An Empirical Study of the Collaborative Use of Construction Information

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Abstract: The public works sector has created an environment permitting the reuse of construction information in electronic form. Through this process, a variety of systems and databases have been developed to manage dispersed construction information. This means that construction information in electronic form is being steadily accumulated. Future attention will be focused on performing work more efficiently collaborative use construction information.

This paper shows, "effectively using dispersion-managed construction information" and "use of data through its life cycle" as examples of efforts to achieve more efficient business through the collaborative use of construction information.

Key words: standard interface, gazetteer, CAD-GIS exchange, CALS/EC, location information

1. Introduction

The public works sector is promoting electronic deliveries: delivery of survey, design and construction in the form of electronic data as part of CALS/EC (Continuous Acquisition And Life cycle Support / Electronic Commerce). This study is intended to create an environment for reuse based on the accumulation and distribution of construction information in electronic form. A variety of systems and databases are now constructed and are being used to perform the management of dispersed construction information.

In the future, public works sector must build an environment permitting the efficient use of life-cycle information that has been dispersion managed. This means that more efficient work through collaborative use construction information in electronic form must be achieved. And "collaboration of construction information" is defined by this study institute as efficiently searching for construction information and effectively utilizing this construction information.

It is possible to link a large quantity of construction information with location information. Therefore, it is the best policy to use dispersion-managed construction information making location information the "collaboration key".

When we effectively use many data throughout the life cycle of a public works projects, drawings of construction information (CAD data) are important. To achieve more efficient business, data must be exchanged and distributed based on its characteristics; uses and requirements of drawings at each phase. Specifically, an environment for the exchange and distribution of the following three kinds of data is necessary.

- "Drawing information in expanded DM(Digital Mapping) data format" that is a product of surveying
- "Drawing information in CAD data format" that is a product of design and construction
- "Drawing information in GIS data format" that is used for maintenance

Against this background, this report shows the

following examples of activities to realize more efficient business through collaborative use of construction information.

- Effective use of dispersion-managed construction information
- Use of data throughout the life cycle

2. To effectively use dispersion-managed construction information

2.1. Connecting construction information with location information

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has created an environment for the reuse of construction information in electronic form. As one of these activities, in 2001 it started "electronic delivery" that is the delivery of products of design and construction electronic data. Products in electronic form are controlled by meta data that are called management files (XML format).

Large quantities of construction information would be connected to location information. So if each product and location information is connected with a maintenance file, it is easy to use electronic products data.

This study was implemented by developing meta data that connects location information with electronic products data. And the results of the study are reflected in electronic delivery regulations [1-3]. Figure 1 is an image of the study results (It shows meta data of location information in the boxes on Figure 1).. The meta data are defined so that products data is searched in digital maps.

2.2. Study of the standard interface

An interface is a necessary part of all information systems. When small scale systems are collaborating, those system's data can be transferred by mutual interfaces. But in the construction field, each information system performs dispersed management. Linking these individually is extremely costly and time-consuming. To build these in, regulations concerning interfaces specialized fields are needed, so river and disaster prevention (disaster reduction) was surveyed [4-7]. These results reveal duplicated and synonymous descriptions in the regulations.

In response to such conditions, an interface that would be a standard for system collaboration was developed so that information systems can used collaboratively more efficiently (Figure 2). The interface standardized through this study has been called the "standard interface."

The standard interface was established to be used commonly in the construction field. Figure 3 summarizes

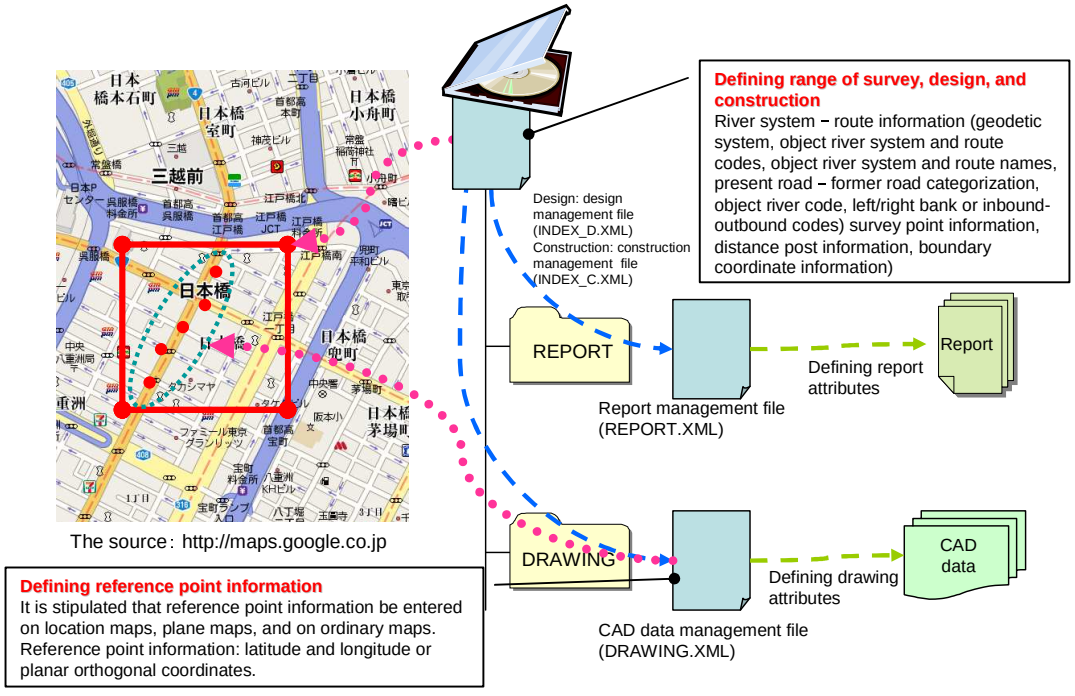


Fig.1 Image of Connecting Products with Location Information

the results of this study. The products of the study are the following three types of standard interfaces that can effectively achieve collaboration between information systems in the construction field.

・Geographical information interface:
provides geographical information to control functions such as the display of geographical information or attribute, etc.

・Meta data search interface:
provides information searches using meta data and displays the results of the searches

・Gazetteer interface:
provides a place name search function

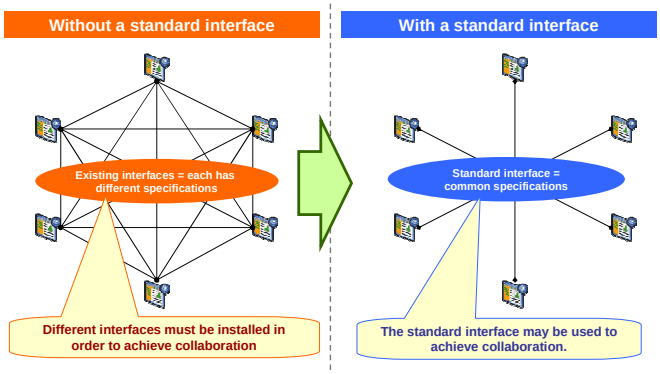


Fig.2 Effect of a Standard Interface

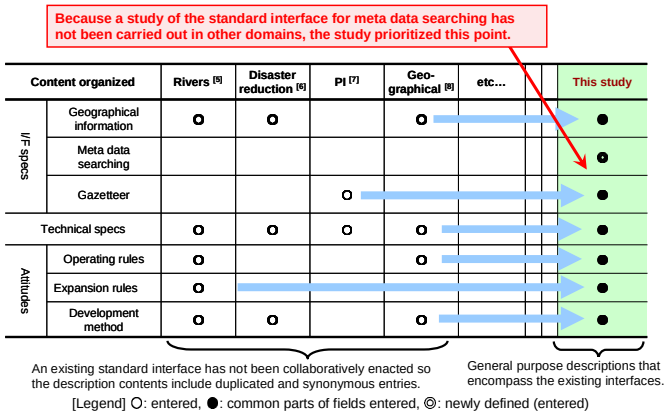


Fig.3 Positioning of the Standard Interface

An effective way to search for construction information is applying meta data construction information. Figure 4 shows the use of meta data searching. The results of the survey in case meta data is application failed to define a meta data search interface. So this study defined a meta data search interface based on standard specifications of the OGC (Open GIS Consortium, Inc.) [8].

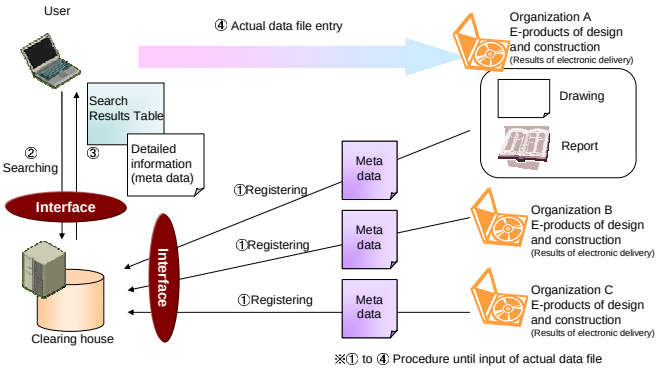


Fig.4 Image of Use of the Meta Data Search Interface

2.3. Study of the provision of a gazetteer

A gazetteer is a glossary that connects the “geographic identifiers” such as addresses and place names with “coordinates” such as latitude and longitude. In a word, it is a dictionary of location information. The conversion of location information is done by converting addresses to latitudes and longitudes and by converting postal codes to addresses (geocoding). This technology is realized with GIS (Geographic Information System). But, there is no standard location information conversion.

A standardized gazetteer is an important geographical spatial information infrastructure. If a gazetteer has been established, addresses and the names of facilities that people understand easily can be converted to coordinates that are easily read into computers. As a result, the usability of location information in a variety of applications is improved. Figure 5 shows an example of the use of a gazetteer that confirms locations of emergency support facilities by comparing them with the locations of damage during a disaster.

This study prepared the Gazetteer Preparation and Operation Guideline (Draft) that is a record of concepts of the preparation or operation of gazetteer, their data structure, and operation rules in the construction field [9].

2.4 Study of construction information collaboration portal

Generally, much construction information is linked to locations. And construction information is controlled for long periods. Names of locations change as time passes (changes of addresses when cities, towns, or villages merge for example). One way to resolve this problem is to put location reference information in part of the index. As a result, even differing systems can be used to perform integrated searches for the same location using

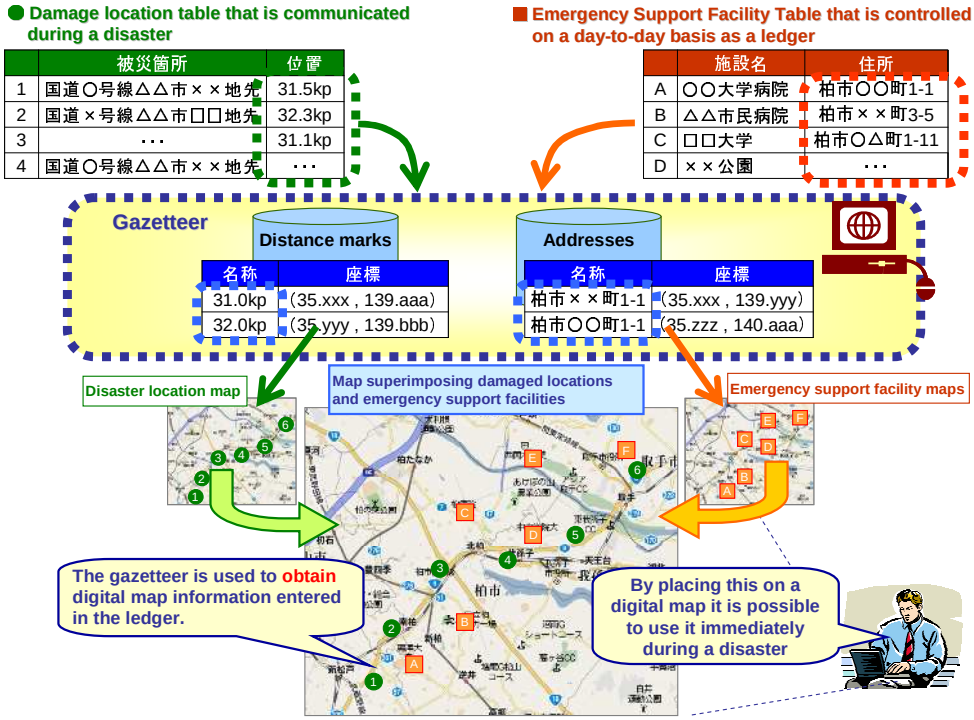
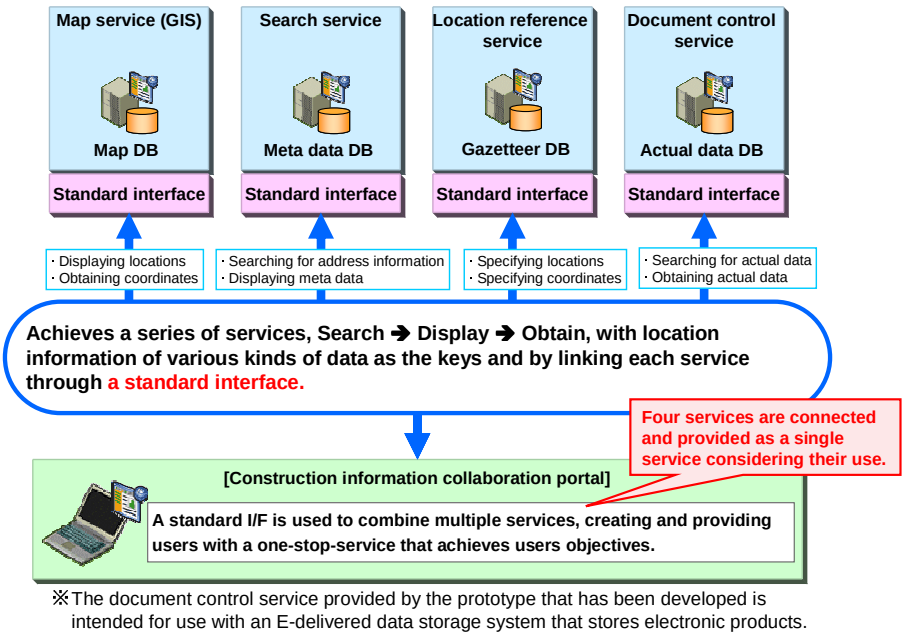


Fig.5 Example of the use of a Gazetteer



※The document control service provided by the prototype that has been developed is intended for use with an E-delivered data storage system that stores electronic products.

Fig.6 Outline of the Construction Information Collaboration Portal

multiple keywords.

This study included a study of collaborative use environments for construction information that is dispersion managed based on the results in sections “Connecting construction information with location information” to “Gazetteer”.

・Document control services based on the results of section “Connecting construction information with location information” (electronic products linked to location information)

・Standard interface and search service based on the result of section “Study of the standard interface”

・Services based on the gazetteer and digital map services such as GIS are connected based on the result of section “Gazetteer”.

Specifically, a prototype of a construction information

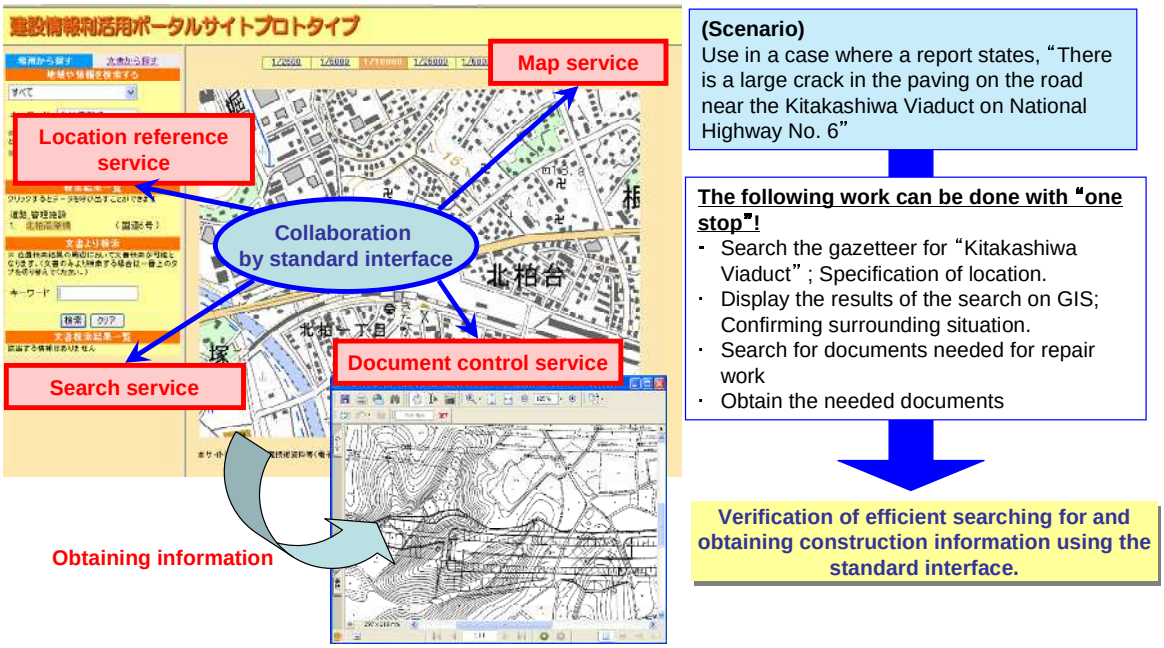


Fig.7 Image of Collaborative use of Information on through the Construction Information Collaboration Portal

collaboration portal intended to search for and obtain construction information was developed. Figure 6 shows the system configuration of the construction information collaboration portal that displays locations on an digital maps, searches for them based on meta data, specifies locations and coordinates based on a Gazetteer, and searches for and obtains actual data based on a document management service. It also links the systems through a standard interface. Figure 7 presents an image of the collaborative use of information based on the construction information collaboration portal. And its effectiveness was verified in line with the scenario shown in Figure 7. The results confirm more efficient procedures from the data search to obtaining data and the ability to effectively use the portal as a one-stop site.

Based on this result, this study has prepared the "Construction Information Collaboration Portal Standard Interface Guideline (Draft)" that contains the concept of the standard interface, function specification, mounting specifications, and operating rules.

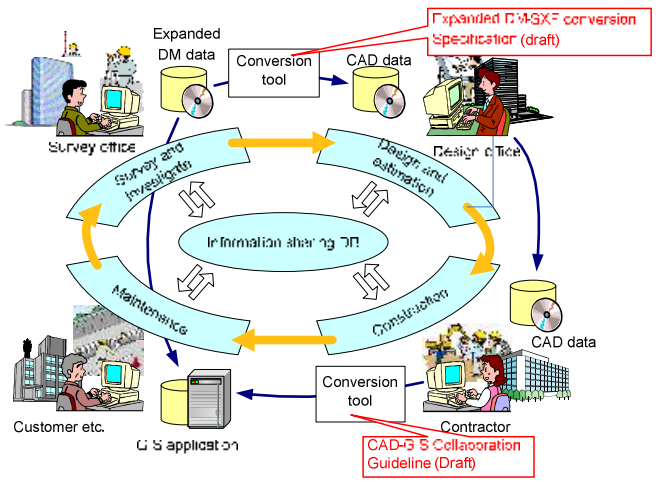


Fig.8 Life cycle of Construction Information

3. Initiative intended to achieve use of data throughout a life cycle

This was a study of the following data collaborative use method intended to achieve an environment for the use of data throughout the life cycle (as shown in Figure 8).

- DM-CAD data exchange focused on the survey and design phases
- CAD-GIS data exchange focused on the construction and maintenance phases

CAD data that is the theme of this study is SXF [10] that complies with ISO10303. The object of GIS data is the Japan Profile for Geographic Information Standards (JPGIS) [11] that complies with the ISO19100 series. As a result, the permanency of the data is assured. In this study, careful attention was paid to interchangeability of internationally recognized formats (IGES, IFC, IFG, for example).

3.1. Study of measures to support collaborative use of DM-CAD

DM-CAD data exchange, technical conversion specifications were studied. It is intended to convert expanded DM data (data format used for survey) into SXF (Scadec data eXchange Format) [10] data that is a CAD data exchange standard. And Expanded DM-SXF Conversion Specifications (Draft) were prepared [12].

3.2. Study of measures to support collaborative use of CAD-GIS

The data specifications of GIS data vary according to purpose of use. Therefore, it is difficult to prepare technical conversion specifications such as the expanded DM-SXF conversion specifications that were proposed. So this study used a "CAD-GIS Collaboration Guideline (Draft)" that shows standards and preparation procedures to advance collaborative use of CAD-GIS data [13].

4. Conclusions

This paper shows, "effectively using dispersion managed construction information" and "use of data through its life cycle" as examples of efforts to achieve more efficient business through collaborative use of construction information. The technical specifications and guidelines will be effective only when they are used widely. We want to promote the use of the standards and guidelines.

Acknowledgements:

The authors wish to express their deep gratitude to the members of the Construction Information Standardization Committee, Digital Map Sub Committee (Chairman: Prof. Ryosuke SHIBASAKI, Center for Spatial Information Science, University of Tokyo) for sharing their valuable opinions to support this study.

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