

< 謝 辞 >

本稿作成に至る過程で、多くのユーザーの方々から、貴重なバグ報告やご意見を頂きました。とりわけ、データ作成のための調査や、サンプルデータ掲載にも快諾して頂いた下記の方々には感謝いたします。

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<A B S T R A C T>

I. Communication System for Town Planning

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The Communication System for Town Planning that is introduced in this report is, as shown in Fig. 1, a package of systems that can be used to prepare three-dimensional data representing the present state of, and proposed plan for, the district that is the object of a town planning project, transmit this data through the internet from a server at city hall, receive opinions and proposals (text, images, and three-dimensional data) from citizens etc. who have examined the data on the internet, and examine and present these opinions and proposals. The citizens can use freeware transmitted from the server not only to walk around the town as it is and as it is proposed, but also to modify the proposal. In 2002, the experimental preparation and public release of data for 15 model sites was carried out.

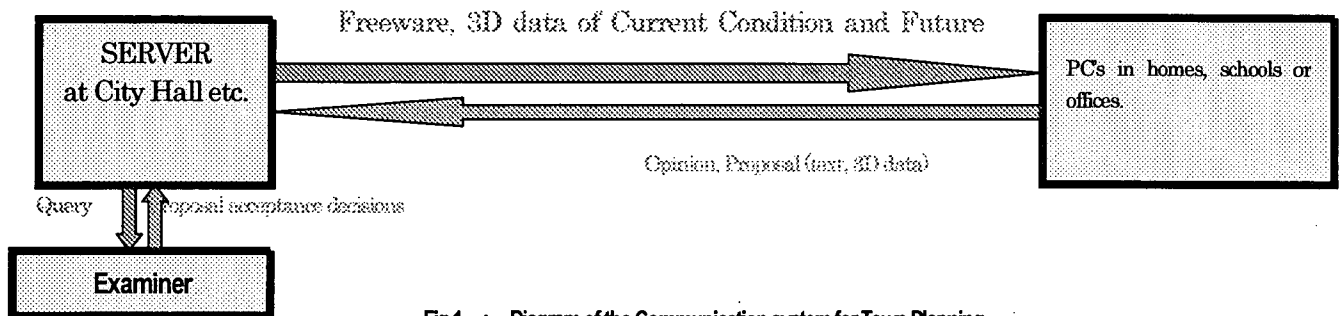


Fig.1 : Diagram of the Communication system for Town Planning

1

1. Background

(1) Accumulation of examples applying Landscape Simulator

From 1993 to 1996, the Landscape Simulation System was developed jointly by the Building Research Institute and the Public Works Research Institute of the former Ministry of Construction. Since then Building Research Institute applied the system for explanation to residents of redevelopment and land readjustment project districts, while Public Works Research Institute applied the system to high standard road and dam construction projects. Thus it was tested, debugged and improved for achieving a highly reliable and stable practical system. As a result of this success, the PWRI and BRI are allowing the public to download the freeware from their home

pages and also have distributed almost 5,000 copies of manual book of the system with CD-ROM containing the freeware¹⁾.

(2) Growing need for dialogue-type administration of town planning

In the face of the growing needs for urban strategies, local governments are now required to explain the contents of town plans to interested parties and the general public at as early a stage as possible in easily understandable form, and at the same time to introduce dialogue-type administration so that they can, through the internet, obtain many views and proposals, including those of ordinary citizens formerly never consulted, and reflect these in the plans.

(3) Spread of broadband services

As a result of the rapid growth of the internet, the

introduction of broadband systems that can carry vast quantities of data, and the astonishing improvement in the performance of personal computers used by the general public, extremely large three-dimensional data (as large as urban regions) can now be transmitted and displayed.

In response to past achievements and the new needs described above, budget was apportioned between the NILIM (system development) and the City and Regional Development Bureau of the MLIT (data preparation), for the 2001 project: the Development of Technology for Communication Systems for Town Planning Using Virtual Reality and Networks implemented under the Special Budget for the Revitalization Japan. Under this project, the following technologies were developed and the submission of model projects was requested. As a result, the system that has been developed was used for trial operations at 15 locations in Japan.

2. Development of basic technologies

(1) Data transmission through the network ²⁾

The earlier Landscape Simulator was used by first installing the entire system then viewing and editing by using it. With this approach, a future image on the Web page cannot be viewed easily. In this development, the viewing function, editing function, and the data base functions for handling parts etc. have been separated, and clients who only want to see the city after a project need simply to install the basic functions of the viewer from the network. The system has also been revised so that a user wanting to add editing operations can download the additional required functions, and when the user wishes to search for and arrange parts, can obtain them on the network.

(2) Improvement of data preparation functions suited to town planning

The functions of the earlier Landscape Simulator have been strengthened so that creators can edit present topography + town data publicly available on a web site and efficiently create an image of a completed plan based on planning diagrams (pamphlets etc.). The improved system was also adapted to new OS's such as WindowsME, 2000.

(3) Compatibility with various file formats

File conversion functions, particularly output functions were strengthened so that it is easier to work linked to off-the-shelf software that the creator is accustomed to using. Functions that save still pictures or moving pictures (AVI) when necessary during a simulation have also been prepared.

(4) Achievement of low cost stereoscopic viewing

While stereoscopic presentations are expected to be effective at field offices and event venues, the cost of the equipment has obstructed its wide use. A function that creates stereoscopic image data was added to the Landscape Simulator compatible with a latest low cost display device based on the technology of the micro pole that a venture company in Niigata has just released. It can provide stereoscopic presentations in natural color on a liquid crystal monitor (modification cost of ¥60,000 or less) with viewers wearing special paper glasses (polarizing type, approx. ¥100), or on a liquid crystal projector + special screen (about ¥700,000 for total equipments).

(5) The Macintosh version

For a long time, Macintosh users have wanted it to be compatible with their PCs. The viewing functions to provide the contents on the web have been modified for Macintosh use. This included the reorganization of the source code that has been modified many times by debugging work.

(6) Development of basic functions for the server

The first developed was the data transmission function needed by web sites that provide creators with design drawings, basic data representing the existing topography + city etc. and the freeware + data base needed to construct data. The next step was the preparation of a prototype for web contents for individual model project sites needed to publicly release the data representing the present state and future image of a city that has been constructed to the general public to obtain their opinions regarding the project. This consists of three functions: a basic introduction to the project (top page), 3-dimensional data transmission part, and the questionnaire or space for the members of the public to submit their opinions and proposals.

(7) Virus and cracker prevention measures

When a test use web server was started up in the computer room at the NILIM at end of July, the server was repeatedly attacked by crackers such as CodeRed, NIMDA, etc. To deal with this problem, service packs, patches, etc. were added appropriately to the server's OS and the pattern of the attacks was analyzed to add security measures to the applications that had been developed.

3. Construction of the data (present state of the city + future image)

(1) Making the data construction work simpler and more efficient

With the participation of summer trainees, the Research Center began testing, debugging and preparing the data at the same time as it improved the system, beginning with a model projects proposed earlier. In many cases, three-dimensional data representing the proposed plan was efficiently created by preparing data consisting of design drawings (plane drawings and site plans) applied as texture on the full-size ground surface and utilizing it as a guide map or template.

The next step was the beginning of the preparation of data representing present conditions; a task done using aerial photographs (color positives and black and white contact printing) taken by the project implementation body to prepare basic maps and manage real estate taxation. Topography + building's three-dimensional data base(3DDB) was provided by using stereoscopic aerial photographs analyzing technology that was developed during the past year as a joint research project by the Building Research Institute and the private sector.

Later, under a contract to prepare data signed with the MLIT, the Japan Association for Building Research Promotion began full-scale data preparation work and the creation of the web contents, including the advanced preparation accompanying topographical change, synthesis of present conditions and the proposed plan etc.

(2) Preparation cost

We were aware that the unit cost of data preparation that should be paid to its creators as wages has been extremely high for three-dimensional data and the

grounds for its calculation have been unclear. Advance predictions of the amount of work that will be required are unreliable, but by totaling and analyzing the past work by the summer trainees referred to above, we obtained an approximate unit cost of about 100 yen per significant group in the Landscape Simulator data format. We succeeded in assessing the required work from the three-dimensional data that was prepared by loading data into the scenery simulator to automatically summarize and display it through the reporting function. On the other hand, a cost of about 300,000 yen per model was obtained for present topography + city district based on analysis of stereoscopic aerial photographs revealing that depending on the precision of photographs obtained by aerial photography, this corresponds to about 3,000 yen per hectare.

4. Development of applications

During the first half of 2001, a set of functions were developed and the successive release of the data to the public began, then in the second half of the same year, we undertook the challenge of developing new functions not possible by improving existing functions.

(1) Examination function

In the past, when a project body received opinions from citizens through a web-based dialogue (not including three-dimensional functions), the officials in charge often examined their contents, manually selected and edited the contents that should be released, and prepared a public release page. And some regional governments provided completely unrestricted billboards for people to present their views. The function that has been developed so that examinations are performed more systematically selects examiners from a list to examine the opinions and automatically displays only proposals that are approved. A proposal can include images and three-dimensional data.

(2) Increasing display speed

The earlier Landscape Simulator was improved with priority on the conformity and stability of data, primarily during editing, storage, and re-reading in

operations, with almost nothing done to speed up data transfer or display processing operations. But the evolution of computer hardware has rapidly improved display performance. In this case, if large scale city data is created in such detail that it takes a long time to display it, it is highly likely that when a member of the public tries to view it, the waiting time will psychologically discourage the person from continuing. Therefore, we, and worked, to prepare a special viewer to be used only for viewing and capable of high speed display.

(3) Town planning problems and discovering system challenges

We are examining the "town planning" problems unique to each of the 15 model sites (urban redevelopment: 6, land readjustment: 5, continuous grade-separated crossing 2, height restrictions: 1, urban recovery: 1), and the contents of the proposals and opinions that have been submitted, and have established a research committee that is now studying future improvement policies etc. Although we requested submissions of model projects from throughout Japan, most have come from south-western Japan. And the hypothetical members of the public that would be the object of communication using the system (its regional range) varies between the projects. At the same time, we are now preparing and modifying contents and discovering new challenges by clarifying (1) public benefits of a project and (2) interests of local landowners in the project, to (3) discuss future dreams that can be achieved anew through the success of the project.

5. Future prospects

Because it is a single year project, the development achievements of the year will be quickly summarized, a manual and examples of its operation attached to the summarization, and these returned to society as free software.

A massive quantity of three-dimensional data has been prepared this year, and that which will be useful following its release to the public will be organized and compiled in document form, and provided for use as raw material for other research and development

projects.

The goal for future research and development is progressing to a system that can manage three-dimensional data + attributes by a time series on a data base (four-dimensional GIS).

We are also considering studying and implementing individual town planning schemes of regional public bodies etc. based on regulations etc. We are also including a policy simulation function of this kind treating the three-dimensional conditions (building lots and buildings) that have been input or conditions that will exist immediately after a land readjustment project entered as initial conditions.

6. Conclusion: panorama

We are now at the stage where the release of systems and the data that has been prepared has started and opinions are being received from the general public. Additional features that are successfully developed through this process are being added as they are ready. Viewing three-dimensional contents and moving pictures etc. is still extremely troublesome for members of the general public, most of whom are still connected by telephone lines. But broadband is spreading rapidly, so that solving the speed problem is only a question of time.

People are being urged to move to new industries from old industries where unemployment is high. In such conditions, those corporations that have received past orders to develop conventional software and prepare data for this project, plus young newly established venture companies (3 companies), have handled important parts of this development work. Specifically, the preparation of the Apple version, development of the public release function based on the GIS data + VRML viewer, and development of server functions based on ASP.

The results of a survey of the latest technologies done before development started revealed that practical and potentially useful technologies that would improve three-dimensional display, stereoscopic display, and various service functions existed not only in the private sector, but also at universities and the National Institute of Advanced Industrial Science and Technology. But because many of these researchers

and developers lack their own networks outside their institutions, and therefore, do not have the experience and channels necessary to release products, they did not go beyond obtaining patents and publishing papers after the trial manufacture and demonstration stages. They also lacked established procedures for selling technology. Because the Ministry of Land, Infrastructure, and Transport has a large number of facilities where it tests various kinds of intelligent technologies, it may be asked to actively discover and evaluate such technologies that are awaiting practical application, then purchase them and introduce them in the field to refine them.

Note 1) Japan Association for Building Research Promotion (tel: 03-3453-1281) is distributing the Building Research Document No. 96, Mature City Simulator 1.0 + Landscape Simulator 2.05 User's Manual (July 2000, accompanied by 2 CDs). Back numbers include, "Building Research Document No. 92 "MOC Version of the Scenery Simulator Personal Training Handbook" (Nov. 1997) and Civil Engineering Research Document, "Landscape Simulator" etc. A Korean language version prepared through joint research with the Korean Rural Research Institute is also available.

Note 2) URLs related to town planning communication systems can be accessed from <http://sim.nilim.go.jp/>.

Note 3) It has been announced and demonstrated at the following places.

- Twenty-first Century Future Exposition (Kobe: July 20 to September 2)
- Children's Science Festival 2001 (Tsukuba, October 7 to 8)
- Civil Engineering Day (Tsukuba, November 18)
- Ministry of Land, Infrastructure, and Transport, Technology Conference (Tokyo Shinagawa TOC, November 20 and 21)
- Civil Engineering Exhibit of Life and Technology (Tokushima, December, 7 and 8)



Photograph 1. Stereoscopic Presentation

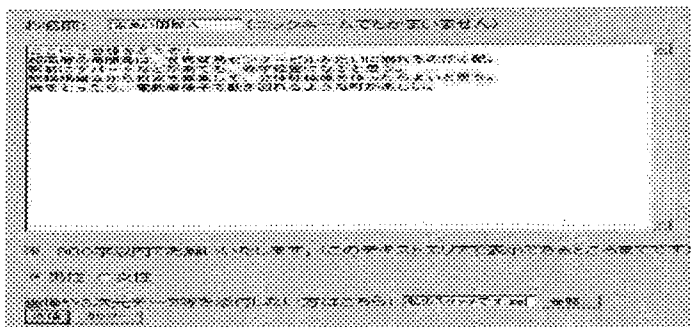


Corner for Virtual Reality

The first visitor needs to install the Landscape Simulator from the "Download" menu above. After that, you can walk through the 3D current / future town by clicking the "Current" of "Planned Future" titles.

Current (clicking here you can walk through the town in Landscape Simulator)

Figure 2. Three-dimensional Corner



Name : Old Internationalist Nickname is OK.

Please write your opinion here:
 I'm afraid that urban renewal with a skyscraper will have a risk of collapse like WTC.
 Department store in front of the station will not succeed today.
 I will propose to bicycle parking cooperative to invest for three dimensional bicycle parking.
 After getting older, I will enjoy the town with powered wheel chair.

Please don't exceed 800 characters(within this area)

◎Male ○Female

If you will attach an image or 3D data, please assign here.

Figure 3. Opinion Input Corner

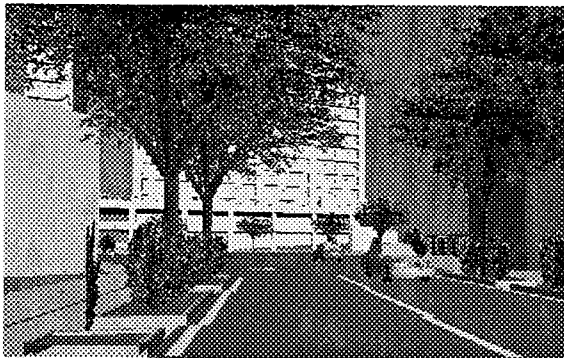


Figure 4. Future image of Fujimi-city

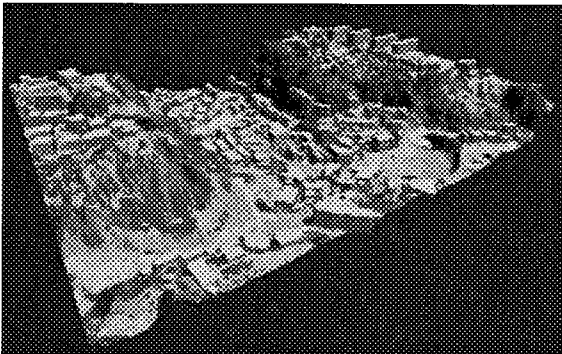
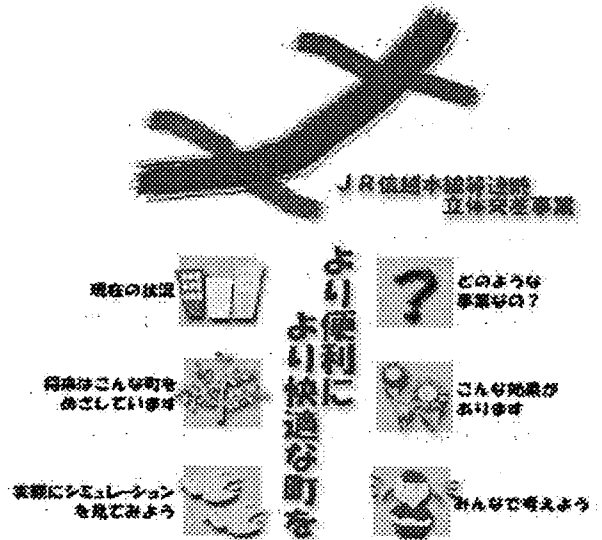


Figure 5. Present Topography and the City of Hiroshima



1. JR Shin-etsu Line Continuous Grade-separated Crossing Project
2. Present situation
3. The town that is the goal of the project
4. Let's see an actual simulation
5. A more convenient more comfortable city
6. What kind of project is this?
7. It will have these effects
8. Let us know what you think.

Figure 6. Example of a Top Page Menu

II. Outline of Landscape Simulation

0.Outlines

This is a kind of open source 3D graphic system, developed by Building Research Institute, and Public Works Research Institute, under Ministry of Construction (1993-6) at that time. The system was developed for the purpose to promote local branch offices and their staffs to utilize This system requires no heavy training, and provision of special budget.

0-1. Outline of the system.

The system is consist of following components:

(1) Data Base of 3 categories:

- Past examples of projects (provided by public sector, browsed by yuu.exe)
- Building materials (commercial base, browsed by zai.exe)
- Elemental components of landscape (non commercial base, browsed by yuu.exe)

(2) sim.exe : main load module for modelling and browsing:

- various viewpoint setting, walk-through, etc. of 3D landscape data.
- modelling and editing 3D data
- analysis of image data and synthesis of photo and 3D model
- time dependent materials (deteriorate / mature)

(3) maju.exe : city planning & build up process simulation

(4) file converters

- dxf format
- minicad text format
- DEM format

(5) user defined parametric components

- XXX_D.exe (GUI dialogue)
- XXX.exe (3D model generator)

0-2. Licence

- Copyright(C) Ministry of Construction
- free ware, and source code is disclosed
- sale without additional value is eliminated
- international portability

Japanese, Korean, Indonesian (English is under construction)

0-3. Conditions for installation

The platform is PC (i486-), Windows95,98, WindowsNT3.51, 4.0

Disk space : 300MB (maximum), 70MB(minimum)

Memory : 16MB-

Graphic Display : 800*600(minimum), 32768 colors(minimum)

Recommended OpenGL accelerator

Users : Staffs of local branch offices of the ministry

Construction-related staffs of local governments

Related corporations, consultants, architects, planners and designers

Graduated senior high school, with self training less than 3 months

Not daily use, but sometimes require those system for their work

0-4. Major functions and characteristics

- file load/save convert of 3d model, scene

- analysis of viewpoint of image data, accurate montage with 3D data
- basic 3d modeling (primitives, typical elements, user defined parametric...)
- various plotting functions on ground
- earth work (cut and mine, calculation of amount of soil)
- sweep functions(use section and orbit : to create road, river, etc.)
- view point setting, walk through
- analysis of visible area
- on line simulation of build up process (evaluation of rules and regulations)

1. Process of Development

The system was developed through an Integrated Technology Development Project, titled as "Technology Development for Landscape Amenities", undertaken by the Ministry of Construction (1993-96). Among the 6 topics, the fifth topic titled "Development of Landscape Simulator and Landscape Database" was assigned to the Building Research Institute (BRI) and Public Works Research Institute(PWRI), under the ministry. Unlike to the usual case, the task was not shared among the two institutes according to the "objects" (namely, building and social infra), but according to the "functions". The development of the system and software was undertaken by BRI, while the database was undertaken by PWRI.

1-1. Background

The reason why MOC started this project, was the citizen's emerging consciousness on the impact of development projects to the environment and landscape.

Previously, design and program was decided mostly considering the technical and economical conditions. However, it has become frequent that several citizens and opinion leaders protest and criticize the negative impact of the development. In order to conquer the situation, technical staffs of local branch offices of the ministry had better to acquire the ability of evaluating the impact of any project they are engaged in.

However, most technical staffs for civil engineering in our country have no educational background on designing and drawing, but only calculating the mechanical problems. Landscape-related matters are mostly considered by the consultants, who have almost similar educational back-ground, and sometimes assisted by designers and architects.

Therefore, they seem to need smart tools to visualize the impact of their design to the existing landscape. This had been done through perspective drawing or rather expensive CG simulation done by external experts and accordingly the re-evaluation session was not enough frequent.

In 1992, preliminary research & survey on existing needs and technologies was done by the team. At that time, existing systems were mostly English based ones, and required fairly expensive graphic workstations, and the systems themselves were also very heavy (general purpose) and expensive. It seemed almost impossible to

apply those systems into every branch offices and let them to operate.

While, the performance of PC, especially the graphic processing, seemed to start advance rapidly in the near future, and conditions for developing appropriate system is becoming ripe.

By considering those conditions, the team decided to develop original simulations system specially designed for MOC projects, as free-ware (to be distributed without licence constraint, and maintenance free). In order to adapt to the rapid growth of hardware, which seemed difficult to forecast, the system would be multi-platform, written mostly by using ANSI-C language.

1-2. Initial development

The initial prototype (man-machine interface and skeleton functions) was elaborated on INDY provided newly by SGI, comprising merely skeleton GUI operations and simple photo montage function, while data structure

was designed for the next step.

The second version realized major viewer functions and time-related alteration simulation (deterioration of materials after completion, seasonal change of trees and forest, lighting conditions depend on climate, time and weather, etc.). At the same time, the team started to convert into the PC version utilizing the OpenGL functions started to be provided with WindowsNT 3.51.

The third version utilized the GIS data obtained from stereo air-photo and full 3D functions (automatic move of viewpoint, cut and fill of slopes, etc) were added.

In the final year (1996), the team made the installer with sample data, and started to distribute, even though there were so many defects.

1-3. Testing and Debugging

In the end of the project period, the major functions originally designed were achieved, however, stability was very poor. The only viewer functions was sustainable, but modeling and editing functions could not be continuously operated. Therefore, after the project completion, requesting budgets from the local branch offices (for survey and design), the team continued to improve the system, until 1998. While this process, several requested functions were added, like advanced editing functions, newly requested networking functions, etc.

1-4. Application to the development site The first application was tried in the bridge project in Fukushima prefecture in 1995, on INDY, and re-construction of Flat in Fukuoka prefecture, on PC. In former case, the 3D data were prepared by the team (not by the end user), while the second case, the data was prepared by the newly experiencing local soft-house, chosen through open tendering, showing that the cost for preparing the visual media is almost half as providing model or perspective drawing.

After 1997, the system was distributed to many local offices through internet and CD-ROM. Some of local staffs elaborated very complicated data and reported (complained) many bugs and troubles.

1-5. International co-operation

In 1996, Korean governmental Rural Research Institute started to develop landscape simulation system, and dispatched survey team to Japan. Realizing that there is no legal and technical constraint on transferring and translating Japanese free-ware, proposed international joint research. This was adopted to the Japan-Korea agreement on co-operation in Science and Technology, as "Application of Landscape Technologies for Regional Development". After that

In the August 1997, translation of Japanese latest version into Korean-Hanguel system was successfully achieved. This was achieved through a composite team within 3 days (8 translator, programmer, civil engineer etc.). Japanese side will also expect advanced functions through role sharing, and exchange of experience of actual application on the site.

1-6. Co-operation with private sectors

Since 1997, private sectors are promoted to develop application functions jointly.

In this case, especially, the companies which has already developed some kinds of software or data are invited to jointly develop file converters to achieve that the privately developed software could be utilized with free-ware jointly. If seen from the user of the free-ware, some kinds of data will become easier to make, by purchasing private products. However it is not (should not be) compulsory, but alternative choice. If seen from the private sector, the potential target user will be more.

Through this scheme, 3D Modeling software, and GIS data are connected to the LSS system through developing file converters jointly.

1-7. Advanced research and development

After the completion of the project, several related research and development are undertaken, to utilize the

basic graphical functions :

(1) Simulation of social and urban phenomena :

To simulate the change of buildings, according to the lot subdivision pattern and building regulations (applied to the land re-adjustment projects).

(2) Project simulation

To simulate expected progress of the project, and to feed back the forecasted result to the initial designing stage.

The results of those related projects were realized in the form of separate software, which generate the 3D data to be transferred and visualized by the LSS system running somewhere within network, dynamically.

The transferred 3D data can be treated as usual 3D object data on the side of LSS system.

✓ 2. Example Operations

2-1. Processing digital images taken from sites.

Digital photo data is very useful for creating a scene. The most simplest way is to use as background (like wall paper). The simulator has a function to analyze the rendering-related parameters (view-point, view-center, focal length, etc.) from more than five viewable points which are given xyz coordinates by the operator. After that, the simulator will render any 3D object in the position just same as the camera(fig 1.).

The system also utilizes the image data for texture. For example, in order to model a proposed urban renewal project, the texture data taken from the buildings surrounding area, by using digital camera, can relief the data entry work, and makes it possible for less skilled local staffs to operate.

2-2. Modelling and database.

The team assumed that those who will create some complicated shape are already good at operating some CAD system. File converter will be more suitable for them.

For less skilled operators, the system provided 3 types of database, with various plotting functions (single, linear, area). The database is consist of three kinds, namely, (1) past and popular examples of buildings and public works, (2) commercial landscape materials, and (3) popular components of landscape, like trees, street furniture, popular buildings, mobiles, etc.

(1) will be supplemented by the local branch offices of the ministry.

(2) will be provided by the makers and providers for the commercial purpose.

The team organized the landscape material committee to classify the many kinds of components and prepared the example core data set during the project period, with system for maintaining the data.

Beside the said 3 types of 3D data said above, which are rather fixed in shape, the system also provides parametric components, described as ANSI-C functions, to make geometrical data more compact, and to make the system more flexible. If a user elaborate some new functions, and GUI dialog to give parameters, then he or

she can add it to the system. For example, if a function which gives 3D shape of a clock, based on the parametric data of time, e.g. CLOCK(TIME) and the function is referred as :

```
G1=FILE(CLOCK,"2:30");
```

Then, a 3D shape of a clock showing the time of half past two will appera. The GUI part is a dialog box for user to edit the time.

Simple road or river can also be a parametric components, described by section shape(file) and orbit shape(file).

After creating the shape, some boolean calculation is done with existing shape of land surface (fig).

2-3. Editing texture data

At the start point of development in 1993, we assumed that the texture data will be a kind of database for building materials, provided by the supply side. Therefore, we tried to collect texture data of popular building

materials (timber, concrete, trees, grass, etc.), and provided them usually in the form of tiling data (1m * 1m). When users try to apply them to the 3D model, the system can automatically calculate the texture coordinates of each vertex of polygons, in repetition.

Recently digital camera is becoming popular, therefore preparing texture data is becoming easier. Therefore, users can also easily make, for example, a texture mapped 3D data of an existing office building. In such case, functions to make a orthogonal texture, which will be applied only once on a whole wide face.

Since 1997, we are co-operating Fujitsu company who has developed Real-Modeler system now on sale (c.a. 200 k-yen). Actually, the system realized almost similar function of our system to analyze the viewpoint and camera angle of a photo (image data). For example, an object in a photo could be assumed an "cube", the system abstract edges from the image, and semi-automatically calculate the dimension of the object and camera position. After that, the system subdivide the image to each seen surface of the cube, and output the orthogonal texture image data.

However, the purpose (object) of the system was very general, designed by computer programmers (not by designers or planners). In order to make it easier to make a 3D data of existing buildings, we co-operated to make a file converter, and we requested them to enhance the system to become easier and more practical for our field. By using this, a 3D model of simple building can be obtained in a few minutes. This can help to make the data of existing landscape, and also useful to collect the local components to be assembled in the future image.

2-4. Plotting objects and editing the scene

We assumed that most users don't want to make primitive models by hand, but like to choose components from data base and plot them in the scene. Therefore, we tried to enhance the plotting functions.

Repetitive plotting is done by only one actual 3D data, appending link matrixes with different coordinates, causing less bulky data size.

Automatic plotting along a line, spline curve, and certain area is possible, with desired density. Size and direction of objects can be randomized. By using those functions, e.g. street trees can be easily plotted.

Geographical Survey Institute, our ministry of construction, examined and authorized the technology for stereo air photo grammetry, provided by c.a. 8 private companies in 1993, and after that, we can get DEM format data from each service in the same data format. We made a file converter from DEM to lss-g format, which is recognized as "ground" data. Therefore, we can plot any objects on the orthogonal view window, and the height can also be automatically determined by the system, in relation to the ground data.

2-5. Dialectic presentation

The most popular way of presentation is done in the meeting room on development site, inviting citizens' participation. Video projector (LCD) connected to the note-book type or desk-top type computer shows the future landscape on the screen.

Current request of the users is "dialog" type session. If someone requests to change some components of the project, planners are requested to change the 3D presentation immediately, to evaluate it. On contrary, conventional usage of CG presentation had tend to postpone the corrected and altered design as planners' homework.

Usually, the most interesting aspect of participants' is not the physical shape of the project, but economical impact. Therefore, we have to prepare the contents carefully, in order that the presentation of alternative plan will not give to much impression of economical difference (price of rent, amount of compensation, etc.), along with adequately arranged questioner.

Sometimes, evaluation session in the meeting room together tends to influenced by the loudly speaking persons. In such case, monitoring the evaluation of silent majority should be arranged. For the time being, said questioner will help this(SD method, etc.). In the future, when PC connected to internet shall become

more popular, individual evaluation done by citizens watching personal computers prepared in their home will replace this. In this scope, the simulator has the function to send commands to other simulator through TCP/IP protocol, by sending compact code to realize the simultaneous scene change in remote computers. However, this function is actually not yet tested on site.

2-6. Evaluation sessions on site.

Sometimes, evaluation session in the meeting room together tends to be influenced by the loudly speaking persons. In such case, monitoring the evaluation of silent majority should be arranged. For the time being, said questioner will help this (SD method, etc.). In the future, when PC connected to internet shall become more popular, individual evaluation done by citizens watching personal computers prepared in their home will replace this. In this scope, the simulator has the function to send commands to other simulator through TCP/IP protocol, by sending compact code to realize the simultaneous scene change in remote computers. However, this function is actually not yet tested on site.

2-7. Advanced simulation of social phenomena

In case of re-construction of apartment house, or urban renewal, the future landscape will be designed by a few planners and designers in harmonious way, hopefully. This purpose will be fulfilled by simple modeling function, like well arranged popular CAD system. However, in case of land-readjustment project, the future townscape will consist of various individualistic construction activities. For controlling this, "detail plan system" is becoming more and more popular. In such case, manual data entry of individual houses whose behavior is statistical is too exhaustive. Therefore, we provided functions to simulate such kind of social phenomena (individual construction regarding common rules), by using typological building, described as parametric objects realized by external functions (several XXX.exe 's which receive the land conditions and generate the 3D shape data, according to the rules or regulations. By using those functions, in the evaluation session, we can quickly compare the alternative rules and regulations, by watching and comparing the physical statistically forecasted future landscape.

2-8. Evaluation through Networking

Recently, a research institute of power supply company developed a new system to collect the citizen's evaluation directly through internet, and immediately sum-up the result of evaluation against the 3D images of planned power plants provided from the company's homepage in VRML format.

Our counterpart of joint research (mentioned above) in Korea are also elaborating similar system.

The "Communication System for Town Planning" presented by this article is a new bi-directional approach, which enables clients (citizens) to edit or modify the disclosed 3D data and reply to the server as an attachment of opinion letter.

3. Example applications.

Most users are civil engineers. The ministry of construction had c.a. 300 local branch offices on site, mainly for public works, while architects are confined in 8 major provincial headquarters, to design and build public buildings.

For urban development and small-scale construction, 47 prefectures and c.a. 3000 local governments will be the users.

3-1. Renewal of housing complex.

This case is the earliest trial of simulation in 1996. At that time, the system performed only a simple viewer of the 3D data, provided by using other CAD system (Intergraph's Microstation) through converters (DXF format).

The housing corporation of Fukuoka prefecture planned to re-build the old 4 storied apartment (rental), consist of several blocks built in 1950's, to become a plaza style complex of housing an commercial use. A design competition was done, and an architect in Fukuoka city won the prize. We are afraid of negative

impact

of evaluation session by using the system still under development, and did the evaluation session after the design was already announced to the inhabitants, through perspective drawings and models.

We tried an tendering session to select a soft-house for data entry in Tsukuba, more than 1000 km distant from site, afraid of information leak to the contractor who will participate in the tendering for the construction.

The cost was merely 50% of the cost, which the corporation spent for preparing said drawings and models (more than 3 million yen). The cost covered the data entry of questioners and simple statistical analysis.

The evaluation session was held on the site office, by preparing Intergraph's TDZ 300 and 21' monitor display (leased). This was the best (fastest) way at that time, and might be the first trial of such simulation on actual construction site in our country.

Many of 25 respondents on site were elderly ladies (20, without background of education for drawing civil engineering or architectural design. We provided a questionair on both "design of future home (SD method)" and "the presentation system (simple questions)".

By walking through the future 3D complex, most of them replied that 3D graphics is easier to understand the design, than drawings (birds' eye view) or models, even though the monitor display is too small. At that stage, they were more interested in the choice of units than the design of building itself. Therefore, we were requested to show the scene from several units they are considering to choose.

We came to realize that providing too many adjective-pair in the questioner for sensory evaluation is hard for elderly people to fill over. Based on statistical analysis, we have to prepare smarter and more effective set of items.

After this session, low price graphics card (OpenGL) has become popular, and LCD projector came. Therefore, some of said problems were solved.

3-2. Land re-adjustment project.

Fukushima city is now conducting a land re-adjusted project in the inner-city built up area. They provided the local office on site in 1997, and the staff of the municipal officers are working on site. The mayor was interested in the dialectic CG presentation and provided budget for machines and equipment.

However, same as other local governments, they don't like to provide budget for data entry, but assigned a young officers to be in charge. Their educational background is senior high school (not technical).

The stuffs elaborated to provide the data only by using our still buggy system.

At that time, viewer functions had well performed, but modeling functions were not so sustainable, causing frequent memory leakage and memory access violations.

GUI was also not so friendly to the users who don't want to prepare CAD system, but like to make up whole complex data only by using our system. The stuffs sent us so many various bug reports and proposal for betterment.

Generally, this type of project last very long (sometimes more than 20 years).

In order to cope with such situation, Addressing of re-adjusted lots and data management is essential. In the future, equipment and software will drastically change. Therefore, we have to be careful of initial design for data management.

The stuffs are now entering the data from land map by using digitizer, and convert it for the system. The lot shape data, including city planning conditions, are utilized for the said simulation of statistical social phenomena. For this purpose, more detailed data format for lot conditions was made possible to assign, like a corner lot, long lot which faces 2 streets, inner-block lot which faces only a narrow footpath, etc.

They also requested us to develop a modeler to make 3D model of streets and crossings, according to the technical standard of our ministry, which easily create a model by giving a few parameters. We assumed

that the land condition is not necessarily flat.

The project is still on going, and they utilized our system to determine the width of the planned streets, and to consider the desired height of buildings along them.

However, against our expectation, the system is mainly utilized among the governmental officers, because the most urgent issue is not negotiation with inhabitants and land owners, but the budget resource sharing among several public bodies, in this severe economical situation. The progress of the project itself is far delayed than initially scheduled.

3-3 Urban-renewal projects

Makuhari area, conducted by Housing and Urban Development Corporation, Chiba city, and local co-operative (three zones) utilized this system to presentation and discussion on planning among related staffs of the corporation and local government and land owners, inhabitants. Following data were provided:

(1) Textured 3D model of existing town, utilizing Real Modeler(TM of Fujitsu co.ltd) which process the image data taken by digital camera. The 3D data of each existing buildings (houses, shops, offices, etc.) were recorded in separate LSS-G file, while total town area were integrated by using plotting function of sim.exe.

(2) 3D model of surrounding area, including land and buildings was provided by Asia Airphoto Company as an test case. Browser and converter was worked out, and any desired partial area, chosen by users, can be converted into LSS-G data. This data is useful for checking the landscape view from the planned high-rise housing unit, before making any model for planning (only by setting viewpoint at location of future balcony etc.) This data is also useful as base for constructing 3D model for the project site.

(3) 3D model for plan was elaborated for several stages, including housing blocks, road (underpath for railroad, underground bus terminal etc.), and discussed among designers.

Through this experience, it has become clear that before city planning scheme, there are many obstacles and difficulties to prepare the feasible plan, containing financial negotiation, proposal for expected commercial capitals for the planned building, that are rather interested in the economical aspect than 3D shape. Therefore, another research project to combine several non physical (visual) factors with physical planning is now undertaken. In this research, simulation of the process of urban renewal project (many steps of procedure) and the function of site office is elaborated, in the shape of "VIRTUAL SITE OFFICE" on WEB, to which any related people can access and participate into the process. Clients are classified into 4 categories, namely:

- a. Project managers (corporation, local government, and related consultants, etc.)
- b. Land owners
- c. Citizens and inhabitants in the surrounding area
- d. Intersted private sector and candidates of new commes (future inhabitants)

4. Distribution and acquisition

(1) Download from ftp server

<http://sim.nilim.go.jp/MCS>

Anyone can download the installer for the whole system, and also refer to the source codes. Until now, the system is for Japanese, Korean and Indonesian users only.

(2) CD-ROM version

In May 1997, the trial version (2.01) is distributed in the form of attached CD-ROM of a magazine on Landscape Design. In November 1997, the more debugged version(2.03) with textbook for self practice, was published from our Building Research Institute, and distributed to anyone who requests. This was revised in July 2000 as version 2.05, and published from Building Research Institute (Building Research Data No.96).

(3) Multi-language approach

In 1997, we co-operated with Korean Rural Research Institute, who would start the similar development

project, and translated our system into Korean language to enhance the start line of them. It took 3 days to translate the whole system, by 8 persons, consist of professors, researchers, students, professional programmers and translators. Recently, they started to distribute in the form of CD-ROM.