<A B S T R A C T>

The Architecture of Landscape Simulation System Ver.2.09, provided by MLIT

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0. Outline: basic purpose, features and functions

This system is a kind of open source 3D graphic system, developed by Building Research Institute, and Public Works Research Institute, under Ministry of Construction (1993-2000) at that time, and succeeded by the National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure, Transportation and Tourism which was newly organized through the process of restructuring the previous ministries and related institution (2001-now).

The system was developed for the purpose to promote local branch offices and their stuffs to perform CG simulation and presentation without no heavy training, and provision of special budget, in order to enhance the visual design and evaluation of regional development projects and related public works.

0-1. Outline of the system

The system consists 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 modeling and browsing:

- Various viewpoint setting, walk-through, etc. of 3D landscape data.
- Modeling 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

- Lot subdivision pattern must be prepared as the stage of events.
- The simulation continues hundreds of years.
- Houses and buildings appears and disappears with probable length of life.

- Types of houses which newly appear follow the statistical probability.
- Shape of houses which newly appear follow the city planning scheme.
- Sim.exe is used as an output device like three dimensional printer.

(4) File converters

- Dxf format
- Minicad text format
- DEM format
- VRML format
- SXF format (official data format for archiving designed and constructed land & infra)
- Other formats used for simulations: urban fire spread process, etc.

(5) User-defined parametric components

XXX_D.exe (GUI dialogue)

XXX.exe (3D model generator)

(6) Plugin dll

Sim.exe dynamically loads the plugin dll-s when the user selects it from the list (plugin.tab).

All the library functions and static variables used by sim.exe are exported to the developed dll through sim.lib, so that the plugin dll-s can perform as a part of sim.exe with full access to the system variables and status.

Such examples are provided, as a result of re-structuring the derived versions of sim.exe:

Land.dll: To manipulate and modify the free form of the land

ParkRoad.dll: To design foot path in the parks

Tunnel.dll: To append a kind of pipe in a mountain to achieve short-cut road.

Nori.dll: To evaluate new artificial slopes that accompany to the constructed road.

0-2. License

- Copyright(C) Ministry of Land, Infrastructure, Transport and Tourism
- Free ware, and source code is disclosed (open source)
- Re-sale without additional value is eliminated
- International portability

Japanese, Korean and Indonesian are available (English is under construction)

0-3. Conditions for installation

The platform is PC installed with Windows 2000, XP, VISTA and 7.

Disk space: 70MB (minimum)

Memory: 16MB (minimum)

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

Recommended OpenGL accelerator

(In short, any recent models of PSs and Laptops are useful for this system, and the requirements depend on the size and quantity of data that users wish to handle.)

0-4. Users

Target user group of the development was construction-related staffs of local branch offices of the ministry, local governments, relevant corporations, consultants, architects, planners and designers, with educational background of senior high school, with self training less than 3 months. They will not operate for daily use, but sometimes require the system for their work

0-5. 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 pile, 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)

0-6. Purpose of this report

This purpose of this report describes the inside of the system, to support the further development of additional functions, in the form of appended external functions or appended plug-in dll-s. However, this report will also be useful to those who wish to develop any similar systems for different purposes (tourism, agriculture or transportation etc.). Because all the source code is open, anyone can take some part of the program of this system for the purpose to develop own system. This report may also be useful to those trials.

0-7. Contents of this report

1. History
2. Basic geometry and data structure
3. Own file formats
4. Structure of source codes
5. External functions
6. Plugin dll
7. Graphics process
8. File converters

1. Process of Development

The system was initially 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 simulation system specially designed for MOC projects, as free-ware (to be distributed without license 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 inter-net and CD-ROM. Some of local staffs elaborated very complicated data and reported (complained about) 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 regal and technical constraint on transferring and translating Japanese free-ware, we jointly proposed international joint research. This was adopted in the Japan-Korea agreement on co-operation in Science and Technology, as "Application of Landscape Technologies for Regional Development".

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 have 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 this choice is not or should not be compulsory, but alternative. If seen from the private sector, the potential target user will be appended.

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 forms 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 in the local environment of LSS system.

2. Application to landscape design

2-1. Processing digital images taken from sites

Digital photo data is very useful for creating a scene. The 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. Modeling 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.

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

Database (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, along

with software for maintaining the data.
Database (3) will be provided by research institutes.

Beside these three 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 elaborates 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 appear. The GUI part is a dialog box for user to edit the time.

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

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

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 photos with high quality/resolution are becoming popular, therefore preparing texture data is becoming far 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 defining 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 photogrammetric, 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.

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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

In 2001, when NILIM was established, the “Communication System for Town Planning” was developed, which also included the server-side programming. The web-based system is described in the technical note of NILIM No. 134 (Sept. 2003).

In this system, sim.exe was used as a viewer installed in the client side, and used to examine the 3d data provided from the web server. For this purpose, minimum functions are selected and sim.exe was simplified. However, if a user wishes, additional functions are also available at web servers.

The setup was classified into 3,

(1) Minimum: for rapid browsing the 3D data provided from web servers.

(2) Compact: for users who wish to edit the said 3D data.

(3) Full-set: for users who cannot access to the web

Those "purifying" works for the system encountered many troubles, especially on the Windows ME, which seemed more strict and severe for memory management. However, identification of the cause of troubles was easier than previous versions of Windows, because the troubles occurs immediately after the cause appears.]

Stereoscopic presentation of 3D data was also introduced at that time, which is becoming popular today.

3. Examples of application

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) consists of several blocks built in 1950's, to become a plaza style complex of housing and 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 a tendering session to select a soft-house for data entry in Tsukuba, over 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 questionnaire 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 choosing.

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 stuff of the municipal officers is 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 ongoing, 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 Air photo Company as a test case. Browser and converter were 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 (under path 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. Interested private sector and candidates of new comers (future inhabitants)

4. Distribution and acquisition

(1) Download from web 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.

5. 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 which are 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) vary 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.

6. Re-structuring process toward completion

During the application into the practical use in the field, functions are added upon requests of the users in many fields, including urban development, water resource management, dam site, bridge design, park etc. The system was also applied to international cooperation, including evaluation of Sea Level Rising at coastal cities, designing alternative future of housing complexes regarding the elimination of increasing energy consumption, recovery of large scale urban disasters etc. Those

activities resulted versions with different additional functions and languages.

Between 2008 and 09, efforts were made to re-organize those versions, and resulted the unified ver.2.09 that is precisely described in this report.

In short, this new version does not contain any new attractive/useful functions. But the most significant feature is the new architecture.

(1) Core part (sim.exe) is consist of basic functions that covers all the field of public works.

(2) Core part can dynamically change the language, and only one executable is enough to support any language.

(3) Core part can be translated to new language at text-base works (without programmers)

(4) Core part can dispatch external functions and plugin dll-s that are provided for specific needs of some field of public works

(5) The selected language is informed from the core part to the external functions and plugin dll-s, so that they can change the language in synchronic way.

In this restructuring process, major useful functions were collected to new core part, including various graphic features (shadow, stereo sight, rapid viewpoint move, etc.).

Also, specific functions available that are specific to some fields of construction were organized in the form of 5 plugin dll-s as mentioned above.

This restructuring will have the impact to the long term future development of the system.

(1) Improvement of the core part will pay attention of the “completeness”

(2) Innovative development will occur in the form of developing plugin dll-s.

(3) Transfer to the new language will be performed by the literal translators.

7. 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 who 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 + VR technologies, and development of server functions based on ASP, or so-called "cloud computing".

The results of a survey of the latest technologies done before development started revealed those 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.

In the long term, diachronic communication will also be important, which enables the communication of 3D data from the carpenters that constructed a house to another carpenters who will reform the house after 30 years, or to a real-estate dealer who will evaluate the house after 100 years.

Notes:

1) Japan Association for Building Research Promotion (tell: 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.

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)

Example 1: Future image of Fujimi-city

Example 2: Present Topography and the City of Hiroshima Crossing Project