A Research Study On Lifecycle Infrastructure Management With Shared Product Model On Collaborative Information Systems

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ABSTRACT

In this study, enhancement of productivity and efficiency of construction work throughout design, construction and maintenance is discussed. JACIC and MLIT (Ministry of Land, Infrastructure, Transport and Tourism) have been introducing and promoting CIM (Construction Information Modeling) in the civil engineering field since 2012. Here, we focus on concurrent CIM model based on the information sharing/exchange system throughout the life cycle of structure and National fundamental infrastructure model to be used as common background information. To introduce activities of government on application of CIM/BIM concept in construction of public infrastructure, recently carried out model projects are also shown.

Finally, idea of collaborative CIM design information systems is shown as a framework to support CIM/BIM activity and possible role of JACIC in the context will be discussed. Furthermore, we show it about the development of the efficiency support system of the disaster-relief project that we cannot lack in and proof about the effectiveness of the topography model of CIM by the maintenance.

We carried out the survey to explore and evaluate Photog-CAD based on photogrammetry technology on survey site support for local governments which is one of the solutions. It will enhance efficiency of survey work and three-dimensional terrain model for CIM and drawing recovery plan. Some of possible future developments presently discussed are also shown. This results have lead us to propose a concrete approach to be implemented in the method of promoting CIM.

BACKGROUND

CALS/EC has been promoted for 17 years since 1996 by MLIT and JACIC. As the results of CALS, the computerization and networking use of construction production-related data, the use of ICT in the construction site were accomplished. However, the electronic delivery couldn't catch up with the changes of social conditions, and other systems were tied up in many strict standards, and each phase became independent, and we weren't able to use the information sharing/exchange system across the wall of an organization and the life cycle.

CIM was aimed at Integrated Project Delivery (IPD) and the Industry Foundation Classes (IFC) of BIM concept as innovative construction systems in 2011 by MLIT. Three policies were suggested as follows, in construction site, 1) we mobilize all the ICT such as three-dimensional model and carry out model construction, 2) we should circulate by data for the idea from maintenance, and 3) each engineer should reform consciousness, and use the ICT forward. Pilot implementation began as kickoff by JACIC seminar in April, 2012.

CIM technology study meeting at the JACIC are held and are active. JACIC would carry out active activities about technology development and experimental studies for using CIM, systems for practice. MLIT had 11 trials of the design projects in 2012, and seven projects are going to be tried in 2013.

In addition, recently, the number of climate-related disasters has greatly increased locally. On the contrary, the number of civil engineers to cope with such damage has decreased. Structure supporting efficiency and safety of requirements for a disaster recovery project plan is regarded as demand from the viewpoint of maintenance.

PURPOSE

A concept called CIIM is recently proposed as a policy correction for the maintenance to shift from individual maintenance to the overall optimization management newly. Therefore, CIIM is the concept that added civil infrastructure information management system and National infrastructure management system to CIM.

As the first step to realization of CIM, we need to be able to easily use three- dimensional model on survey site at maintenance phase.

The purpose of this paper is that we evaluate precision inspection of the specifications and the software of terrain model, and make a plan for the introducing CIM and CIIM into maintenance and disaster recovery project with shared product model on collaborative information knowledge systems.

METHODOLOGY OF STUDY

Method of Concurrently shared product model need conditions and resource, environment. This will be detailed in the following section.

1) Conditions

a. Utilization scene is clarified, it is a main premise to be the useful model.

b. Not a model to make in the short term, but in the long term is necessary.

2) Viewpoint

We must pay attention to QCDSE, PDQ, SCM/DCM, risk management and finance management of project management (PM) elements. In conformity with IPD, PM need a communication tool supporting knowledge management. In addition, it is important to cooperate keeping the relations and take load for a previous phase. Therefore, we would perform the risk management of the project appropriately.

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3) Work flow

a. BIM related information collection

b. IPD, understanding of BIM, inspection

c. IPD, quotation

We are divided into two of the next specifically in the long term. It is possible to prevent rework because actual operation contractor makes a construction plan with a designer from the early time. Based on these factors, we can shorten term of work and reduce cost and improve quality, and accomplish improvement of the productivity. Here is that CIM learns from BIM. However, BIM is only a tool of IPD.

ANALYSIS OF NEEDS AND EFFECTIVENESS OF UTILIZATION SCENE

We investigated element data and attribute item on specification of terrain model and its software to confirm validity of the precision of model. From these findings we found out that software with double precision of the input and output and calculation columns is enough. We show rearranging of the data precision on Table.1.

Table 1. Precision inspection of specifications and software of terrain model

Attribute item	Input value precision ※The number of the input figures		Output value precision ※The number of the output figures		Calculation precision ※The precision at the time of the calculation	
	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
Distance	3 columns	16 columns	3 columns	6 columns	4 columns	16 columns
Coordinate(x,y)						
Width						
Height						
Gradient	0.00001%, 1:0.00001		0.00001%, 1:0.00001		0.00001%, 1:0.00001	
Angle	0°0' 0"001		0°0' 0"001		0°0' 0"001	
Name	16 characters	127 characters	16 characters	127 characters	16 characters	127 characters
Terrain	5 columns		5 columns		10 columns	

Based on these results, we arranged the indication to road cross-section data and alignment data exchange standard, and explored item of specifications and guidelines, and arranged it as LOD (Level of detail). Depending on a use, it is necessary to raise data precision than LOD3. In addition, it is necessary to display precision quality about the LOD of three-dimensional data. As LOD for CIM and CIIM in lifecycle infrastructure model, Figure.1 is shown.

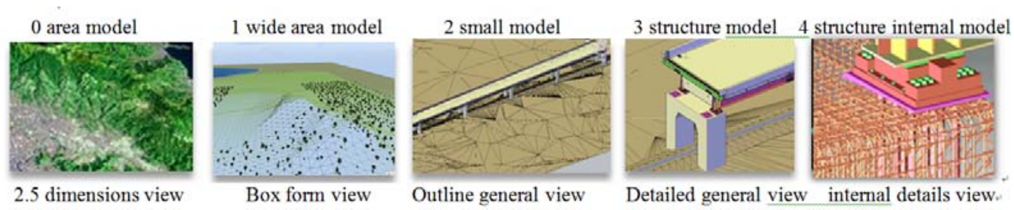

Figure 1. LOD image for CIM and CIIM

We could make three-dimensional terrain model from photogrammetric acquisition data easily at an investigation stage and being available with the first step to the CIM realization that made use of ICT by other three-dimensional CAD. The use of the terrain model in the field of not only the field of disaster but also other earthwork would be available easily by adding the file export function of the three-dimensional terrain model from Photog-CAD developed by

JACIC. The next Figure.2 is the image that photogrammetric surveying data are exchanged for CIM and CIIM, and are utilized.

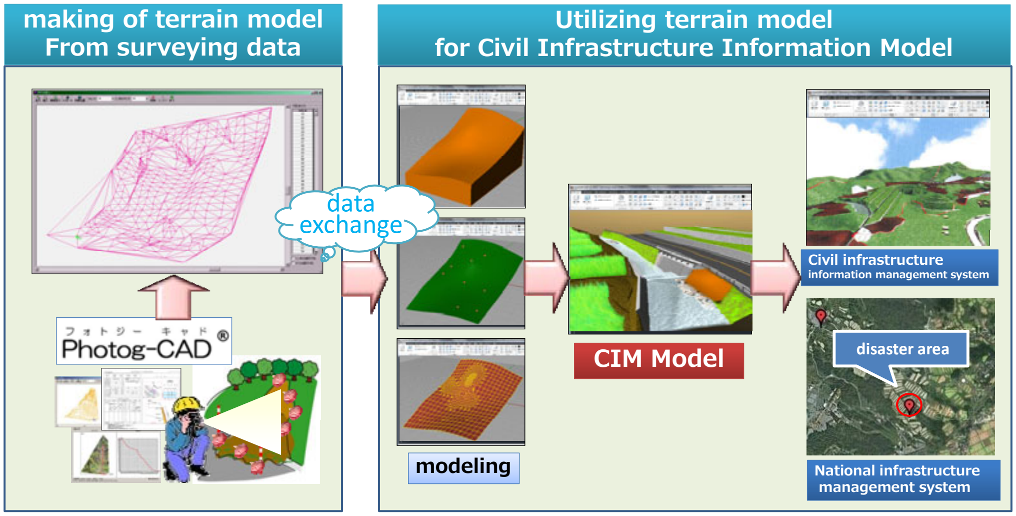

Figure 2. utilizing image in CIM and CIIM for photogrammetric surveying data

In the field of disaster restoration at the maintenance stage, we explored structure of VE using infrastructure model of CIM and CIIM. As analysis work space and disaster situation database, Figure.3 of next image is shown.

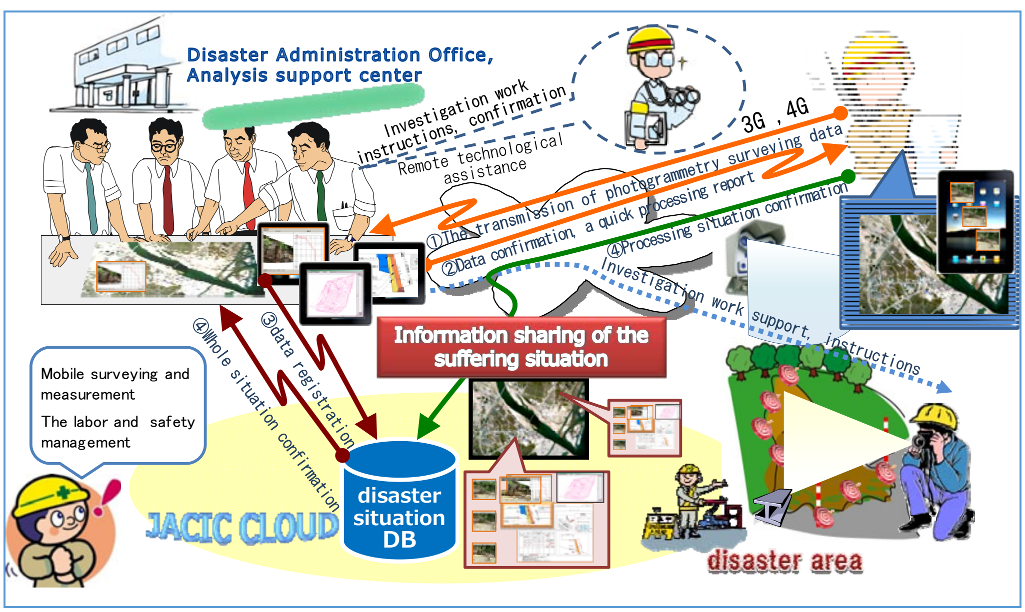

Figure 3. Analysis work space and disaster database in the VE environment

We send local surveying data to the support center on the Internet and process confirmation and analyze of the acquisition of photogrammetry data in the center by collaboration, and using cloud service and Photog-CAD, disaster restoration DB and notify field charge after having confirmed terrain model and register data with disaster situation database. We handle all of functions of the support center semi-automatically in the future in a server side and may become cloud service. Image of the efficiency support system of the disaster recovery project is shown on figure.4.

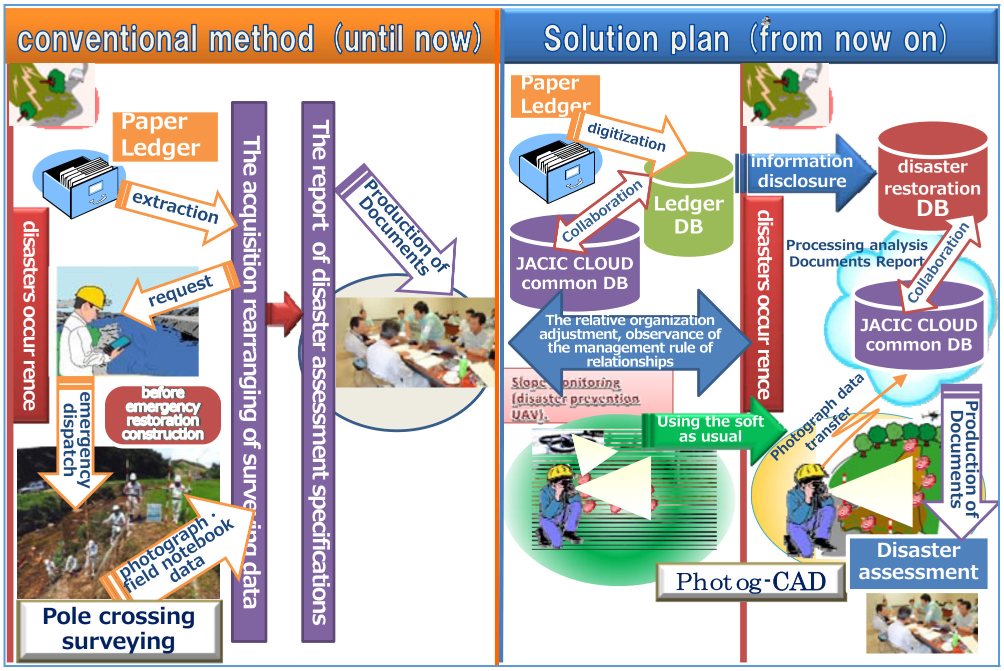

Figure 4. Image of the efficiency support system of the disaster recovery project

We used CIM-LINK based on collaborative information systems which we have ever developed in Kumamoto University and furtherance collaborative investigation as the tool for Collaborative Design which could handle CIM data based on Knowledge Management (KM). This "Information Sharing/Exchange System" is considered as a tool resolving the whole problem on the construction sector. With the agreement formation between stakeholders in future, we could create the environment that knowledge and the know-how that is sophisticated by compiling the infrastructure lifecycle information using CIM product model specifications on collaborative information systems.

CONCLUSION

We found out that this study could be applicable to Infrastructure Lifecycle Management based on Big Data by CIM database. The experimental trials on CIM was just started with the innovation of the construction production system, therefore, we would apply these results to study CIM trials.

As a problem left unfinished in this study, we could not make Big Data model on Infrastructure Lifecycle information model about both common resource and domain such as terrain model like Land XML. We should push forward the application to other constructs.

Toward the suggestion of neutral fair structure "JACIC Cloud" which we made use of JACIC' strength in, we get the cooperation of the person concerned and, based on the technical institutional inspection and sophistication of this service model idea, want to go ahead through this study.

FUTURE STUDY THEME

The next is the imaged plan of the JACIC managed Cloud Service Model included various services on the construction sector. We will collaborate in Web-API. As a mission of JACIC, Figure.5 of next image is shown.

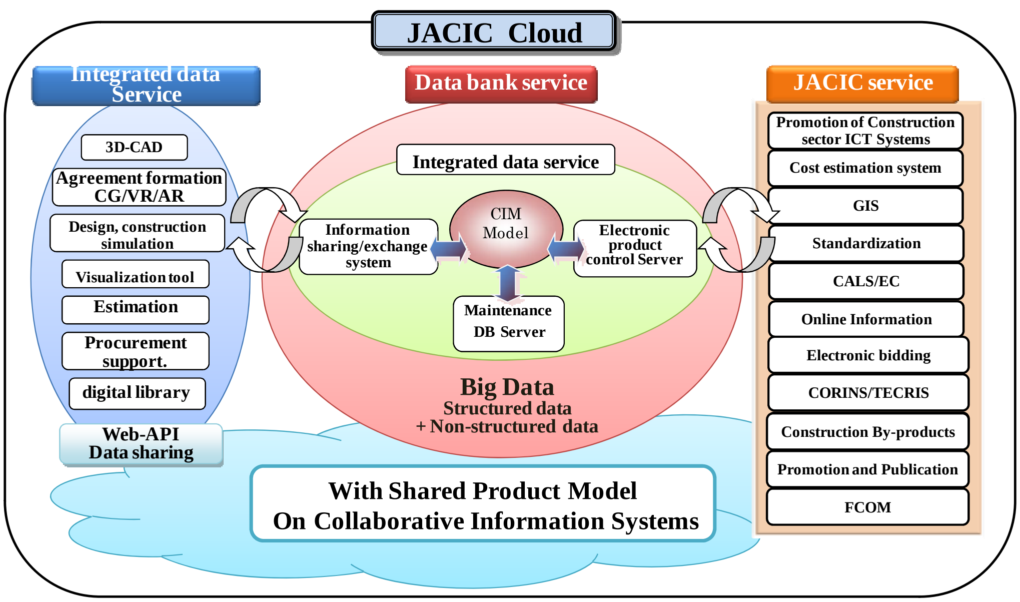

Figure 5. JACIC Cloud image on CIM integrated service

As experiment environment, we established "virtualized evaluation place". Surveying and monitoring of investigation on lifecycle infrastructure management is important. The measurement investigation could be conducted at all times to collect Big Data. Big Data can be accumulated into a database, and derivable and utilized.

And as Construction Information Service Model, we should use virtualization technology to raise IT utilization next-generation. We would create best practices to promote innovation in virtual enterprise environments on lifecycle infrastructure management, would suggest it.

ACKNOWLEDGEMENTS

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REFERENCES

buildingSMART (2013). IFC release specifications from buildingSMART website: http://www.buildingsmart-tech.org/specifications/ifc-overview

Katsunori Miyamoto (2012), A research study on the information sharing/exchange system during construction, International Conference on Computing in Civil and Building Engineering, Moscow, Russia, 236-237

Dr. Ikujiro Nonaka (2010) Professor, Hitotsubashi University, Japan) Developing Unified, Dynamic Knowledge Management Systems Presentation. In: UC (unified communication) Summit, Tokyo ,Japan

Integrated Project Delivery (2007) : A Guide version 1 ; AIA National | AIA California Council http://www.aia.org/contractdocs/AIAS077630

Candidate OpenGIS® (2006) CityGML Implementation Specification; Open Geospatial Consortium Inc. Reference number of this OGC® project document: OGC 07-062 Version: 0.4.0, 9-14