TENDENCY OF STANDARDIZATION OF SPATIAL DATA AND PRESENT STATE OF ITS APPLICATION TO PRODUCTION DATA IN JAPAN

Takashi TAKEMOTO, Koji MIZUKAMI

Kokusai Kogyo CO.,LTD, 3-6-1 Asahigaoka, Hino City, Tokyo, 191-0065 JAPAN - takashi_takemoto@kkc.co.jp
koji_mizukami@kkc.co.jp

Commission□ , WG □I/4

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ABSTRACT:

Administrative agencies in our country are considering that the use of GIS is the effective means to improve and enhance the efficiency and accuracy of their business for improving the services to citizens and satisfying the needs of explanatory obligations. On the other hand, the huge amount of cost necessary for the arrangement of data is the impedimental factor for the utilization GIS as it is necessary to collect various spatial data such as the data of roads and buildings, land use, etc. One of the means to solve this problem is to define the standards such as of encoding specifications, spatial schema and to establish the system to facilitate the interoperability of spatial data (standardization). As for the standardization of spatial data, the International Organization for Standardization (ISO) has organized "ISO / TC211" and has defined the international standard. In line with this movement, our country has laid down "Japanese Standards for Geographic Information (JSGI)" incorporating it to JIS, and is employing it as the technical standard of governmental agencies. In concrete, the activities have already started in the areas such as definition of data product specification, construction of clearing-house, arrangement of metadata and web services. Especially as for the definition of data product specifications, almost all of the governmental agencies handling the spatial data are proceeding with this activity, which is considered to exert a great influence on the data users and producers. In this representation, we will introduce the meaning of standardization of spatial data, present state in our country and the examples of application of data production, and explain the present issues and future prospects. As for the example of production data application, we will take up the spatial data used for the business of road facility management, and will introduce and explain the standards conforming to the defined data product specifications such as the rules for application schema, spatial schema, temporal schema, principle of quality, quality evaluation procedures, spatial referencing by coordinates, metadata and encoding specifications. In addition, we will introduce the example of created spatial data (XML format) and its application to construction of map. Lastly, we will describe the idea of supply of value added data and importance of quality assurance as an example of influence that the standardization of spatial data may exert on the data producers.

1. SIGNIFICANCE AND TREND OF SPATIAL DATA STANDARDIZATION

1.1 Significance of standardization

Utilization of administrative information has been expedited in Japan in an aim to simplify the administrative works, improve the efficiency and transparency and offer advanced services to the nation by applying information communication technologies (IT) to every field of administration and reviewing the conventional system and practice accordingly. Among them, GIS (geographical information system has an important role as the information infrastructure, and therefore, has been promoted and expedited according to "GIS Action Program 2002 – 2005."

On the other hand, however, the preparation of spatial data has been a great stumbling block for the dissemination of GIS. This is because the huge cost is required for the arrangement of data as the spatial data prepared by various agencies cannot be easily exchanged each other in introducing the GIS. The "standardization of spatial data" is effective to address this problem. If the standard governing the spatial data is specified, the users and producers of data can easily exchange the data each other by following this standard. Following significance and effect can be expected to the "standardization of spatial data."

1.2 Trend of standardization

1.2.1 Trend of international standardization

As for the international standardization, ISO / TC211 (geographical information / geomatics) was establish in April 1994 as 211th expert committee of ISO and is now working out the standard for geographical information.

The standard worked out by ISO / TC211 roughly has the structure of 3 layers (Fig.1). There is the "standard that supports the standard" relating to the phraseology, conformity and tests at the base, upon which positioned is the spatial information model. In addition, the standard relating to the acquisition, management, exchange and application of data is positioned on it.

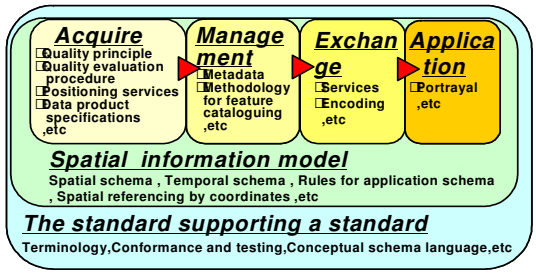

Figure 1. System of standard

1.2.2 Trend of standardization in Japan

Japan has established ISO / TC211 national committee is formulating JIS standard as the national standard when the standard of ISO / TC221 is materialized as the national standard. At present, a part of JIS standards and JIS drafts has been completed, and therefore, JSGI which has been made by the joint research of Geographical Survey Institute of Ministry of Land, Infrastructure and Transport and private sector is used presently. JSGI is almost conforming to the standards of ISO / TC211.

Table 1. Structure of JSGI

□ Spatial schema	□ Spatial referencing by geographic identifiers
□ Temporal schema	□ Metadata
□ Rules for application schema	XI Encoding
□ Quality principle	□ Methodology for feature cataloguing
□ Quality evaluation procedure	□ Portrayal
□ Spatial referencing by coordinates	X□ Data product specifications

The "GIS Action Program 2002 – 2005" has been expedited in Japan for the purpose to promote GIS and its standardization. This is an action plan for the arrangement and dissemination of GIS decided by the liaison council of governmental agencies relating to geographical information system consisting of many governmental agencies. In this plan, geographical information standard or JIS is specified as the "technical standard of government" for the method of data exchange. Administrative agencies of Japan are required to follow this standard when they prepare the spatial data.

2. APPLICATION TO DATA PRODUCT SPECIFICATIONS

In this Chapter, we will introduce a case of determination of data product specifications based on the geographical information standard raking up as an example the "data product specifications for the management of road facilities" made at a certain National Road Office to use it for the road management operation. Employment of standard is important in the utilization of information for administrative works to maintain its public nature.

2.1 Structure of data product specifications

Figure 2 shows the structure of data product specifications conforming to the geographical information standard. The data product specifications are composed of application schema which is the design drawing of data, spatial attributes, spatial schema that defines the temporal attributes, temporal schema, spatial referencing by coordinates that defines the coordinates referencing system, metadata and encoding specifications.

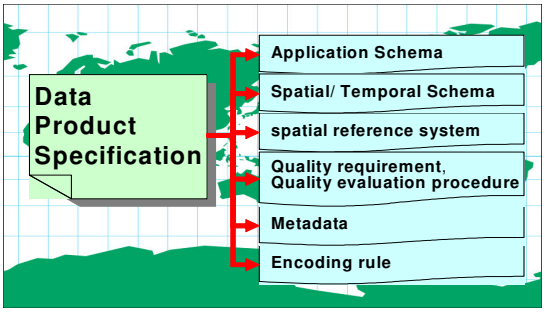

Figure 2. Structure of data product specifications

2.2 Procedures to make the data product specifications

As shown in Figure 3, the data product specifications are made by the procedures of extraction of data items, design of application schema, discussion of quality and method to evaluate the quality, other coordinates referencing system and encoding specifications.

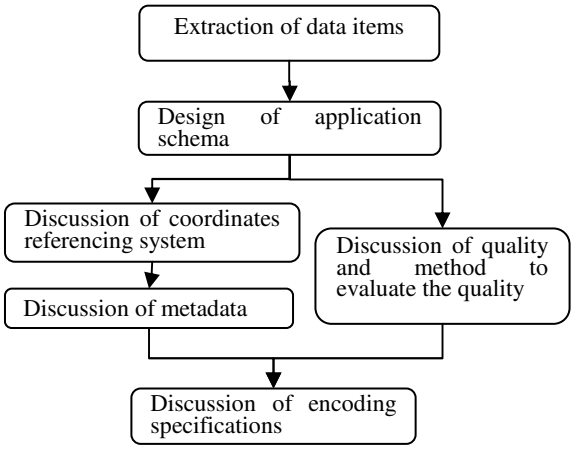

Figure 3. Procedures to make the data product specification

2.3 Extraction of data items and design of application schema

The most important works in making the data product specifications are the extraction of data items and design of application schema.

2.3.1 Extraction of data items

In this section, we describe the method to extract the data items. In this example, we investigated and analyzed at what scene, using what type of materials and how the data items pursuant to the divisions engaged in the road management operation were used. As a result, it became clear that the data relating to road operations could be systematized by the conceptual model as shown in Figure 4. In addition, we constructed the logical model for the road facilities and extracted the data items necessary for the road business operation.

As stated in the above, it is important to extract the data items taking into account the usefulness for the purpose of business operation.

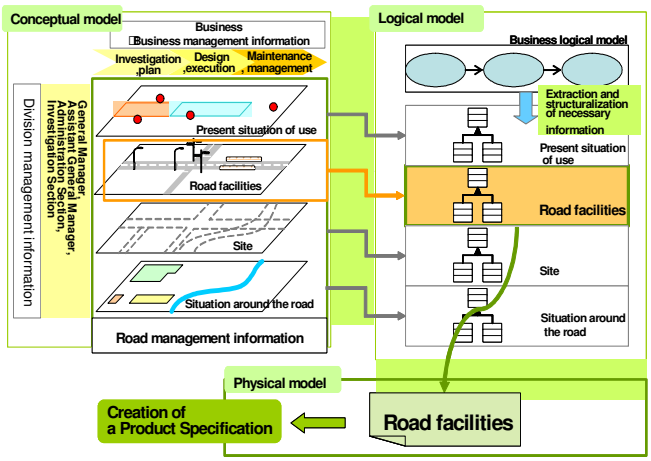

Figure 4: Model of road management information

2.3.2 Design of application scheme

Application schema is the design drawing (physical model) of spatial data and is composed of structure and attributes of data, relation among the data, UML class drawing and definition documents. As shown in Figure 5, the application schema is designed by defining the spatial attributes, thematic attributes, temporal attributes and relation with the land structures taking into account the use method in the business operation and relation among the data items based on the extracted data items.

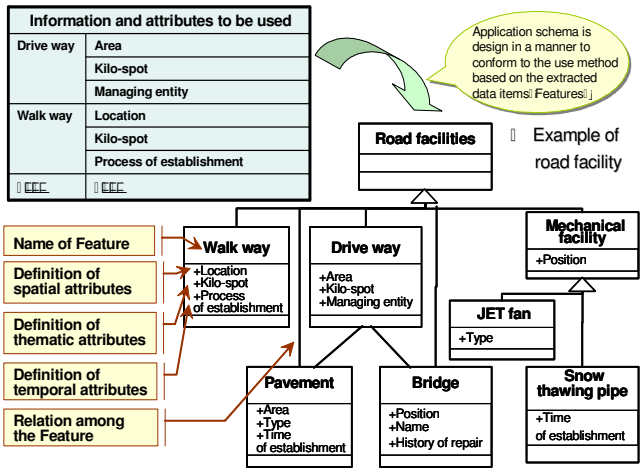

Figure 5. Design of application schema

3. APPLICATION TO DATA PRODUCTION

3.1 Construction of data

We prepared the data according to the "specifications for spatial data product used for road management operation" decided in Chapter 3. The plan was drawn up by clarifying the ground objects and scope for which the data should be compiled and determining proper procedures for data construction and quality evaluation. As for the measurement and determination of spatial attributes, the measurement is done by using either one of site survey, aerial map or existing map, and the spatial attributes (point, line, surface) which show the position and shape of ground objects. The thematic attributes (type, etc.) and temporal attributes (date of establishment) are determined based on the existing materials (records, etc.) and materials of site survey. Quality is finally evaluated to confirm whether the spatial data compiled satisfy the quality requirements of data product specifications. As for the final outcome, the data file is compiled according to the encoding specifications.

3.2 Quality evaluation

It is the quality evaluation to which the attention is paid in applying geographical information standard to the data compilation. It is possible to define the data specification in detail taking into account the properties of spatial data if the geographical information standard is applied as stated in the above. In addition, it is possible to clearly evaluate whether the compiled data are conforming to the data product specification by setting forth the quality requirements and quality evaluation procedures. It means to contribute to the quality improvement of spatial data.

The quality of spatial data is evaluated by the factors such as integrity, logical consistency, accuracy of position, accuracy of time and accuracy of theme. Figure 6 shows an example where the quality is evaluated according to the quality requirements and quality evaluation procedures of "data product specifications for the management of road facilities."

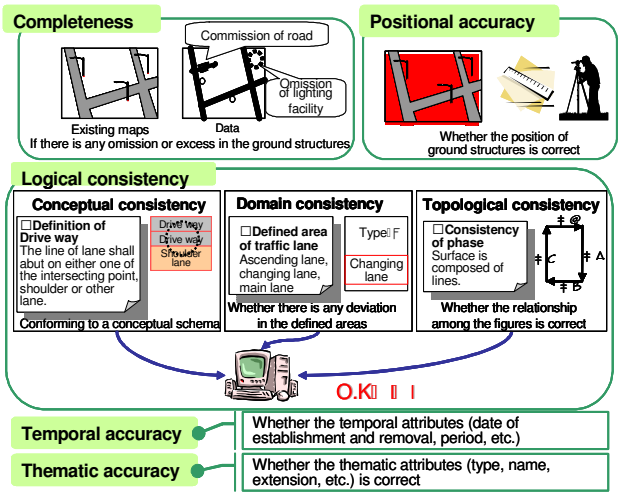

Figure 6. Quality evaluation

3.3 Compilation of metadata

Metadata means the "data describing the spatial data" which describes the information such as "when the spatial data was created," "which area the data are referring to," "who is the manager" or "how it can be acquired." The metadata are the data subject to the retrieval of clearinghouse and are playing important role to promote the distribution of spatial data. It is recommended never to fail to make the metadata when to compile the spatial data according to the geographical information standard.

4. CONSIDERATION AND ISSUES IN THE FUTURE

4.1 Consideration

We have reported about the application of "geographical information standard" in the use of information relating to the road management operation of National Road Office. The following is our consideration about the result of application.

- Geographical information standard is object oriented design method and is effective for defining data specification taking into account the utility.
- Geographical information standard makes it possible to handle the properties of geographical information in detail and is effective defining highly precise data specification.
- The data product specifications conforming to geographical information standard can clearly indicate the application schema and quality requirements as well as the quality specification as the quality evaluation procedures, and are effective for the quality improvement of data. It is also effective for the quality control in compiling the data.
- We recommend compilation of metadata as it contributes to the improvement of distribution of spatial data.

4.2 The issues in the future

The standardization of geographical information in Japan has just arrived at the level of practical use and dissemination from the level of research. Considering the fact that the present report is one of very few example of application, it is also true that there are many problems in the use and dissemination of the

standard. Through the application of this time, we will point out the following matters as the issues to be solved in the future.

- It is necessary to have the knowledge in the field of information technology such as object orientation, UML and XML for determining the spatial data product specification. Since the compilation of spatial data is mainly carried out by survey companies and new knowledge is required for it, it would be necessary to education to engineers.
- The purpose of standardization is to enhance the efficiency and level of administrative works by improving the distribution of spatial data. It is necessary to urgently enlighten the administrative agencies about the meaning of this purpose, which is considered to expedite the materialization of the standard.

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