

# CONSTRUCTION IETM(INTERACTIVE ELECTRONIC TECHNICAL MANUAL) FOR URBAN REGENERATION

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**ABSTRACT:** Urban Regeneration, a program of land redevelopment in areas of moderate to high density urban land use, has complex procedure and consists of large sub-projects. This make a difficulty in understanding the overall work procedure and acquiring various information which are required to perform work. Especially, information and professional knowledge which are related to performing a work are needed to succeeding in Urban Regeneration. However, layman, such as landholder, resident, and unions of Urban Regeneration, lacks the professional knowledge and information. Therefore, this research aims to introduce IETM (Interactive Electronic Technical Manual) which is used in manufacturing and maintenance industry for providing procedures and guidelines for performing work to solve the problem.

**Keywords:** Information Management, Construction IETM, Collectice Intelligence, Web 2.0

## 1. INTRODUCTION

As the domestic and overseas construction projects are becoming large and complex, it is difficult to understand the overall work procedure and provide various information which are required to work [1]. Accordingly, researches of Construction IETM are carried out to support the provision of construction projects procedure and information, such as to delivery and search of required information timely and to increase usability through standardization and visualization, through the introduction of IETM (Interactive Electronic Technical Manual), used to provide information on work procedure in the existing manufacturing and maintenance industry, Construction IETM systematizes a variety of construction information and then, provides the information to users timely.

Especially, urban regeneration is a typical example of large and complex construction project. Urban regeneration's life cycle is long and consists of complex procedure, such as planning, organizing an association, selecting a construction company, construction liquidation and professional information and knowledge is needed to

perform the project successfully. Therefore, manual about the process and guidelines of the projects is made and distributed annually. However, a practical use of Manual is law because the contents of manual consist of simple information related with laws and regulations and provision of knowledge, such as precedents, is lack. And as the project's procedure and related information change continuously depending on the business environment change, the manual is needed to manage the information change.

To overcome these difficulties at building and maintenance phase, this research proposes the Collective Intelligence-based Information Management Model and applies it to Construction IETM. "Collective Intelligence" is a shared or group intelligence that emerges from the collaboration and competition of many individuals. The Collective Intelligence-based Information Management Model expands the information management group from a system administrator into a whole user and is consist of processes that enable real-time information management with a repetitive collaborations and competitions of them.

## 2. RESEARCHES ON IETM (INTERACTIVE ELECTRONIC TECHNICAL MANUAL)

IETM (Interactive Electronic Technical Manual) is a technical manual in the form of an information system that digitizes paper documents, combines any electronic formats, such as text, image, sound, or video that can be accessed using a computer-based device, and provide the functions that interact with users [2].

IETM is classified five classes (Class I through Class V) based on the source data format of the IETM and its functionality. The structure of each class is illustrated in Fig. 1. This summarizes the key points of each class of IETM [3].

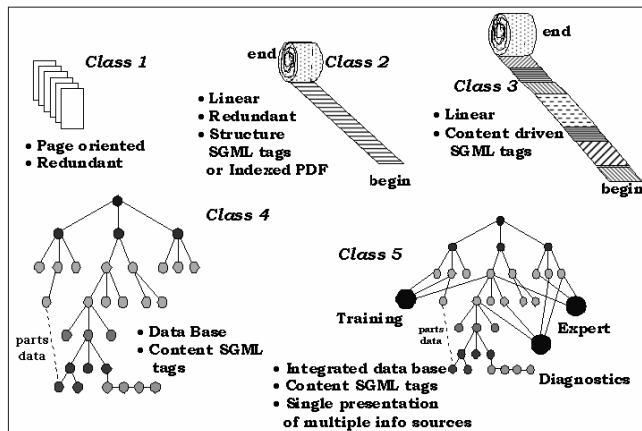


Fig. 1 Graphical Representation of IETM Classes

In case of existing IETMs in manufacturing and maintenance industry, it is easy to develop and maintain the system, as working procedure is clear and the possibility of information change is low. In construction industry, however, working procedure is complex and the possibilities of information and procedure change are relatively high depending on the difference of business environment (e.g., types of contract, construction methods, management types, related laws and regulations). Therefore, it is very important to manage the information change as well as development of Construction IETM. However, as construction IETM has been developed by a system administrator or a small number of experts, it takes a long time to modify and redistribute the construction IETM.

In addition, information and knowledge provided by construction IETM are collected by only an administrator or a small number of experts although the information and knowledge generated by project participants are distributed to the individuals tacitly because construction projects have a manpower-centric production structure [4]. Therefore it is difficult to collect the information and knowledge related to the project and modify the manual.

However, precedence researches have focused only on the information integration and the development of Construction IETM through the analysis of construction projects, and researches related with the maintenance of Construction IETM are minuscule and insufficient.

Although “Wiki-based IETM for Construction Project Management: Through a Case Study of Urban Regeneration Projects” [5] suggested wiki-based IETM for construction project management to support the information change and prevent Vandalism, it reviewed only the conceptual model of Wiki rather than theoretical considerations of Collective Intelligence.

## 3. COLLECTIVE INTELLIGENCE

Collective Intelligence, called Collective Consciousness or Collaborative Intelligence, is a conceptual term that is a shared or group intelligence that emerges from the collaboration and competition of many individuals and is beyond the individual's intellectual ability.

Collective Intelligence has appeared in various fields (e.g., sociology, science, politics, and economics) and includes animals and plants in the study as well as human. Typical example of Collective Intelligence is Internet-based Wikipedia. The development of Wikipedia shows characteristics of Collective Intelligence that everyone, without producers and beneficiaries, can produce and easily share knowledge and information while knowledge and information is not congested and continue to progress. Detailed views on Collective Intelligence are slightly different, but possibilities of creating a collective thinking ability, along with the development of information technology and voluntary participations by people, are commonly suggested, as shown in Fig. 2.

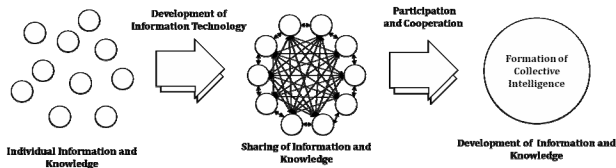


Fig. 2 Formation Flow of Collective Intelligence

Thomas W. Malone [6] suggested a framework to help provide the understanding of how collective intelligence system works. He gathered nearly 250 examples of Web enabled Collective Intelligence and identified a small set of building blocks called “genes”, as shown in Fig. 3 which are combined and recombined in various ways in different Collective Intelligence systems. This framework identified the underlying building blocks that are at the heart of collective intelligence systems and suggested the conditions for when Collective Intelligence genes are useful.

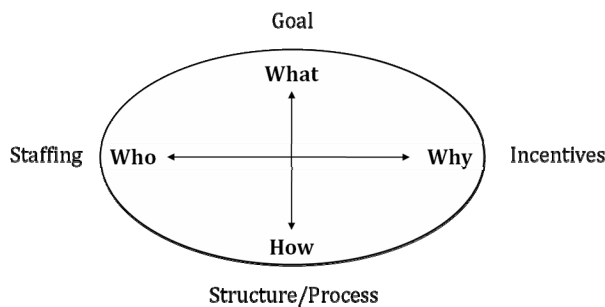


Fig. 3 Elements of Collective Intelligence “Genes”

#### 4. COLLECTIVE INTELLIGENCE-BASED INFORMATION MANAGEMENT MODEL

Urban regeneration involves a wide range of stakeholders with multiple and often conflicting objectives and have a complex relationships among them, so there is a possibility of loss due to the errors of modification by unverified public or intended errors of modification by stakeholders if information and knowledge are managed by Collective Intelligence. And in this case, it is difficult to clarify where the responsibility of loss lies and the possibility of legal disputes exists. Therefore, a reliability of Collective Intelligence-based Construction IETM on information and knowledge is more important than other Collective Intelligence systems.

To solve these problems, this research suggests the non-anonymous user group and organizes the expert group based on the career information to set a management process and role-based permissions for information management, as shown in Fig. 4.

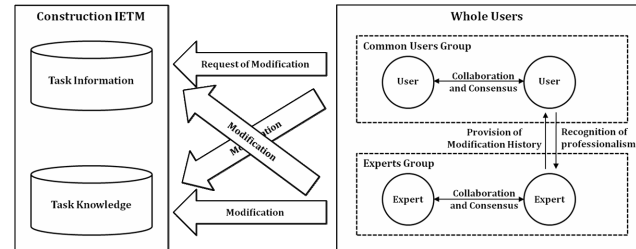


Fig. 4 Concept of Collective Intelligence-based Information Management Model

Existing information management model for construction IETM is managed by a system administrator or a system administrator or a small number of experts group. Fig. 5. shows the process of existing information management model.

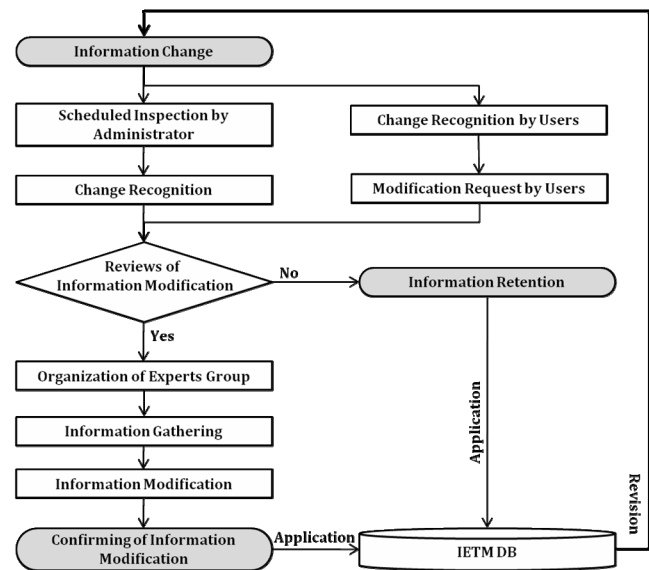


Fig. 5 Existing Information Management Process

In this “Top-down” information management process, the needs of modification are recognized by user’s request or scheduled inspection and a decision whether to modify information is considered by a system administrator. And then, a small number of experts group are organized to

collect and modified information and knowledge whenever construction IETM's information is need to be modified. Therefore, it takes a lot of time to recognize the needs of modification, review and decide whether to modify the information and organize the experts group. Also, considering the characteristics of construction information management (i.e., high working frequency and difficulty of information gathering), the number of people who collect and modified information and knowledge is too small to complete the information gathering and modification in time and this cause the problems of reliability decrease in Construction IETM.

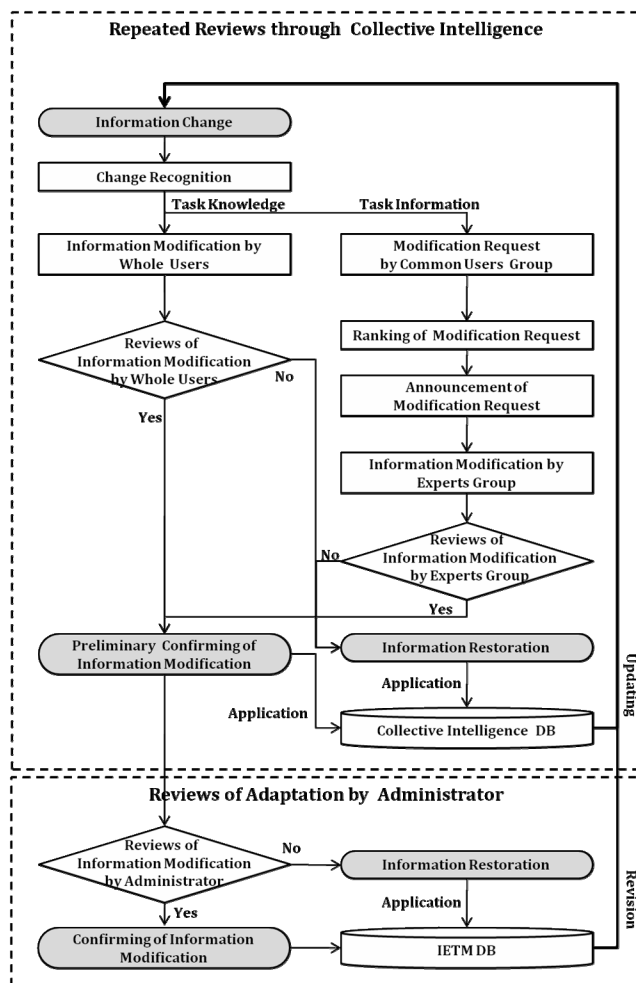


Fig. 6 Collective Intelligence-based Information Management Process

Therefore, this research suggests a Collective Intelligence-based Information Management Model, as shown in Fig. 6, for Construction IETM in order to support the information

change on the system. In this Collective Intelligence-based information management process, information provided by construction IETM is classified to “Task Information” and “Task Knowledge” and reviews in a different process as mentioned above. If information change occurs, information is reviewed repeatedly by whole users through Collective Intelligence and administrator just review whether confirm the information change and apply it to construction IETM or restore the information change to pre-existing information lastly.

## 5. DEVELOPMENT OF PROTOTYPE

To evaluate the suggested information management model for construction IETM, a prototype has been developed. The system provides “Task information” and “Task knowledge” information based on work procedure. Fig. 7 shows the conceptual model for Collective Intelligence-based construction IETM.

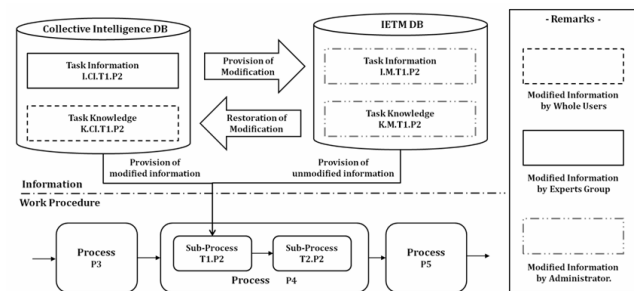


Fig.7 System Model for Collective Intelligence-based Construction IETM

The system was built using ASP.net, HTMS, and java script and has been provided through HP DL380 G6 Server. System's software was developed by “Microsoft Visual Studio 2008”, based on “.Net Framework 3.0”. Web server was developed based on “MS Window Server 2008”, and DBMS (Database Management System) was developed based on “MS SQL 2008 std”

Figure 8 shows the architecture of the system. System provides an administrator control and a user control on the Web. The administrator control consists of process management module and information management module. A process management module creates and modifies project's work procedure based on process and this result is

saved in process database. An information management module in administrator control creates and modifies existing construction IETM's information and this result is saved in IETM database. On the other hands, an information management module in user control creates and modifies Collective Intelligence-based construction IETM's information, and in addition, creates requests of information change. This result is saved in Collective Intelligence database. In short, Work process and existing IETM's information are managed by administrator through the administrator control and Collective Intelligence IETM's information is managed by whole users through the user control.

Collective Intelligence-based Construction IETM has Collective Intelligence DB and IETM DB. IETM DB reposit the unmodified information by public, and this information is managed by Administrator. On the other hands, Collective Intelligence DB reposit the modified information and this information is managed by Collective Intelligence-based Information Management Model. Users can be provided the unmodified information and the modified information simultaneously, so Users can get a variety of reliable information through reviews of modified information based on unmodified information.

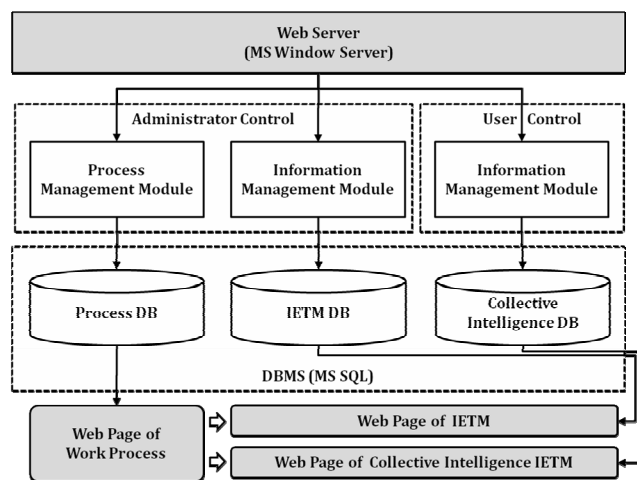


Fig.8 System Architecture

## 6. VERIFICATION

To verify the suggested information management model for construction IETM, a case study was implemented through an application in urban regeneration. As a case study, this

research applies Collective Intelligence-based IETM to urban regeneration to verify whether suggested model can solve the problems result from information change and lack of detailed contents about urban regeneration. Contents of urban regeneration manual quoted the research, Development of Optimization and Standardization of Process in Urban Regeneration Project [7].

A case study was verified through expert face-to-face interviews with pilot test, and 20 experts who have more than 10 years of experience participated in the interviews. Experts consisted of government organization officials (6), urban regeneration management company's hands-on workers (8), members of an association (2), and researchers (4). Expert interviews were conducted in the following:

1. Approximate description of Collective Intelligence.
2. Comparison between existing information management model and Collective Intelligence-based information management model for construction IETM.
3. Explanation of the system functionalities.
4. Pilot test.
5. Evaluation of the functionalities.

In expert interviews, 70% of experts expected that Sharing of information and knowledge is activated by a using of the system through users' participation and cooperation. In addition, 80% of experts expected that information was modified faster than existing modification method and various information and knowledge were gathered. This would validate the research's approach. However, some experts are concerned about "reliability" because of lack of participation. They commented that understanding of Collective Intelligence and publicizing of Collective Intelligence-based IETM would result in higher participation and this would result in higher reliability.

## 7. CONCLUSION

The Collective Intelligence-based Information Management Model expand a system administrator into a whole user as the information management group and consist of processes that enable real-time information management with a repetitive collaborations and

competitions of them. In Collective Intelligence-based information management process, information provided by construction IETM is classified to “Task Information” and “Task Knowledge” and reviews in a different process. If information change occurs, information is reviewed repeatedly by whole users through Collective Intelligence and administrator just review whether confirm the information change and apply it to construction IETM or restore it to pre-existing information lastly.

Based on the suggested methodology, a prototype of Collective Intelligence-based Construction IETM has been developed and case study in urban regeneration was implemented to evaluate the applicability and effectiveness of the methodologies. A case study was verified through expert face-to-face interviews with pilot test and the following results were derived compared to the existing management method.

- (1) The sharing of information and knowledge will be activated.
- (2) Modification of information and knowledge will be done quickly.
- (3) The gathering of information and knowledge will be done efficiently.

These results show that Collective Intelligence-based information management model is expected to cope with an information change promptly and support the information management.

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However, only the pilot test was conducted, and implementation by public is not conducted. Therefore the evaluation of system through the testing by common users is needed to verify and improve the detailed functionalities of construction IETM. Therefore an evaluation of system through the testing by common users is needed to verify and improve the detailed functionalities of construction IETM and a research to facilitate the participation of experts practically is needed to improve the reliability of the modified information.

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