



Monitoring and Controlling the Construction Project by Project Management Information System (PMIS)

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Abstract

Information management and communication process is an important element in a construction project for the efficiency of human resource cooperation where a large number of human resources of different specialties interact and cooperate for performing the various project tasks. Enhancing communication among project participants, however, proves to be a challenging task due to the extended fragmentation of the construction industry and the huge amount and wide dissimilarity of the information that is involved in the construction process. The distance between the construction company headquarters and the (often remote) construction sites renders the communication even harder. As construction projects become larger and more complex, an efficient way to provide such information is through the use of information management systems. In order to surmount current information management and communication deficiencies, more emphasis should be given to information technology tools. The objectives of the paper are to develop a data base system for document management and controlling the project through web management. For this a construction project has been undertaken to investigate how the use of Internet based construction information management systems could be encouraged and facilitated.

Keywords:

Construction management information system; Project management system; Management information system; Web management for construction

1. INTRODUCTION

(PMIS) is a system for collecting, organizing, storing, processing and disseminating the collected information, The term “PMIS” can pertain to a manual or computer-based system, but most commonly it refers to the latter .with the growing important of computers in management and the proliferation of computer-based PMIS software and hardware system available, and appreciate the issues in selecting and implementing these systems.

1.1. FUNCTIONS OF THE PMIS

The purpose of a PMIS is to support project management decisions and to provide information necessary to conduct the project, the function of PMIS closely parallel those of project management in most projects, these are

- i. Planning and scheduling
- ii. Budgeting
- iii. Work authorization and control
- iv. Control of changes
- v. Communicating all of these functions

It is important to note that currently many computer –based PMIS software system are able to support only the first, and to a limited extent, the last functions on this list, this is because software that is able to perform the control function requires features beyond those for planning, these include the ability to

- i. Save an old version of the baseline database for comparison with current status and actual costs
- ii. Accept actual start and finish dates, and revise task durations without having them override the plan dates.



- iii. Accept actual costs incurred, for comparison to budget.
- iv. Track actual resource usage.

2. WEB BASED PROJECT MANAGEMENT

The construction industry is fragmented due to the many stakeholders and phases involved in a construction project. This fragmentation has led to well documented problems with communication and information processing and has contributed to the proliferation of adversarial relationships between the parties to a project. This fragmentation is also often seen as one of the major contributors to low productivity in construction. Information Technology (IT) is now routinely used in the construction industry as a tool to reduce some of the problems generated by fragmentation.

The use of IT improves coordination and collaboration between firms participating in a construction project, leading to better communication practices. Its benefits include an increase in the quality of documents and the speed of the work, better financial control and communications, and simpler and faster access to common data as well as a decrease in documentation errors. IT spending in Engineering/Construction (E/C) firms has increased significantly during the past few years, indicating that E/C firms are increasing their interests in IT applications to facilitate construction projects. Among all IT applications, the Internet is the technology that best facilitates a collaborative working environment in a construction project. Internet, and more specifically the World Wide Web (WWW), will be the key to a change in global construction business in the near future and will impact professions, collaboration, and the construction business structure. Its use as a communication medium can help information transfer occur faster and more effectively and enable new opportunities for the development of distributed systems that can cross organization boundaries and provide a unique opportunity for teamwork and workflow automation.

The Web can also overcome the incompatibilities of data formats through smart browsers and servers. Therefore, independent project

participants using different hardware platforms can share the same system over the Web the advantages of Web technologies in construction can be broadly categorized into three areas: the support of relevant information services, communication between project participants, and engineering and management computing.

3. LITERATURE REVIEW

A number of research efforts have dealt with the information management needs of the construction industry and the use of information and communication technology (ICT) for improving the efficiency of the construction process. Breu² discussed information management problems in construction and existing solutions, Chassiakos¹⁶ presented the key elements of the information management process in construction and discussed the use of computers for information management and communication.

Deng⁶ proposed the development of an internet-based system that comprises six major functions including data exchange, emailing information exchange, internet chat, live video-cam, search engine, and auxiliary services. Such efforts, however, have been mostly directed to data transfer applications and less to information modelling. Electronic document management systems (EDMs) have been developed to track and store electronic documents, providing storage, versioning, metadata, security, as well as indexing and retrieval capabilities. An early research effort on EDMs is presented by Bjork¹⁹ who provided the functional description of an integrated construction project document management system. The approach adopted concentrates on the management of documents in digital form and not on the management of the information within documents or databases.

The development of information management systems that combine database and web technologies is considered significantly beneficial for the communication process. A large number of literatures for computer based construction management consultancy (PMC) systems are available in the internet. For the purpose of this



survey, the literature search has been divided into several sections as outlined below:

- i. Project Management Framework
- ii. Web based project management
- iii. Project management software

3.1. PROJECT MANAGEMENT FRAMEWORK:

Amor, Betts¹ (2002) investigated the application of information technology (IT) in construction over the last 20 years. Data seems to indicate that there is little formal research in the Indian context in this field. They found that visualization and integration between processes and people is the most important area of current research.

Wetherill M, Rezgui Y¹⁴. (2002) studied about development of tools for knowledge management in construction in Europe. They felt that it has not yet been properly developed.

They identified several obstacles namely:

- i. Construction knowledge mainly resides in the minds of the individuals.
- ii. Construction is an intensively information processing industry due to the uniqueness of each building project.
- iii. Intent behind a decision is often not properly documented.

3.2. WEB BASED PROJECT MANAGEMENT

Wierzbicki & Uzdavinis¹⁵ (2002) felt that effective communication and comprehensive Documentation is the most important factors for a project. They have provided a list as presented in **Table 1** for effective project management

- iv. Data is saved in details but is not properly compiled and collated.

They have recommended development of a web based standardized knowledge management system for the construction industry.

Tang¹³ (2003) studied management systems for the construction industry in the United Kingdom. A questionnaire survey was conducted. The study suggested a guideline which focuses on training and staff participation to adopt integrated management systems.

Broomfield³ (2003) edited "ISO 9001-2000 Interpretive Guide for the Design and Construction Project Team". He opined that establishing a construction management system is a challenging task. Tables including examples have been published to set up an ISO quality construction management system.

Ma and Qin⁹ (2004) studied information management systems for construction projects in China. They analyzed major aspects and the evaluation criteria for the information management systems. This method can be used to design and evaluate an effective information management system for construction project.

jack cheng cp²⁹ (2003) developed the system SC Collaborator implements a service oriented portal framework and provides a secure, modular and flexible solution for managing construction supply chains. The system architecture of SC Collaborator. And Demonstrating project rescheduling Scenarios

DOCUMENT	DESCRIPTION
Shop drawing submittals for acceptance	In order to clarify details contractors are asked to submit shop drawing for approval
Request for information	Request for information (RFI) is a query to client/consult which should be responded to in time for timely execution
Clarification memos and notice	Clarifications are provided by owner/consult for various issues

Progress meetings agendas and minutes	Progress meetings at regular interval are essential for micro planning ,results of the meeting are summarized in minutes
Payment requisitions	Timely payment is required for progress .records of payment requisitions are required to monitor the payment aspect
Daily progress report	Daily reports are the records of what transpires at the project site each day, these could become key evidence in future
Change order requests and approval	Change to the contract scope occur on most projects ,all team members need to be kept informed of the status
Field orders	Field orders are instructions the owner /consults. Field orders are a basis of claims for extra time or amount
Punch lists	Punch lists is a set of observations which are to be attended for completion of a task or project

Table 1: List of important documents for operational control management

This case study paper comprises the Design of project management information system for chimney construction in Mangalore, India and also creating of web page design and their important concepts to evaluate the requirements for the information system.

4. SYSTEM ARCHITECTURE

The objective of the system architecture is to design a robust and effective tool which can carry out the ‘dms’ methodology with minimal effort from the designers. The system development involves the design of a relational database, a communication engine (which allows active integration of the input data, the ‘diMs’ processes and the output data) and an effective user interface. Apart from this a DSM backend engine has been used to carry out the DSM analysis such as Partitioning and Tearing. As the quantum of information and communication in construction design is large, it was decided to utilize web-based software architecture to perform the same. The ‘diMs’ engine is built using Object Oriented Programming (OOP) concepts. OOPs provide a clear modular structure for programs which makes it good for defining abstract data types. The system development is a two step procedure; system analysis and its design. This consists of three parts, an application layer, a database layer and a presentation layer. System architecture is shown in Figure 1

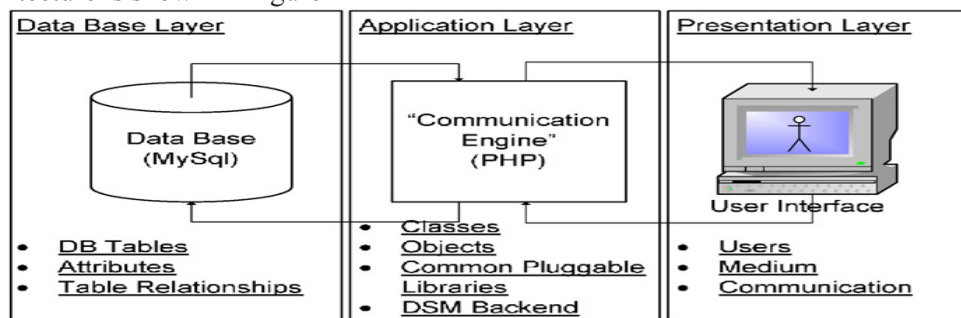


Figure 1: System Architecture

5. SYSTEM DEVELOPMENT

A survey was conducted prior to the system development within the Indian construction

industry with an appropriately designed questionnaire. According to the practitioners, an effective information management system should mainly include information about project planning, activity execution and project progress, manpower and equipment management and allocation, procurement and inventory management, and construction company information.

The development of the proposed system involved two types of analyses, project information analysis, which identifies the type of information that will be stored in the database and project organizational analysis, which determines the end users of the system along with their particular information needs and responsibilities. Organizational personnel employed and external strategic project participants were further identified. Typical company members include the project manager (ERP) head office, Project manager (site) outside participant's project owner and public

6. THE DATABASE

The database design involves loops of two main phases, entity modeling and normalization. Entity modeling is used for determining which tables (entity types), fields (attributes), and relationships will be needed in the database management system (DBMS). A table includes a set of records (entities) and is structured with a set of fields. Relationships are used to define any logic association between records in two tables. After defining the tables, a field list for each table is developed and a primary key is set for each table. Apart from simply extracting appropriate pieces of information, the queries allow data processing and manipulation providing composite output information. An indicative query regarding the project progress is shown in **Table 2,3**. Other queries provide information about the activity progress (percent complete, schedule variance, cost variance, etc.), the monthly equipment usage (working time, total cost, etc.), the inventory management, and others. Database sample documentation view can be showed in **Figure 3**.

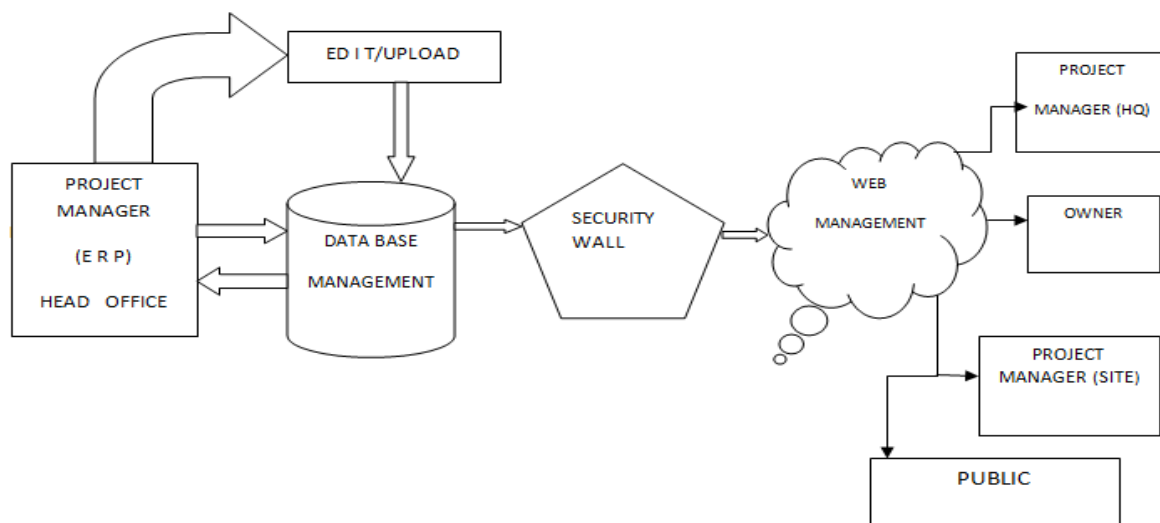


Figure 2: Flow chart of PMIS system

7. PMIS APPLICATION

The PMIS application development requires the design of a set of data-driven dynamic the search page facilitates a database search based on appropriate search parameters. Submitting the search information redirects the user to the results page where only records satisfying the search criteria are shown. In some

cases, the retrieved records are lengthy and viewing the results on this page can be inconvenient. By clicking on a particular record, the user is automatically redirected to the corresponding detail page of this record, which analytically presents the information that is related to this record (master-detail structure). The update page and the delete page are used to modify or remove an existing database record.

7.1 Design of Coating for the PMIS

PMIS Design work is carried out in PHP, HTML language with the additional software java also for the designing and set of web pages for each entity type of the database. The log-in page checks the authorization level of end users by matching the username and password with the corresponding information in the database. The authorization provides access to the database, and determines the actions that the user can perform on particular data parts. For each entity type of the database, two main pages are generally designed. The insert page allows the insertion of a new record in a database table.

Framework of the web pages PHP, HTML is used. Valid and the verification process is checked through the JavaScript. The view of the coading with the samples is showed in the Figure 4.

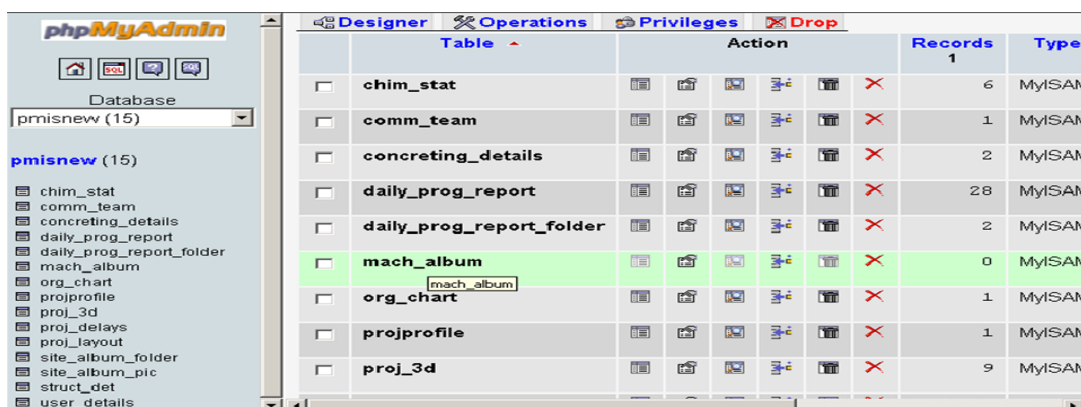


Figure 3: Database in MYSQL

Table 2: User layer access PMIS page view



	FIRST PAGE	SECOND PAGE	DOWNLOAD	UPLOAD
PUBLIC	YES	NO	NO	NO
OWNER	YES	YES	YES	NO
PROJECT MANAGER (site)	YES	YES	YES	NO
PROJECT MANAGER (HQ)	YES	YES	YES	YES

Table 3: User layer access Documents view in PMIS

DOCUMENTS	PUBLIC	OWNER	PM	PM(HQ)	DOWNLOAD				UPLOAD			
					P	OW	PM	PM	P	OW	PM	PM
							(S)	(HQ)			(S)	(HQ)
SCHEDULING	NO	NO	YES	YES	NO	NO	YES	YES	NO	NO	NO	YES
CHIMNEY STATUS	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
DAILY PROGRESS REPORT(DPR)	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
PROJECT LAYOUT	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	YES
SITE PHOTOS ALBUM	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
ORGANISATION CHART	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
TEAM FOR COMMUNICATION	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
STRUCTURAL DETAILS	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	YES
CONCRETING DETAILS	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	YES
MACHINERY ALBUM	NO	NO	YES	YES	YES	NO	YES	YES	NO	NO	NO	YES
PROJECT 3D VIEW	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
DELAYS	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
QUERY	NO	YES	YES	YES	YES	NO	NO	NO	NO	YES	YES	YES

CODING FOR THE PMIS IN PHP

```
<?php
```

```
include('info.php');
```



```

include('dbCon.php');

session_start();

if(!(isset($_SESSION['login_result']) || ($_SESSION['login_result'] == "failed")))

echo("<script type='text/javascript'>window.location = 'index.php';</script>");

?>

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">

<html>

<head>

<title>PMIS</title>

<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">

<link rel="stylesheet" type="text/css" href="Css/index.css" />

<script type="text/javascript">

function changeLogout() {

    var now = document.getElementById("logout").src;

    image1 = "logout.png";

    if (now.match(image1) != null)

        document.getElementById("logout").src = 'images/logout_over.png';

    else

        document.getElementById("logout").src = 'images/logout.png';

}

function clearLog()    {

    window.location = 'clearlog.php';

}

function goSett() {

    window.location = 'Setting.php';

}

function hideMenu()    {

    document.getElementById("ifr").style.display = "none";

}

function showMenu()    {

```




```

document.getElementById("ifr").style.display = "block";
}
</script>
<!-- Vertical menu-->
<link rel="stylesheet" type="text/css" href="vertical-menu/cssverticalmenu.css" />
<script type="text/javascript" src="vertical-m
<script type="text/javascript" src="vertical-menu/cssverticalmenu.js"></script>
</head>
<body><div align="center">
<table id="table1" border="0" cellpadding="0" cellspacing="0"
height="561" width="100%">
<tr><td height="10" bgcolor="#c9def5" style="border-width:
1px; border-bottom-style: solid;" bordercolor="#CC3300" background="images/bottomstrip.jpg"
></td></tr><tr<td bgcolor="#dfeb9" style="background-
repeat:no-repeat;" background="images/topImg.jpg" height="100"></td>

```

Figure 4: sample coding for PMIS

7.2 PMIS online website

PMIS can be designed and operate through the website, in this project we have carried out a server for running the project in local. The server using for local running is XAMPP and the database using is MYSQL. There are many server are available in market but this is the highly security and user friendly for the accessing and using the project. This PMIS is designed by the frame work for the chimney construction. All the segments are used and checked out finally proposed a suggestion to the management , This PMIS is highly security and quick decision making for the management to take required steps as soon as possible. Four types of Users are involved in this Chimney construction work.

PMIs is designed for the four

Users(owner, project manager(ERP),project manager(site),public .In this four users only three (owner, project manager(ERP),project manager (site), are having the separate login and password ID to sign into the PMIS website to view the documents, Public can view the first page of the PMIS only .This is the advanced method of controlling the project status day to day ,and also to reduce the problems between the project involvers. Live site video can also check through the PMIS, this video can view by the cctv camera that have placed in the site already, through the link of the website and camera current video status can be checked .Query is the another menu to ask the question to the management about project status are reports, answer can be replied through the mail, from management to the required persons

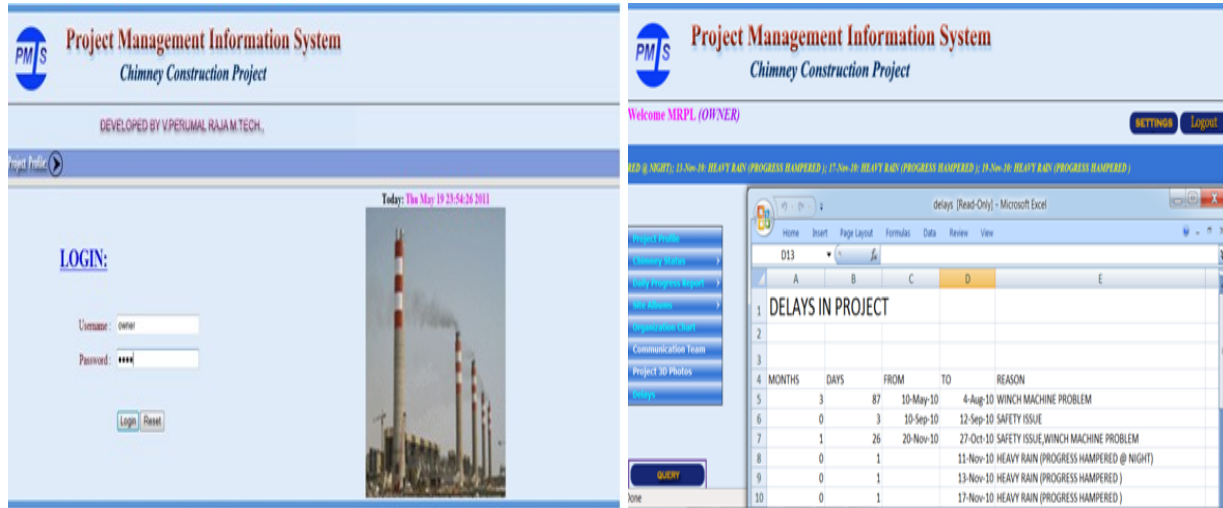


Figure 5: Owner login on PMIS window and view on the Delays report

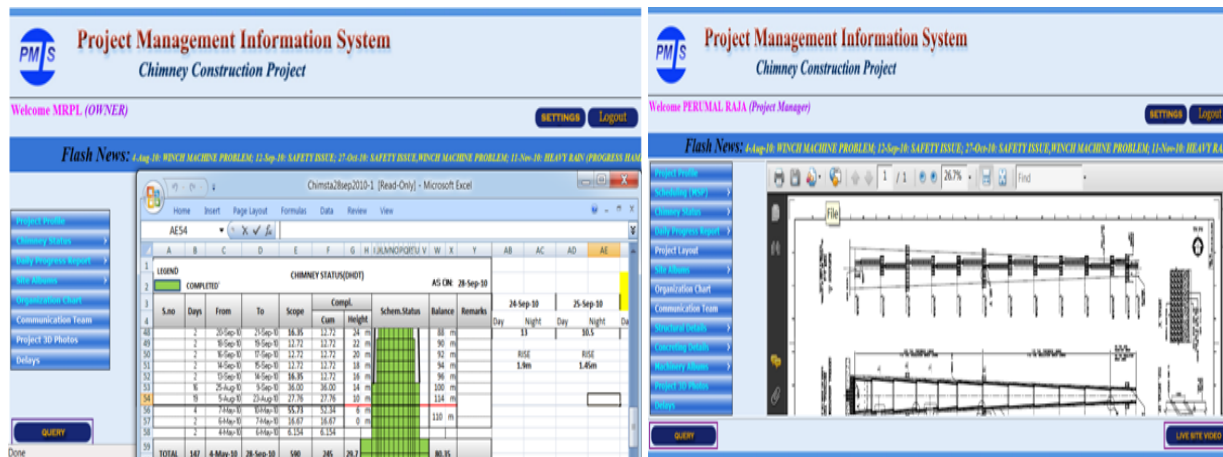


Figure 6: Project manager (HQ) view on Chimney status and structural details document



Figure 7: Project Manager (site) view on 3D site photos and View on Time progress scheduling report



CONCLUSION:

In order to surmount communication deficiency in Construction industries, an information management system has been proposed that combines database and internet technologies.. Further, this work has aimed to put emphasis on information modeling, i.e., representation of the construction process in data to facilitate exchange and interoperability of information.

The system consists of a relational database and a web application that allows the end users to remotely interact with the database. The database design has followed an analysis of the information necessary for project monitoring classified according to the needs of project participants. The database consists Of many tables and fields ,it contains information about projects, construction sites, activity progress, daily progress report , site album ,team for communication, manpower and equipment usage, material arrival and usage, headquarters orders, problems encountered, etc. The web application consists of a set of data-driven dynamic web pages through which the user can interact with the database and perform certain actions, such as inserting, searching, viewing, printing, updating, or deleting data. The access to the system is controlled with usernames and passwords. The system operability has been tested with a chimney construction case studies without encountering problems in the user-system interaction, data manipulation, and output provision. Although the application of such a system in practice would require further development as well as addressing a number of issues, such as the information standardization in the construction industry, it appears that such approaches can provide structured and reliable information to all project participants, quick and remote access, and prompt updating capabilities. This can lead to enhanced communication and less misunderstanding, allowing more time to be spent on decision making. Consequently, time and cost savings as well as higher construction quality can be achieved.

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