ESTABLISHMENT OF A DATA CREATION METHODOLOGY UNDER THE GEOGRAPHIC INFORMATION STANDARDS

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ABSTRACT:

A new Japanese law requires that basic spatial data covering the entire national land of Japan are to be developed in accordance with the Japan Profile for Geographic Information Standards (JPGIS). As a result, the parties developing the data will need to acquire the technology to develop more advanced, higher-quality spatial data than ever before. In order to develop various types of spatial data under the JPGIS, we have established some working methods that are different from conventional methods. For example, a system to reduce mistakes by limiting the planimetric features available according to knowledge and skill level. A data input system that allows workers to apparently perform the same operations for data entry without confusion, even though they are using a working method that is different from the conventional method. These methods and systems have enabled the easy development of spatial data under the JPGIS. In future, various types of spatial data as well as basic mapping information will be created in accordance with the JPGIS. In order to meet specifications, a total production system that supports workers, software and documents must be developed.

1. INTRODUCTION

A new piece of legislation, the "Basic Law on the Use of Geographic Spatial Information", otherwise known as the "NSDI (National Spatial Data Infrastructure) Law" came into effect in Japan. Under this law, basic spatial data covering the entire national land of Japan will be developed in accordance with the Japan Profile for Geographic Information Standards (JPGIS). (JPGIS are standards extracted from the ISO- and JIS-based geographic standards that are actually used in Japan.)

The national basic map information will also be made available free of charge via the Internet and other media. Since the national basic map information will be developed under the JPGIS, it is expected that prefectural and municipal spatial data will also be developed in accordance with the standards in the future.

As a result, the spatial data of Japan will be made available for the convenience of the administration and the public; but the parties developing the data will be required to deal with the technology to create more high-quality and highly-specified spatial data.

One of the reasons for these higher requirements is that the parties developing the data, who have so far been providing spatial data for specific uses to specific clients, will have to provide the same spatial data for various uses to an increasing number of clients.

For instance, there will be calls for the planimetric features forming the backbone of geographic information to be of higher quality; and it is also anticipated that the data architecture will be more complicated in order to provide greater applicability.

The cost of data creation for this purpose will be higher than ever before. In addition, problems arising from more complicated procedures and more advanced technology in data creation will become apparent.

For municipal services, we have been promoting data creation in accordance with product specifications that are compliant with the JPGIS standards, and have accumulated a great deal of know-how on data creation methodology.

We have established some working methods that are different from conventional methods, in order to develop various types of spatial data in compliance with the JPGIS. This paper describes the data creation methodology in detail.

2. DATA CREATION METHODOLGY IN COMPLIANCE WITH JPGIS

2.1 Comparison of Data Creation Methods

The production method that we have established is a data creation method that is not only compliant with the JPGIS but also allows JPGIS-based data to be developed for the same cost as the creation of conventional topographic map data. Figure 1 shows a comparison of the new data creation and the conventional topographic map data creation method.

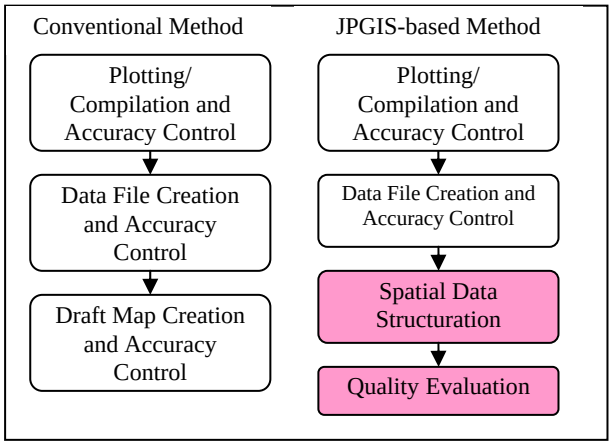

Figure 1 Comparison of conventional and JPGIS-based data creation methods

In the conventional method, the main work is to create digital data for topographic maps and to carry out accuracy control at each stage of the work process. The final products in most cases are draft maps.

In the JPGIS-based method, in addition to the creation of digital data for the production of topographic maps, the spatial data created must also allow data analysis and statistical calculations. Each stage of the conventional process also requires product quality evaluation in addition to accuracy control.

In the development of the JPGIS-based spatial data, there is also a requirement for the production of conventional products such as draft maps. The application of conventional methods to build JPGIS-based data will result in unacceptable increase of the production cost. To solve this problem, we have developed a new data creation method, which will be described in the following sections.

2.2 Description of New Production System

The new production system that we have configured allows data creation at a cost that is not so different from that of the conventional data creation method. For this purpose, we have simplified the complicated procedures and data structures to enhance the productivity of workers. The features of this new data production method are as follows:

① Techniques to convert the XML schema as defined in the product specification, to prepare a table of works for data entry and compilation and to create the data in compliance with the schema.
② The function to create and inspect the spatial data such as phase structures.
③ Techniques to limit the planimetric features available depending upon the knowledge and skill level of the worker, in order to reduce mistakes.
④ Data input function to allow a worker to perform apparently the same operations without confusion with conventional work specifications.
⑤ Techniques to standardize data input and compilation procedures for spatial data creation
⑥ The function to refer to the product specifications and work specifications during data input and compilation work within the system, without having to look up the specifications on paper or in a PDF file.
⑦ The function to enable logic inspection in quality evaluation as far as possible

These techniques and functions will be described below.

2.2.1 Data Creation Method to Meet XML Schema

The XML schema describes the rules of XML texts, to which the data creation should also conform. As shown in Figure 2, it is possible to reduce mistakes in the final product by providing in advance an input environment that matches the XML schema.

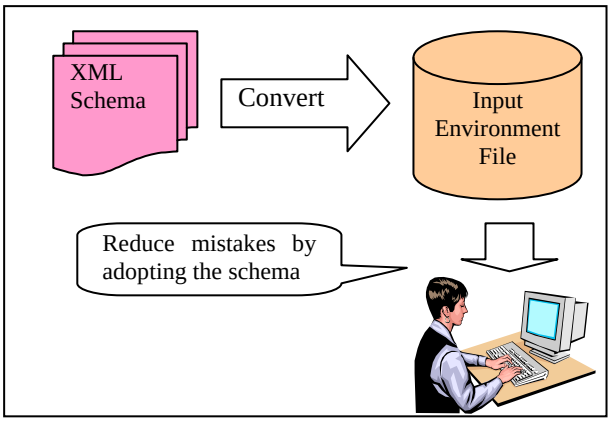

Figure 2 Application of XML schema

2.2.2 Function to Create and Inspect Topology

We have developed an environment in which data models of topology describing the acceptable spatial relations between geometrical elements can be created and inspected. These functions enable the inspection of the topology of planes and lines. As shown in Figure 3, the topological relations of the lines to configure planes and the points to configure the lines can be inspected, allowing creation of data that meet the spatial schema as defined in JPGIS.

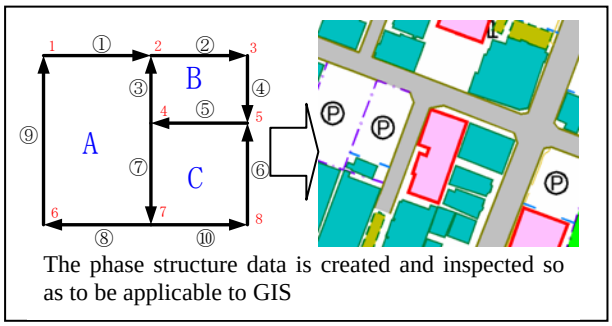

Figure 3 Topological data creation and inspection functions

2.2.3 Limiting Available Items According to Operator's Skill, in order to Reduce Mistakes

It is possible to reduce mistakes by limiting the planimetric features available for a worker to assign. The available planimetric features and work items can be controlled according to the worker's skill level in executing any work, as shown in Figure 4. This prevents mistakes that may be caused by a worker's lack of skill.

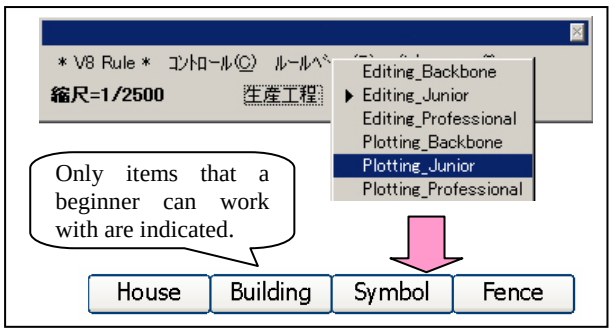

Figure 4 Technique to change work environment

2.2.4 Function to Allow Operators to Work without Knowing New Specifications

Workers can operate the system paying little attention to the differences from conventional data models. As shown in Figure 5, the planimetric features for which figures only had been laid out in the conventional method can be laid out automatically together with the "thematic attributes" and "associations", allowing workers to create new data models using operations similar to the conventional method.

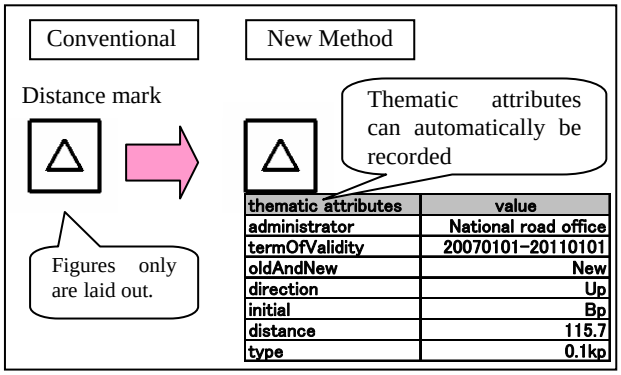

Figure 5 Function to add attribute information by laying out figures

2.2.5 Techniques to Standardize Work Procedures

The differences in the working methods used by workers may result in differences in quality and efficiency. The new system leads workers to operate in the same way. Figure 6 shows the working procedure to allow workers to operate the spatial data creation system in the order in which the work processes are numbered.

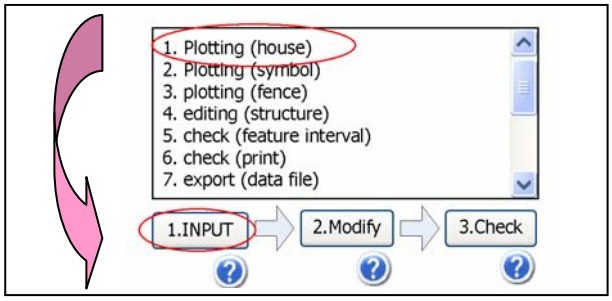

Figure 6 Working procedure standardization method

2.2.6 Functions to Enable Reference to Product/Work Specifications during Work

Workers have to check product or work specifications often, and may overlook some detailed specifications or instructions. To prevent such mistakes, the new system allows those specifications to be referenced within the input system, as shown in Figure 7. As a result, workers can readily find unclear points in the work procedures, reduce mistakes and shorten the time taken to check the specifications.

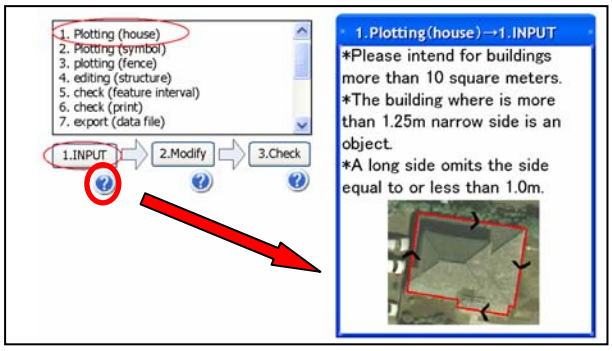

Figure 7 Function to enable reference to work specifications within the System

2.2.7 Functions for More Efficient Quality Evaluation

In quality evaluation, logical consistency can be checked through program processing, but other quality elements are often inspected by visual check. As visual checks often result in high cost, involves a higher cost, the position-related elements such as positional accuracy and thematic accuracy, and those elements that can be compared by combinations of attribute values, are evaluated by program processing. The function to obtain positional accuracy for each line element by spatial calculation has been developed as shown in Figure 8.

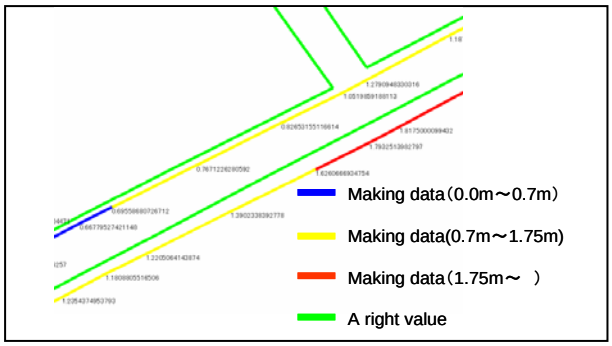

Figure 8 Function to assist positional accuracy inspection

2.3 Operational Advantages of the New System

The operation of the production system has facilitated the creation of spatial data in compliance with JPGIS. This method is more advantageous than the conventional method in structuring higher-specified spatial data to be as simple as possible and easier to create.

The new system is intended to have the effect of arousing no resistance in skilled workers against the creation of spatial data with a new structure, and of preventing mistakes caused by inexperienced workers due to their insufficient understanding of specifications. This dual effect makes it possible to create spatial data under complex specifications at a cost that is not so different from the cost of creating topographic maps using the conventional method.

3. CONCLUSIONS AND FUTURE WORKS

3.1 Conclusions

In the future, various types of spatial data as well as basic map information will be developed in accordance with JPGIS. Because the JPGIS specifications do not correspond to a specific form of data, we need to have a flexible data creation methodology to produce various JPGIS-based spatial data.

It is difficult to create such spatial data using only the conventional technology and knowledge needed to create topographic map data. It is desirable to configure a production system that integrates not only software but also a method of improving workers' knowledge and a method of preparing the documentation including easy-to-understand work instructions.

For this purpose, the spatial data to meet the required specifications could not be created merely by purchasing and use of advanced GIS software. In order to achieve the purpose, what is required is the development of a production system that supports workers, software and documentation in an integrated way.

3.2 Future Works

One of the existing problems is that it takes a great deal of labor to build a working environment in which the burden on workers can be reduced to the same level of total working hours for the conventional method. Building such environment requires managers who understand all the product specifications, spatial data structures and the workflow of the actual work. It is also necessary to train managerial personnel for this work. Therefore, it is necessary to develop a production system in which the building of the working environment is as automated as possible. In addition, it is necessary to build a production system that is not only efficient, but in which consideration has been given to the education and training of engineers.

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