an auxiliary means to ensure consistency between committee guidelines and the proposed rules. Meanwhile, all citizens in the planning site can access the tool from the web without spatial and temporal limitation. In this paper, we show how a visualization tool can be validated through experimental planning practice of decision-making, regarding townscape rules based on a district plan, through the deliberation process of a local planning committee.

2. Research Approach

Regarding the validation of a visualization tool, it should be noted that this tool works as an auxiliary means for planning committees.

The planned target in this paper is townscape rules enacted in a district plan according to the Japanese planning system. It is a kind of local bylaw draft proposed by a local planning authority on which consensus should be achieved among stakeholders. Otherwise, it will be considered invalid because of

the absence of a stakeholder agreement. As usual, a local committee will be organized and accompanied by a working group in order to make proposals. In Japan, the members of the committee are composed of academic experts, technicians, consultant planners, officers and citizens. In many cases, citizens take part in the working group and put forward their planning proposals. The committees are held to deliberate the planning proposals suggested by the working group and try to reach consensus between stakeholders. Questionnaire investigations are conducted in many cases to collect all the citizens' opinions in the planning site. After the townscape rules are decided by consensus, the planning committee can launch advisory action to residents who breach the rules in a district planning area.

The first task of a visualization tool is to visualize planning proposals in order that stakeholders can share a common image. The tool suggested here should be able to be utilized by a committee and opened to the public on the Internet. The tool is also necessary to match the needs of the planning deliberation process. Actually, the committees' decisions regarding planning and design are made step by step, for which a visualization tool should reflect these decisions every time. Thus, the tool developed in our project is not an individual tool for a design game but a tool that reflects the proposals of a working group. These proposals are built from different townscape rules and their combinations. Object groups of VRML data as visualized townscape rules can be replaced in real time based upon the participants' requirements from the committee or web. Consequently, this is a tool for changing the plan under the townscape rules for users to compare planning alternatives.

Following this, a social experiment is conducted in a local planning committee for validation, in which the tool is demonstrated to visualize the proposals from a working group. The committee members make decisions concerning townscape rules whilst referring to the VRML world.

3. Visualization of Townscape Rules

In Japan there is an institution of District Planning that is based on the City Planning Law of Japan. Townscape rules shown in Table 1 are selected from relative items of district plan ordinances. There are several planning and design elements relating to land use, building volume, building design and other elements for each land parcel in a district. For example, there are rules regarding building design concerning color, roof type, the latticed windows of buildings and so on. The rules for land use include number of stories, height and floor area ratio for buildings along the street. In addition, citizens themselves can also make proposals to have more detailed rules based upon their requirements. The above rules are likely to be defined in the district plan as townscape rules through public involvement.

Visualization reflecting the townscape rules could be effective for participants to understand the rules, which are only presented in documents, drafting materials and model materials in a traditional committee situation. Moreover, the visualization tool can also be opened to the Internet environment in order to gain consensus between stakeholders.

Table 1. Proposed Planning and Design Elements of Townscape Rules

Classification	Planning and design elements	
Land use and Planning Regulation	• Land parcel (division and plottage of lots) • Site plan (parking, yard)	
	• Floor area ratio • Building coverage ratio • Building height	
Design of building	• Architectural style (roof/eave/wall/lattice) • Accessory equipment (flowerbed/fence)	• Design • Form/type • Color/material • Installation
Design of street furniture	• Separator in sideway (plant/gate/chain/fence) • Bench • Streetlight • Accessory equipment	• Design • Form/type • Color/material • Installation

3.1 Townscape rules enacted in district plan after street improvement project of Nanao city

For validation of the effectiveness of the visualization tool, a social experiment was conducted in a local committee that was held three times, in Sept., Oct., and Dec. 2004. These meetings were held in order to gain consensus regarding townscape rules after the main street improvement project of Nanao city, as shown in Fig.1. Participants were citizens, academic experts and technicians, officers and consultant planners. Citizens who attended this committee were delegates of householders along the main street or from neighboring areas, most of whom are engaged in a family-based business such as a store, clinic and so on.

The task of the committee was to draw up a bylaw from proposed townscape rules by pursuing consensus between stakeholders. These rules can be enacted regarding street furniture and buildings for improving the landscape of the main street. If the rules come into effect, citizens should review and comply with the approval procedures of the local city government when rebuilding or reforming their building and relative street furniture of the sidewalk in front of their house or office. Basically, the necessity of townscape rules enacted in this area is because of rebuilding projects accompanied with a road-widening project. As shown in Fig.2., the left side is an image of the cross-section of the main street, while the middle and right sides are images of townscape rules that were discussed in the local committee for street furniture and buildings along the main street after the street improvement project. These townscape rules will be described in more detail in the following subsections.

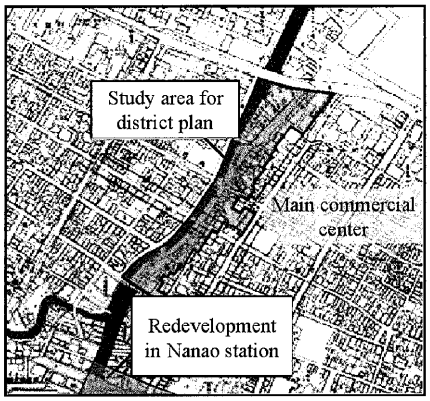


Fig.1. Location Map of Study Area

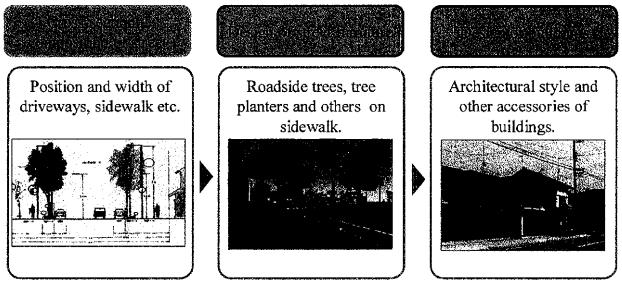


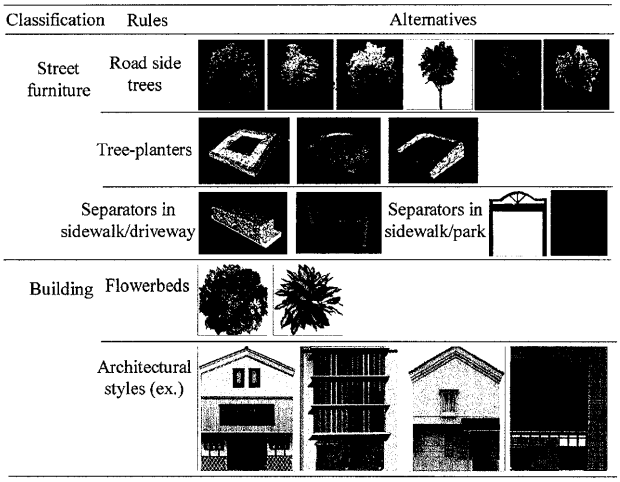
Fig.2. Design Elements in Townscape Rules of Study Area

3.2 System development for visualization tool

Regarding system development of the tool, there are some similar projects around the world, such as that carried out by Tanoue (2005) in Japan. However, these projects have been developed as an individual design game with prescribed data set in their tools. We attempt to explore this function from another approach, in which a VRML data set for deliberation is not prepared before the committee with the exception of the necessary background VRML data. The design elements for townscape rules are added to the tool based upon requirements of the committee, and VRML data should be replaced every time after the committee reaches a consensus.

As with existing visualization tools employing VRML, the VRML data set is grouped into two types, one contains the alternatives of each townscape rule shown in Table 2 that can be utilized for deliberation through replacing design elements such as roadside trees, tree-planters and so on. Another contains the basic data set used as background such as the driveway, traffic control lines and so on, which is not the target of townscape rules. Before computer simulation, the committee discussed which design elements are available to be utilized as alternatives for townscape rules according to cost and other restrictions that are not in the context of design. Hence, alternative VRML data will be added to the tool for visualization following the decisions of the committee. In the other words, it is necessary to employ a visualization tool when a working group needs a conclusion about what is possible and necessary at a planning site. Otherwise, as Matsumoto (2004) pointed out, design elements should be created carefully in order to minimize any misunderstanding. In this project, the visualization of alternatives is carried out for example, the texture files of street furniture are pictures of real products that will possibly be constructed and the VRML data are modeled according to the real size of these products. The ground surface is modeled based on a data set converted from shape features in the geographic information system.

Table 2. VRML Data Set for Representing Alternatives of Townscape Rules in Study Area



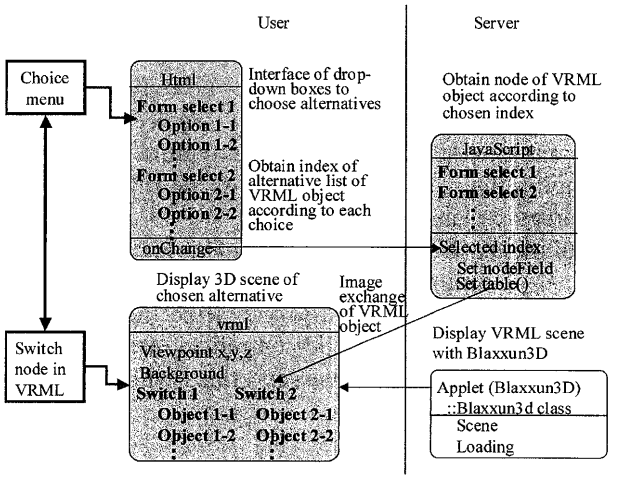


Fig.3. System Framework

Regarding the visualization tool, objects in the VRML data set as alternatives are coded as selective nodes in the "Switch" node of VRML, which can be linked with selected items in the HTML form object, as shown in Fig.3. The function to show the selected alternative and hide the former alternative in the VRML world is operated by JavaScript described in HTML. Thus, it becomes possible to replace the alternative in the VRML world for visualization of a certain townscape rule. New switch notes can be added, while a working group, upon the conclusion of the committee proposes new rules; meanwhile the new VRML data set for the rules should also be prepared.

Accordingly, the visualization tool with an interface is shown as Fig.4., which is developed by the dynamic interaction between VRML browser and DHTML, not embedded inside the VRML world. VRML data set input to a visualization tool is created using 3DSMAX, by which VRML format can be exported for visualization in the browser Blaxxun3D. Blaxxun3D is a Java Applet provided by Blaxxun interactive Inc. (http://www.blaxxun.com/). Although the VRML data set needs to be downloaded, Blaxxun3D has no need to install a plug-in since Blaxxun3D is developed as a Java Applet. The operation of replacing the alternative is done outside the VRML browser, by a selection object and JavaScript embedded in HTML.

Fig.4. A Screenshot of the Visualization Tool (http://webserv.ce.t.kanazawa-u.ac.jp/~kawakami/urbantemp/nanao1/component/nanao1.html)

In this social experiment, while opening necessary planning information to the public, the visualization tool is employed to exchange alternatives in the VRML world for visualization of townscape rules in the committee. On the other hand, the proposals presented by VRML data are open on the Internet, which all citizens in the local city can access without spatial and temporal limitation during the committee period.

4. Better Understanding of Proposed Plan Using the Visualization Tool

As mentioned above, this visualization tool is presented three times for the local committee. The committee arrives at a consensus based on proposals from the working group, where townscape rules and VRML data are created also.

The result of the questionnaire to the participant regarding the effectiveness of using the tool is shown in Fig.5. The replies of "fully effective" and "effective" were 61% -79%, and it can be seen that on the whole evaluation is high. In particular, evaluation regarding "have a common image about a planning proposal" and "understand the contents of the plans" at about 78% has been obtained, and "makes it easy to ask questions and state opinions" at 65% is a comparatively high value. These show that the system had an effect on the checking of the plan proposals as well as comparing and discussing alternatives.

Thus, the tool is a good measure for obtaining a better understanding of planned proposals presented by the working group. However, there are no presentations using VRML before the committee decides what is necessary and possible in the planning site according to the deliberations of participants. It seems that the visualization tool in this committee is effective in aiding the understanding of planning and design.

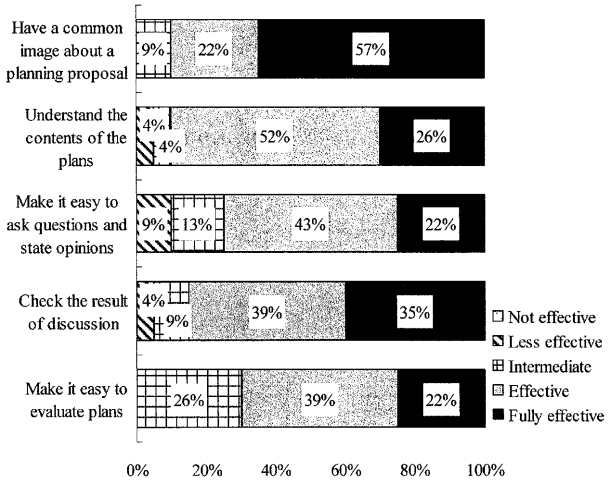


Fig.5. Evaluation to Visualization Tool

5. Deliberation in the Committee

As shown in Fig.6., a facilitator acts as a host in the committee, requires the working group to explain the planning alternatives, and then focuses on participants' thoughts, discusses the rules and makes a decision one by one every time. Basically, what the committee discusses focuses on how to reach a resolution on townscape rules about street furniture and building regardless of the use of the visualization tool.

Working group proposed alternatives for roadside trees, tree-planters, separators of sidewalk and driveway, separators of parking strip and sidewalk (gate), architectural style and some street furniture are discussed as rules in this area (Table 2., Figs.7.-10.). These proposals are discussed in the committee among the stakeholders. Creating VRML data entails discussion regarding the choice of products and their companies; hence visualization of townscape rules is based on decisions concerning which products are chosen as alternatives and what should match the requirements of cost restrictions. VRML data are modeled after decisions are made on potential alternatives in the working group and committee; the

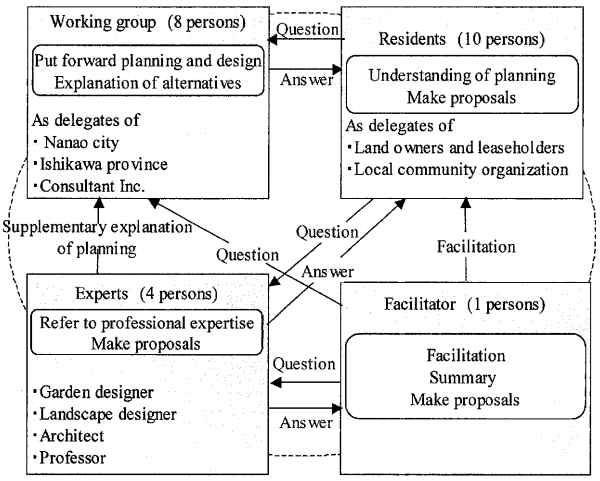


Fig.6. Stakeholders in the Committee Deliberation Process

decision process however is not analyzed in this paper because no visualization tool is utilized.

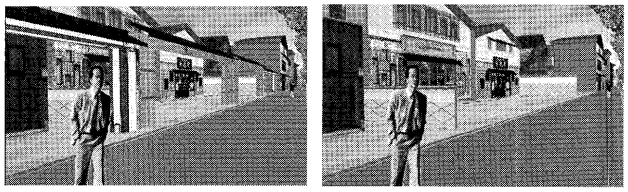
5.1 Rules for street furniture

Most of the street furniture is constructed by the public sector and cost restrictions are confirmed before the committee. For rules concerning street furniture, a working group prepares the VRML data of alternatives. Examples of the scene are shown in Fig.7., which simulate the seasonal change of different roadside trees, and the parking strip with or without gate.

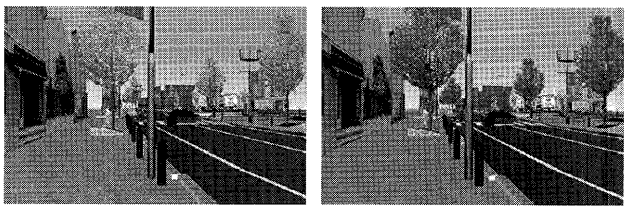
A working group simulated alternatives in the committee, and participants made decisions through discussion comparing the features of alternatives. During discussion, the committee made decisions concerning the rules respectively and participants confirmed what they concern in detail regarding each rule as shown in Fig.8. Meanwhile, participants were able to ask for the simulation of a combination of different rules, for example, "Keep displaying alternative of separation method between the driveway and sidewalk. How will the townscape appear if roadside trees are changed from Japanese Judas to Horse Chestnut?" They also discussed the mutual influence between rules, for example, such as adjustment of the position of streetlights, chains and signs in the sidewalk by going through the VRML world carefully. From an interview investigation conducted after the committee, the VRML of the planning site was created to be consistent with the real site. In addition, the VRML objects as a proxy of real things in simulation have been well designed; hence the participants experience in the VRML world is recognized to be a true representation of the planning result in the real world.

From Fig.8., it can be seen that there are many topics in the deliberation process regarding urban amenities in the context of design, such as tree height, position regarding road side trees, unified townscape for separator of parking strip and sidewalk, color regarding separator (chain) of driveway and sidewalk. Many topics in terms of townscape rules are discussed from a broader perspective while exploring the VRML world, which include road space, space for parking on sidewalk and electric power position during the local festival, relationship of tree interval distance, soil property and planting natural habitat, physical volume of leaf fall and cleanup activity.

We can conclude that participants discussed the rules not only in the context of design, but also from broad perspectives such as local festivals, soil property, climate and urban management during the deliberation process. A knowledge-based database system linking with VRML objects is a promising tool for organizing necessary information for deliberation.



(1-a) Parking strip with gate (1-b) Without gate



(2-a) Judas tree (Spring) (2-b) Judas tree (Autumn)

(2-c) Chestnut (Spring) (2-d) Chestnut (Autumn)

Fig.7. Screenshots Concerning Rules of Street Furniture

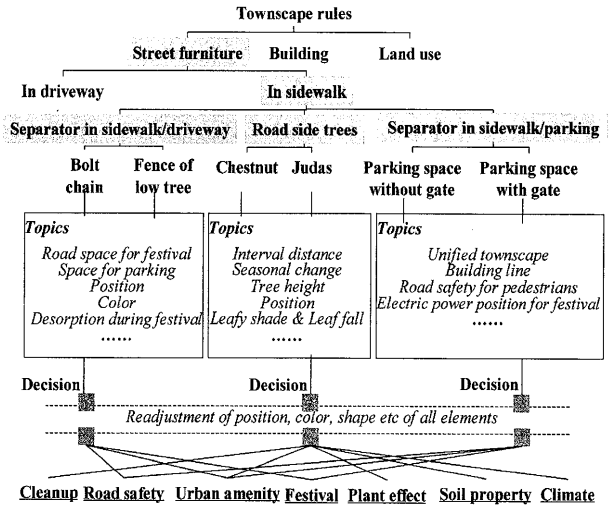
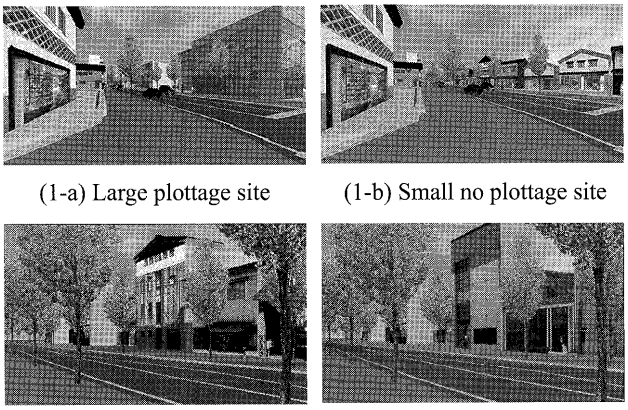


Fig.8. Deliberation for Street Furniture with Visualization Tool

5.2 Rules for building

Concerning buildings that should be reformed or rebuilt along the main street in the planning site, it is important to discuss the rules concerning building design based on each owner's conditions. It seems that guidance on how to reconstruct their buildings is still through the step of concepts, picture, video or film clips of successful anecdotal projects, which can play a positive role in creating a common growing awareness regarding the future. This is because some participants prepared pictures by themselves and made presentations for deliberation in the absence of prior authorization.

Participants said that they did not know how to consider the building design while experiencing the alternatives of their land parcels and buildings in the VRML world. This is because there are many other unconfirmed preconditions, such as indecision regarding plottage sites, household cost restrictions concerning their housing plan and so on. They could not reach answers regarding the architectural style of their buildings and plottage of their land parcels through the visualization of alternatives alone (Figs. 9.-10.). Even though visualization is helpful to share a common image, citizens prevented themselves from making decisions about their properties based on the VRML world, and then the committee released more requirements to the working group for further visualization of the land parcel. Finally, they produced a textbook with sample pictures called "design codes" and avoided discussing issues about real properties regardless of the use of the visualization tool.



(1-a) Large plottage site (1-b) Small no plottage site

(2-a) Japanese style (2-b) Modern style

Fig.9. Screenshots Concerning Rules of Buildings and Land Parcels

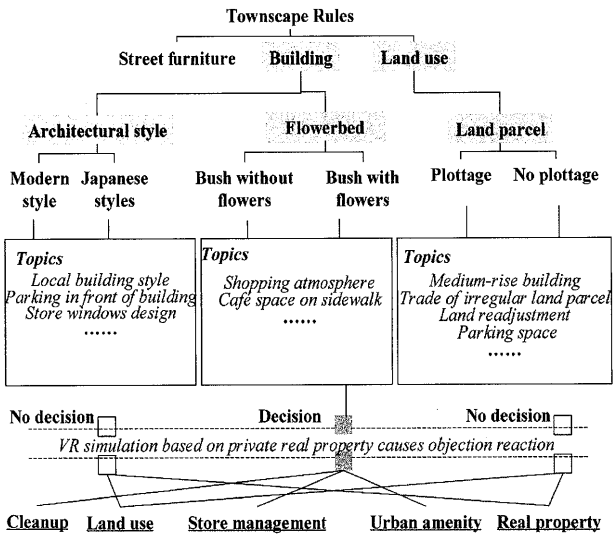


Fig.10. Deliberation for Building with Visualization Tool

Consequently, despite the fact that the discussion of a building can also be related to a wide range of factors such as the situation concerning street furniture, those rules regarding building failed to obtain a consensus using a visualization tool. As shown in Fig.10., however, even though participants could not reach a consensus, visualization still helped participants keep in mind local building style, store window design regarding architectural style, land readjustment, medium-rise buildings and parking position regarding land use and so on. However, these topics were not discussed respectively in the context of a unified townscape.

For alternatives in terms of building and land use without necessary premises, the participants will be confused whether the visualization of their properties in an open committee can be employed as material to help make a decision regarding their private properties. How citizens would like to deal with the private properties should be clear and concluded before visualization in order to gain consensus.

6. Conclusion and Discussion

This paper is a discussion on how to use a visualization tool in planning practice, especially in terms of townscape rules in Japan. A visualization tool using VRML is developed as an auxiliary means for a planning committee, however, it is not employed to replace all traditional methods such as field survey, vote and so on. A social experiment was conducted to validate the effectiveness of visualization.

In this paper, townscape rules are set as planning targets, which are divided into street furniture rules and building rules.

Regarding street furniture that is constructed by the public sector, if the prerequisite regarding cost restriction and so on is clear in advance, stakeholders are active to improve the landscape through obtainment of a consensus of rules in the context of design with the support of the visualization tool. Then, a possible bylaw can be formulated for the future.

On the contrary, regarding the building rules that are usually related to private property, however, when landholders and projectors have not reached a consensus concerning prerequisites such the division or plottage of land parcels and rebuilding or demolition of buildings, it is impossible to have a fruitful deliberation in a committee using a visualization tool, because citizens have no idea of how to discuss in the

context of design rules without thinking over their real properties.

As a result, in the deliberation process of our case study, a visualization tool is effective for obtaining a better understanding of planning and design, and is helpful for discussion in the context of design and reminding participants of the relevant topics that are necessary for gaining consensus. In the context of representing planning alternatives, a visualization tool can be employed as a progressive approach to replace the traditional methods of presenting alternatives.

In this case study, we also found that the visualization tool has its limitations because the deliberation regarding planning and design covers cost, real properties and many other factors that can not be expressed in a VRML world. In other words, visualization could not serve as an omnipotent measure for bringing all problems together, and a knowledge-based database system linking with VRML objects is a promising tool for providing more necessary planning information in the deliberation process.

In addition, municipality officers were concerned that the committee would end in a stalemate because of variety and inconsistency between the conclusions of the committee and individual participants from the web. Actually, the majority population are aged people who are not familiar with computers and few accesses from the web have been observed. So the experiment of web access is a future project. Moreover, for non-expert participants, education and enlightenment concerning planning knowledge using a visualization tool are important during the deliberation process with a visualization tool.

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