

Improvement of Construction CALS System by Adding Environmental Management

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Abstract: The Ministry of Construction and Transportation in Republic of Korea launched Construction CALS(Continuous Acquisition & Life-cycle Support) for leading informationization of construction sector. As these systems have been applied to road and river projects from the Ministry of Construction and Transportation, 65 billion Won is saved a year. While Construction CALS system has many of functions such as schedule, cost and safety management, environment management has been neglected. This study aims to add the function of environment management to Construction CALS system. The results of this study are expected to contribute to make road construction and river construction more environmental friendly in Republic of Korea. As the result, the checklist and manual of nine assessment items in two parts for environment management are developed. The developed checklist and manual were implemented as a prototype, and then its applicability was analyzed by applying the prototype to Construction CALS Portal System in Construction CALS systems. The results of this study are expected to contribute to make road construction and river construction more environmental friendly in Republic of Korea.

Keywords: Construction CALS, Environment Management, Checklist, Manual, Korea

1. Introduction

The Ministry of Construction and Transportation in the Republic of Korea launched the Continuous Acquisition & Life-cycle Support (Construction CALS) to promote computerized information management in the construction sector. Construction CALS is a strategy for creating a network through which employers and construction companies can share and exchange information on different processes in construction projects. With the application of the system on road and river projects from the Ministry of Construction and Transportation, KRW65 billion is saved every year.

Even though the Construction CALS system has many supportive functions such as schedule, cost, and safety management, the need for environmental management has been neglected. This study aims to provide the additional function of environmental management to the Construction CALS system.

To achieve this, the study was carried out in the following stages:

- Analysis of the existing Construction CALS system;
- Development of an environment-friendly checklist for each stage of a construction project;
- Development of a categorized environmental management manual for a construction project;
- Detailed designing of the environmental management for a construction project by module; and
- Application of the environmental management function to the Construction CALS system.

2. Construction CALS System

The Construction CALS system consists of six infor-

mation systems such as CMS (the Construction Management System for construction companies & employers), KOROMBUS (the KOrea ROad Management BUSiness System), CCAS (the Construction Civil Affairs Administration System), LCS (the Land Compensation System), and the Construction CALS Portal System(Jung, 2007). Environmental management requires employers, designers, and construction companies to participate through the course of the planning, designing, construction, and maintenance and management stages. CMS for employers, KOROMBUS, and LCS are used only by employers, and only construction companies use the CMS for construction companies. Construction CALS Portal System is the system used by both employers and construction companies. It would therefore be more practical to add the environmental management function to this system. Construction CALS System doesn't come into play EIA process presently. However, it is essential that an environment management capability is added to Construction CALS Portal System by considering that EIA process and Construction CALS Portal System are related to planning and designing steps of construction projects.

The Construction CALS Portal System was developed to allow construction-related information to become more readily available to the public and to assist businesses in decision-making through the integrated management of the operation environment and the information generated from the CALS unit system. The addition of the environment management function to the Construction CALS Portal System can benefit all participants in a given project. Figure 1 shows the Construction CALS Portal System with the environmental management menu added. The third tab from the right in the upper right corner is the environmental management tab.

3. Checklist Development

The development of a checklist to refer to in every stage of a construction project is essential to the environmental

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management of a project. The checklist was developed based on a literary review of existing construction-related checklists from Korea and abroad (Jamily Andreu et al., 2005). Once the draft was created, comments and suggestions from construction related professionals, scholars, and experts were collected and incorporated (Yoon et al., 2006).



Figure 1. Website home page for the Construction CALS Portal System

The environmental management checklist was developed into three main goals for the format described as follows:

1. A format that can include small-scale development projects as well as environmental impact assessment subjects to allow application in all construction projects.
2. A format through which the user such as the employers and construction companies can easily access

important environmental management related information that lists review items for each project stage.

3. A format that can be converted into a manual type guidebook with outstanding relevance and compatibility with the system development.

The checklist is created for each stage of location decision, planning and designing, construction, and maintenance and management to allow for the application in all construction projects. Since there is such a wide range of types of construction projects and facilities, it is impossible to realistically create an environmental management checklist and manual that can be applied to all construction projects. For this reason, this study focuses exclusively on natural environment and living environment areas that are closely related to construction projects among those areas that are already widely used in preliminary environmental assessment and environmental impact assessment systems. By incorporating expert suggestions, 9 assessment items from 2 areas were selected for the checklist (Table 1).

Table 1. Environmental assessment areas and items for the environment management of a construction project

Area	Assessment Item
Natural Environment	Topography, geology, animal habitation, and vegetation (2 items)
Living Environment	Land use, air quality (inc. odor), water quality, soil quality, noise/ vibration, waste, leisure & scenery (inc. sunlight obstruction) (7 items)

Natural environment and living environment areas are

Table 2. Checklist on the topographical/ geological assessment items in the natural environment area

Category (Area)	Sub-Category (Assessment Item)	Micro-Category (Project Stage)	Detailed Classification (Review Item)
Natural Environment (A)	Topography / Geology (A-01)	Location Selection (A-0101)	Topographical and geological characteristics survey Topographical obstacle study Soil quality and characteristic study Ground condition and disaster-related condition survey Surface water and underground water condition study Study of topographical and geological characteristics in that need preservation Unique topographical and geological feature study Confirmation on the presence of environment-related preservation areas/ zones
		Planning & Designing (A-0102)	Prediction on topographical and geological changes Prediction on the ground condition change Change in soil quality and characteristics Possibility of the damage to topographical and geological characteristics in need of preservation Effect on unique topographical and geological feature Effect based on the earth-moving volume
		Construction (A-0103)	Fertile soil and sand processing plan Soil erosion prevention plan Slope stabilization plan Soil supply plan Flimsy ground processing plan Soil movement reduction plan
		Maintenance (A-0104)	Slope maintenance and management

included the three major areas of EIA in Korea. The other area is a social and economic environment, and in fact, this area isn't concerned much for EIA. By this reason, this study selected excluded the social and economic area.

Table 2 is an excerpt from the environmental management checklist consisting of 9 assessment items from 2 areas that specifically addresses the “topography and geology” under the “natural environment” area.

4. Development of the Manual

Environmental impact factors, related laws, and studies of past projects that are extremely relevant to the environmental management of a construction project, were analyzed in order to create a manual on 9 assessment items from natural environment and living environment areas (MND, 2004). The manual was given a general format and took into consideration various characteristics and different sizes of construction projects. The manual was finalized as demonstrated in Table 3 after verifying the feasibility of each assessment item through expert advice.

Table 3. Contents of the environmental management manual for a construction project

Classification	Detail
Code Categorization	-Code categorization to enhance the convenience of the checklist and system development and the system accessibility for users -Improvement of the management efficiency to facilitate the timely response to change in related laws and development of environment-related indices
Definitions	-Definition of specific terminologies that the general public finds difficult, in order to help the understanding of related materials
Related Laws	-Listing of laws, enforcement ordinances and regulations, notices, and guidelines related to checklist to reflect basic details to be observed in the execution of a project
Note	-Additional information related with the checklist to help the understanding of details
Tip	-Objective summary of additional information, expert advice, and application direction related to checklist to facilitate the user to accurately understand and observe environmental management instructions from the manual in every construction project stage

5. Detailed Designing by Module

An environmental management system for a construction project was formulated by using the following procedure:

Phase 1: Analysis of the system functions and information demand

Users need to be able to view, save, and print out the checklist and manual in order to have access to it as a

reference in managing a construction project and to learn about environment-related laws and regulations. Information about key environment-related issues, as well as those related to completed construction projects, will be frequently updated and managed on a real-time basis.

Phase 2: Development of an algorithm that can efficiently implement the system module functions

A JAVA-based web application development framework will be introduced, and the stored procedure technique will be used to coordinate the CBD technologies and databases, including Meta Table, Data Dictionary, AJAX, WEB2.0, and Component based on Spring Framework's MVC (Model, View, Controller) architecture. The framework-based database procedure will be used to improve the large-scale database processing speed.

Phase 3: Designing of the DB and GUI for algorithm-based system implementation

The database will be organized to facilitate an ease of data entry and editing as well as to ensure compatibility with the advanced search function. The GUI will be organized to facilitate the effective use of a grid in a framework and module alongside the database development of the checklist and manual reference outcomes.

6. Application to Construction CALS System

After logging into the Construction CALS Portal System, the user clicks on the “Environment-friendly Management” menu on the main screen. The Environmental Management System, as shown in Figure 2, will appear on the screen. The system is organized to allow users to enter the project information, create an environmental management checklist, and to search for an appropriate manual. Figure 2 shows the list of projects entered by users.

Figure 3 shows the screen through which businesses can create an environmental management checklist for a construction project entered into the System. The checklist can be made for each construction project stage (location selection, designing, construction, and maintenance/ management), environmental area (natural environment and living environment), or assessment item (topography/ geology, animal habitation and vegetation, land use, air quality, water quality, soil quality, noise/ vibration, waste, and leisure/ scenery). The items confirmed will be marked with a “checkmark,” and those left unmarked will be made the target of focused management. Users can refer to the manual on the relevant review item for details on the unmarked items.

Figure 4 shows the screen through which users can search for a manual on a given review item. The checklist and manual can be printed out for use on the construction site.

If any of the users use this system, considering the environment earlier in designing step, the system can respond to EIA and minimize environmental pollutions in building and maintaining step.



Figure 2. List of projects entered by users



Figure 3. Webpage for users to check factors that they need to manage more significantly



Figure 4. Webpage showing manuals of the factors that the users checked in figure 3

7. Conclusions

This study provided the environmental management function as an additional function to the Construction CALS System in order to help construction companies and employers with the environmental management of

construction projects.

As a result, the checklist and manual consisting of 9 assessment items in 2 areas for environment management were developed. Environment-related laws and past studies were analyzed to develop the checklist and manual. The 2 areas are the natural environment and the living environment, and the 9 assessment items are topographical/geological features, animal habitation/vegetation, land use, air quality, water quality, soil quality, noise/vibration, waste, and leisure/scenery. In addition, the checklist and manual were further categorized for each stage of a construction project, including location selection, planning and designing, construction, and maintenance and management. The developed checklist and manual were implemented as a prototype, and its applicability was then analyzed through the use of the prototype in the Construction CALS System.

Outcomes of this study are expected to contribute to the environment-friendly management of road and river construction projects in Korea. As Construction CALS System is supposed to consider the environment, which hasn't been reflected, the accountability and transparency of construction project will be improved. In addition, it is expected that this study will contribute for foreign experts on environment management to find environment management factors, which are recognized as significant factors in Korea. In order to be improved in the future, the system developed in this study needs to be introduced to the real-life environment for further analysis of its user convenience and applicability.

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