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A STUDY ON DEVELOPING DECISION SUPPORT MODULES OF iPMIS(INTELLIGENT PROGRAM MANAGEMEN INFORMATION SYSTEM) FROM ONTOLOGICAL PERSPECTIVE

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ABSTRACT: Most recent programs in and out of the country are related to urban renewal projects. Contemporary project management information systems have been developed was to manage single or multiple projects focusing on their construction phase, and those have limitations to apply to large-scale complicated mega projects. So, this study explain the core concept of decision support modules for iPMIS (Intelligent Program Management Information System) and its major functions to support project owner and participants by introducing ontology in the web environment. This study confined the scope of research to the planning phase of urban environment improvement projects. Ontological logic structure and relation about planning works is essential parts and three functions to implement decision support module are developed.

Keywords: Ontology, Decision Support Module, Urban Renewal, Information System, Mega Project, Program Management

1. INTRODUCTION

1.1 Research Background and Purpose

As various large-scale projects funded by the government proceeded with programs which are more than just projects have evolved. (Cho, 2008) Most recent programs in and out of the country are related to urban renewal programs. The trend of urban renewal projects is to include various types of facilities i.e. residential, commercial, public, cultural and recreational area arranged in vertical and horizontal space. (Lim, 2008)

However current project management technology to manage the mega projects is at its relatively initial stage. (Kang, 2008) Management system, so far, has been developed to manage single or multiple projects at their focusing on construction phase, and it is inappropriate to apply it to large-scale complicated mega projects. (Yeom, 2008)

The management system for mega projects in urban renewal should have different scope and functions those of PMIS for manage single facility. Especially, regarding atypical and constantly changing decision making process and information, the system in which users recognize the situation, find the necessary data easily, and trace the related altered information on their own is needed. (Kim, 2008)

This study proposes the core concept of decision support module of iPMIS (Intelligent Program Management Information System) and its major functions to support decision making of the project owner and other participants by introducing ontology that is implemented in the third generation of web environment.

1.2 Research Method and Scope

For developing IPMS, the deductive function, which conceptualizes the simultaneous unit works in the projection operation process, is requisite. In addition, it obtains and reuse the relation of each work at the lowest level, and deduces problems in preceding works. By doing this, it can play a role for supporting decision making by informing the project owner and participants on potential problems.

This study confined the scope of research to the planning phase of urban environment improvement project in Korea.

The research is conducted as follows:

First, literature on the owner's demands and decision making support system in the construction sector are reviewed;

Second, the definitions of urban renewal, IPMIS and ontology are given;

Third interviews to the individuals concerned about planning work process of 'Sewoon 4th Commercial Block' are analyzed;

Fourth, ontological logic structure and relations among planning unit works, the functions that would implement decision support module of IPMIS are presented.

2. PREVIOUS RESEARCH ON CLIENT

In each phase of a construction project, the main body who is in charge of final decision making is the owner, so an instrument to support the owner in the pre-project phase is required because there is no expert to help him. (Kim, 2006)

Due to the advanced IT technology, real-time interactive communications is common and technical environment based upon the Web is established to support owner side decision-making irrelevant time and space gap. (Lim, 2008)

The table 1 is about the research of related model and instruments to support owners who, in general, show the lack of experiences

Table 1. Review of Research on instruments to support the client

Researcher	Main Features
Goodacre et al. (1982)	Client aid program in answer-to-questions mechanism
Hudson et al. (1991)	The use of computer systems to improve communication between clients and construction professionals during the briefing process
Green (1996)	Value management based on soft systems approach
Jong-Kuk,Lee et al. (2004)	Prototype system of construction data warehouse
Ju-Hyung,Kim (2006)	An approach to facilitate knowledge streams of building industry clients
Seung-Heon,Han et al. (2007)	Model for evaluation the performance of owner's project management information system
Nam-Suk,cho et al., (2008)	A study of program management information system establishment in large multiple project

3. URBAN RENEWAL MEGA PROJECT

3.1 Urban Renewal Mega Project in Korea

Urban renewal project is aimed at improving the quality of life by renewing physical and environmental, life and cultural, industrial and economic aspects of the relatively underdeveloped existing urban areas due to changes in industry structure and urbanization centered on new cities and towns. (Kang et al, 2008)

Lee (2000) summarizes the evolution of urban renewal in Korea as: (1) state-led shanty clearance and relocation in the 1950s and 1960s; (2) citizen apartment building program in the 1970s; (3) public-private partnership in property-led urban renewal 1980s; and (4) community-led urban renewal in the 1990s. (Kim et al., 2009)

Massive commercial and business district construction projects have been undertaken as part of urban renewal.

These projects show the characteristics of mega projects. Three major urban renewal mega projects that have been undergone in 2008 are presented in Table 2. The Sewoon project is under construction and the other two are in the planning phase. (Kim et al., 2009)

Table 2. Examples of Urban Renewal Mega Projects in Korea(Kim et al., 2009)

Project Name	Area (m2)	Budget(USD)
Sewoon 4th Commercial block	132,000	1,900M
Yongsan Business District	566,610	28,000M
Haeundae Resort	49,830	1,500M

3.2 Characteristics of Urban Renewal Mega Project

Fig. 1 shows the main features of urban renewal mega projects. Various functions such as residential, commercial and public spaces are allocated vertically as well as horizontally. The complicated organization of the client side is also a considerable aspect.

Fig. 1. Characteristics of Urban Renewal Mega Project (Kim *et al.*, 2009)

There can be various similar types of projects in the urban renewal sectors. However the process of each project is unique and has its own features. In an aspect, there could be reusable patterns if the process can be analyzed at the lowest level in which activities are clarified.

Urban renewal includes various projects with various purposes to attain the single large goal of urban regeneration. The goal can be achieved by means of program management rather than project management.

3.3 Program Management in Mega Projects

Urban renewal mega projects consist of subprojects such as residential, commercial and public facilities construction projects. As sequences, stakeholders with various purposes are involved. For this reason, program management should be introduced for successful management. (Kim et al., 2009)

According to Kim et al., program management can be defined as "a concept to deal with huge and complex business activities from social, economical, cultural and environmental points of view and increase their value for client and society. (Yamada and Tanabe, 2005)" e- Builder (2008) categorizes it as follows: "(1) benefit management – activity and technology to maintain justice and maximize benefit or value by program; (2) stakeholder management – activity to manage the individual or team in the early stages which is influenced by the output of program and (3) program governance – process to develop policy, procedure and team structure relating to the program and o guarantee communication, action, and monitoring of those involved." (Kim et al., 2009)

4. The Scope and Features of iPMIS

The iPMIS means that "the system can facilitate the integrated data and information management environment and then support the participants in obtaining proper information in a timely fashion for decision-making through the life cycle of urban renewal mega projects focusing on the program as well as on single facility project management." (Kim et al., 2009)

Fig. 2 shows the scope of the iPMIS for urban renewal projects. Conventional PMIS aims to support the construction process of single facility or multiple facilities projects. The narrow use of the system is partly derived from the responsibility for implementing and operating the system rather than technical feasibility. Unless the client has in-house PMIS, the system may be purchased or implemented after a project manager (PM) is appointed. Considering diversity in terms of process and organization structure, the concept for information systems for urban renewal mega projects should be redefined. (Kim et al., 2009)

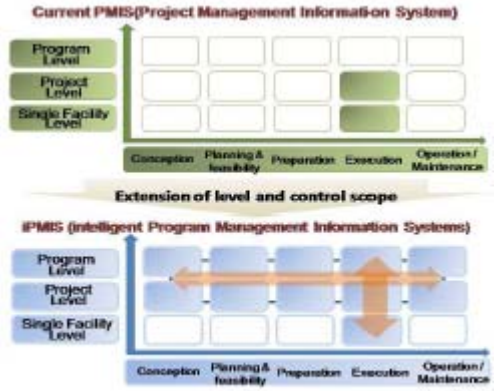

Fig. 2. Scope of the iPMIS (Kim *et al*., 2009)

The main functions of the iPMIS are to support decisions relevant to the soft aspects of program management. Open and consistent information management should be facilitated. In order to achieve this, the operation environment is designed as a web-portal platform in which participants and stakeholders can gave an overview of the plan, simulated results and project process respective of tie and location. (Kim et al., 2009)

Kim et al., clarified features and solutions for the iPMIS are summarized in Table 3.

Table 3. Major Features and Solutions for the iPMIS (Kim et al., 2009)

Features	Solutions
Soft aspects of program management	Open and consistent information management supported by simulation
Diverse process of urban renewal projects	Ontological process map Plug & Play
Abnormal modules according to project types	Plug & Play
Oversight management	Cooperated visualization of BIM data
Communication among diverse participants	Web-portal platform
Standard data exchange protocol	XML-base data exchange

5. THEORETICAL BACKGROUND OF ONTOLOGY

5.1 Definition of Ontology

The academia in the field of artificial intelligence has borrowed the term ontology from philosophy and has developed further. For our purpose, ontology for a knowledge-based system in is an explicit specification for the objects, concepts, and other entities that are presumed to exist in some area of interest, as well as the relationships that hold among them.(T.R. Gruber,1996) Ontology is understood as the specification of conceptualizations on objects and relationships. (Gruber, 1993)

Ontology has been introduced into the field of artificial intelligence, knowledge representation, inductive reasoning and a variety of problem solving techniques, as well as to support semantic web and systems integration. Aarti and Yimin (2007) define it as "a set of definitions of formal vocabulary, it has semantics independent of the reader and the context, which gives it an edge over other methods of specifying a conceptualization; thus making it an obvious choice for development as a possible standard in this thesis for implementing systems integration via the standardization approach." There are many ontology languages that are currently available. This study uses OWL(Web Ontology Language) to present the ontological framework. (Aarti and Yimin 2007)

If you know the meaning of data, and the information recourses are connected each other, you can get information you want with simple method. (1) By using it, you can share general understanding of information structure between individuals and agents. (2) It allows agents to collect and deduce information from other sites and reuse it in the application sector. (3)By processing, reusing and consolidating the existing ontology in other sector, you can build extended ontology. (Wi, 2004)

5.2 Ontology Development Process

The ontology development process is usually composed of several strategies in defining classes, its hierarchy, properties and naming considerations. This paper follows the principle of the simple Knowledge Engineering Methodology (KEM) (Noy, N. F. and McGuinness, D. L., 2001), including seven basic steps as follows:

- Step 1: Determine the domain and scope of the ontology;
- Step 2: Consider reusing existing ontology;
- Step 3: Enumerate important terms in the ontology;
- Step 4: Define the classes and the class hierarchy;
- Step 5: Define the slots or the properties of classes;
- Step 6: Define the facets of the slots; and
- Step 7: Create instances.

Fig. 3 Show the data framework of the iPMIS. iPMIS consists of three layers: national main portal for urban renewal; program definition and program management portal; and oversight management portal. (Kim et al., 2009) During creating the program management portal, classes, properties, facets and relationship of each unit work are defined. Regarding each unit work relationship, decision support module can be created the process menu of each version program. Users input the activities data and its version is saved with data value. The relations of these data are saved in the other database.

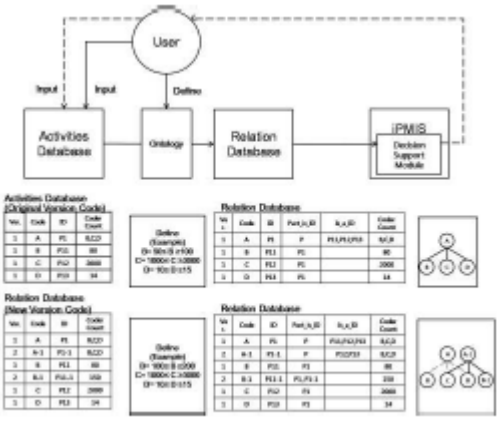

Fig. 3. Data Framework of the iPMIS

6. MODEL DEVELOPMENT

6.1 Domain and Scope

The first work in developing a model is to decide the scope of domain and ontology. We selected planning phase of domestic urban environmental improvement project as domain. Activities in the planning phase with regulations and codes for of urban renewal project are analyzed by means of

case study of 'Sewoon 4th Commercial Block' project. As a result of analysis of its multi-level process (i.e. activities are defined at the lowest level), 131 activities are clarified. We select 9 activities of master planning phase to develop and validate the model.

Upon deciding domain, the examination over whether there are ontology in similar domains, and, if exists, it can be reused is conducted. However, there is no pre-defined reusable ontology in the process of urban renewal project. For this reason, this process was eliminated in this study. 6.2 Enumerating Important Terms Here are important terms based upon planning phase in urban renewal. These are from exact analysis of data in domain. Table 4 shows these important terms. These terms are saved in database and utilized as reusable information in executing other projects.

Table 4. Activities Database

Level	Code	Creating Date	ID
2	Master planning	2009.03	P1
3	Basic research	2009.03	P11
	Making out a draft of master plan	2009.03	P12
	Displaying to the public and hearing of local council	2009.03	P13
	Dialogue with the related administrative bodies	2009.03	P14
	Deliberation of Local City-planning Council	2009.03	P15
	Admission/Modification of development planning	2009.03	P16
	Official notice by local government	2009.03	P17
	Report to the Minister of Land, Transport and Maritime Affairs	2009.03	P18

6.3 Define the Classes

Subclasses should be deduced from the above important terms, the classes of them should be defined. There are three ways of defining classes. First one is bottom-up method which defines classes by enumerating terms, and second is top-down method which deduces subclasses from upper classes, and hybrid method which combines the above two. We used top-down approach in which the following works cannot be done without completing preceding works in this sector.

The subclasses of urban renewal project are planning, operation and completion phase at the level 1 and subclass of planning is basic planning, designing zones etc. at the level 2.

6.4 Define the Properties of Classes

The stage is to define the properties of the designated classes. In this stage of the study, as many as properties of each class should be defined. By doing exact property definition, the classes have meaning as ontological data. Definition and classification of classes play the role for finding the location of data like a map, and the properties and property values do for identifying data like DNA.

Property definition means the unique features of each class, so each class can have the same properties, but cannot have the same property values. Each class has its own information to identify meaning.

6.5 Define the Facets of Properties

Definition of each class is not enough for completing ontology building. Ontology is aimed at sharing general information in the system. Therefore, limitation value of property value should be given. Designing limitation value of property value is called facets. Facets can be limited by designing one or two value, or by designing the scope of value. Particularly, construction project needed a number of legal and administrative processes in the planning phase. The limited value of ontology information can be defined in terms of legal and administrative works. For example, information about the related class's administrative work can be exactly distinguished with limited values of such as consent, authorization and reporting, and the possibility of operating the next works can be judged by designating legal limited values or range such as site, height and other administrative works.

7. DECISION SUPPORT MODULE

It is available for the user to check the prior activities with a notice sign on the screen of web-based iPMIS from the unit of finished activities located at the right side if the prior one is not conducted or is mismatched in the process.

This function can be realized by automatic inference of ontology. Through the composition ontology, the relation tree structure is formed

between each unit activities and then it is inferred automatically on the missed activities of the subordinate class.

In case, it is impossible to progress the present or following activities from the problem of the prior, it shows an error sign on the screen.

This is possible when the relationship of each unit activities is identified by the ontology. Regarding each unit activities relationship, it can be checked the prior activities which influences on the present ones through identifying single progress regardless of the result of the prior, and a causal relationship in which the present one is influenced by the prior one.

If detail of changed progress of an activity is input, the possibility of changes in the following ones can be checked. This is useful when changes in details such as budget, ratio of floor are to land, height etc. occur while progress is undergoing.

Fig. 4 shows the ontological aspects of iPMIS. Users can recognize the progress and flow of data at the level of activities. Any change of certain activity and its potential influence upon others are reported to the user.

Table 5. Database to Implement Ontological Functions

Level				Code	ID	Relation		Properties	Facets
						Part_of ID	Is_a ID		
2				Master planning	P1	P	P11,P12,P13,P14, P15,P16,P17,P18		
	3			Basic research	P12	P1	P121,P122	Cost Due date Purpose Block site planning	Code for master planning
	3			Making out a draft of master plan	P121	P12	P1211,P1212	Document Planning Report	Code for master planning
		4		Preliminary consultation with the related organizations on the public facilities	P1211	P121		Order Contract Paper	Order: Y/N Contract: Y/N Paper
			5	Survey, place an order for a service, and selection	P1212	P121		Order Contract Contact - Document	Order: Y/N Contract: Y/N Paper
			5	Analysis of planning enquiry	P1212	P121		Paper	Analysis result
		4		Arrangement of basic planning	P122	P12		Document	Report Presentation

Inside the iPMIS, property of data is managed while memorizing its flow. The flow is saved as a map at the lowest level of process i.e. activity. Given that the fundamental activities are repeated in other projects, the patterns are so.

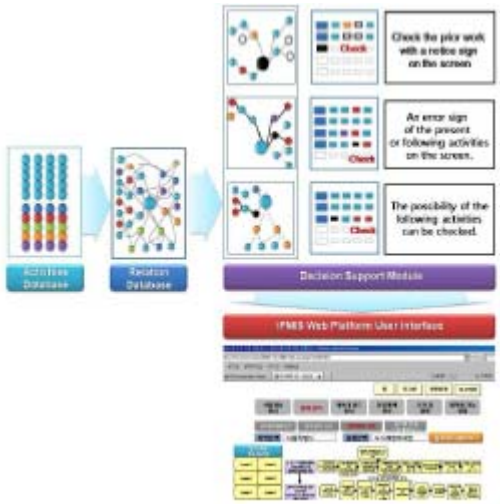

Fig. 4. Ontological Aspects of iPMIS

8. CONCLUSIONS

This study is about the decision support modules in the planning process of iPMIS that are developed by introducing ontological perspective.

The unit works on planning process of urban environment development are clarified in an ontological process model, and then it become basement of data flows of iPMIS.

Through reviewing literatures and cases on the-stateof- the-art project management system, functions to support decision making are clarified.

The users of iPMIS can obtain information timely without consuming time to trace the process as the ontology record the data flows. The knowledge to define the patter of flow can be merged into the user interface when the individual program management portal is developed.

The concept to implement ontology for iPMIS is in its initial phase. Further functions to support artificial prediction remain as a challenge.

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