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The effects of project type, client profile and project value on briefing methods

Project type seemed to have some influence in the sample group. Respondents involved with residential development noted that their clients had less understanding of the construction process and therefore needed a more informal approach to briefing (i.e. informal meetings or early sketch designs to aid in visualising the client's ideas). The respondent working in church construction suggested the walk-through of previous buildings was useful to help clients visualise ideas.

Generally, respondents found their clients to be reasonably sophisticated meaning they would respond to briefing. Most respondents who had regular clients as their clients knew the methods of working and information required.

Most respondents practised in small to mid-range projects. The greater constraints on time and finance in these projects may have contributed to the reluctance to use more complex or sophisticated briefing processes.

CONCLUSION

As the introduction to this paper suggests, introducing innovation is ultimately the responsibility of those practising briefing. The sample surveyed indicates little innovation in briefing practices with most practitioners tending to use their own tried and tested method, based on the traditional practices of their discipline. Yet, according to Salisbury (1998), tried and tested methods can sometimes be used inappropriately. Some respondents indicated that briefing techniques are simply inherited from senior members of the organisation. There was no conscious validation process for their current briefing practices, other than "it's worked before so we'll use it again". There appeared to be no particular move to find more effective briefing methods, merely to adapt the existing to a shorter time frame. Yet, as Hudson (1999) suggests, simply refining existing approaches is unlikely to result in much improvement in practice.

From the survey it seems that practitioners need to be encouraged to re-evaluate their briefing practices to see if other methods may prove more effective or, at the very least, confirm that existing methods are the most appropriate.

REFERENCES


Hudson J 1999, 'Briefing and design: the role of creativity', in proceedings of RICS COBRA Conference, UK.


Lock D 2000, Project Management, (Seventh Edition), Gower Publishing Ltd.


RAIA 1986, Practice Note PN89: Briefing, Royal Australian Institute of Architects.


DEVELOPMENT OF A WEB-BASED INFORMATION SYSTEM FOR CASCADING UTILISATION OF CONSTRUCTION MATERIALS

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ABSTRACT

This paper presents a Web-based information system for promoting the cascading utilisation of construction materials in order to mitigate the increasing environmental pressure by the construction industry. First, this paper points out the weaknesses of current waste material exchange systems. Then, a new approach is introduced to reuse demolished materials, by which the utilisation of demolished materials may be ascertained before the demolition is actually produced. Information technologies, including web-based intelligent and distributed systems, are applied to actualise this approach. Finally, the development and implementation of the system is described in detail.

Keywords: waste-exchange, deconstruction, web-based technologies

INTRODUCTION

In recent years, the increasing pressure of environmental requirements, including the reduction of waste, has widely challenged various industries worldwide. Most industrialised countries, including Australia, have achieved high levels of consumption and correspondingly high levels of waste disposal. Australia has the second highest domestic waste production per capita among all member nations of the Organization for Economic Cooperation and Development as published in the web page of the New South Wales Environment Protection Authority (2003). Nearly one tonne of solid waste is sent to landfill per person each year as the total waste stream in Australia is about 14 million tonnes, of which somewhere between 16% and 40% is construction and demolition waste (Reddrop and Ryan 1997). This number was 33% in the Barwon region of Victoria (encompassing the city of Geelong) in 2002. The demolition of buildings produces enormous amounts of materials that in most countries result in significant waste streams. The construction industry, particularly in the demolition of constructed facilities, is the top contributor among all industry sectors to these levels of waste.

In most current demolition projects a great number of demolished materials are directly sent to landfill after their primary usage due to the difficulties to find their next usages immediately. On the other hand, because of the lack of supply of second-hand materials, new and high quality materials are used in construction projects whose design standards can be fitted by the secondary or used materials. The waste-exchange system is an increasingly widespread solution to this problem (Chen et al. 2003). However, because of the flow nature of the current waste-exchange systems and the demolition procedure, they are inefficient to achieve the goal of waste reduction. The recently created concept of deconstruction rather than destruction for demolishing a constructed facility fails to achieve widespread understanding or acceptance due to various practical limitations (Liu et al. 2003). This research aims to develop a web-based information system for envisaging the deconstruction implementations in practice and promoting cascading usages of construction materials in order to mitigate the increasing environmental pressure by the construction industry. In the following section the weaknesses of current waste material exchange systems are first pointed out. Then, a new approach is introduced to reuse demolished materials, by which the utilisation of demolished materials may be ascertained before the demolition is actually produced. Furthermore, information technologies, including web-based intelligent and distributed systems, are demonstrated to actualise this approach in the system development. The development and implementation of a prototype system are described in detail. The research conclusions are stated in the final section.

WEB-BASED WASTE-EXCHANGE SYSTEMS

State of the art in waste-exchange system development

Because potential users of a waste-exchange system are located in different places and manipulate the system through different computers that are installed with different operating platforms, it is ideal to build the system based on the World Wide Web (WWW). The user can access information despite different circumstances due to the high availability of web browsers. Approaches based on information technologies, in particular the Internet, are used for research and practice to promote such exchanges, and several management systems are developed for waste-exchange (Neuberg et al. 2002). For example, a resource exchange information system was developed for the regional exchange operators by Global Presence (2003). Because waste-exchange involves high flexibility and uncertainty, it is hard to merge online transactions into the system even though the technology is available.
A typical waste-exchange system is a database application built in web pages. Information about the reusable materials, including the amount, location, possible price and the contact detail of the owner, are saved into the database. The user can insert, retrieve and modify a record. Most importantly, the user searches the database using certain criteria and gets the result list along with the contact information of the owners of reusable materials. The transactions, including the inspection, sell or purchase and transportation, are carried out outside the system. The usability of a waste-exchange system can be judged by the information it holds and the actual exchange created under the information from the system.

There are certainly beneficial outputs of using waste-exchange systems. Waste materials are reused or recycled rather than sent to landfill. The total waste is reduced and it is good for the natural environment. Furthermore, by selling materials to others, the owner of demolished building gets the financial benefit. Similarly, the used materials buyer pays less for the project. Finally, waste-exchange and other environment-care building techniques mutually promote each other, such as deconstruction implementation and energy optimisation.

Disadvantages of existing systems

The outcomes of current waste-exchange systems are not satisfactory according to the amount of information available and the actual transaction generated. Generally, the system suffers drawbacks due to its natural procedure and information flow. The functions of the system are also insufficient to carry a comprehensive service to broad users. The reasons why the system does not work as it is supposed to are categorized into four disadvantages:

Disadvantage 1:

The most serious problem is the timing. There is a limited period between the demolition and the cleaning up of the site. The demolition site is very likely to be used to start another construction project. Also, there is a limited period between the procurement and the implementation of a new construction project that needs recycling material. If these two narrow periods do not coincide in an intersection, the transaction cannot be made. In the real situation, the information is put on the web page and it is only available for a very short period. It is hard to find a purchaser who can take the waste materials exactly in that period. Nevertheless, after this short period, waste materials are generally transported to landfill. However, in some systems, the information on the web page still indicates that the materials are available, which brings other users confusion of particular demolition materials and distrust of the system.

Disadvantage 2:

Apart from the timing, the flexibility is also a possible conflict in the implementation of waste-exchange systems. Wasted materials from the demolition might not meet the purchasers' requirements. They therefore need to be reworked, returned or disposed of. For example, a purchaser wants the timber to be cut to 3 metre long bars, and the material owner however has cut the timber into 1 metre bars. The producer does not know the potential reuse and exact requirements of the product before the demolition process, and thus hardly takes into account any specific consideration from the demanding side.

Disadvantage 3:

There is also a lot of information held by professionals that is rarely available to ordinary users. The owners of the demolition wastes are not professionals in the field as the owner is not the contractor who carries out the demolition project. It is hard for them to adequately describe wasted materials. Furthermore, users do not know the proper price for their merchandise because they are not experienced material sellers. One could not sell products while the price is unclear. The negotiation between sellers and purchasers is a possible option, however the suggested price should be provided.

Disadvantage 4:

The final reason, which might be the most common problem, is people have not been getting used to reused and recycled materials and products. People are thinking buying new products instead of using second-hand products is convenient and quick. Environmental factors are commonly put far behind economic factors. Although more and more people are concerned about environmental problems, the campaign for environmental protection is still in its early stages. Education plays an important role in the process that is changing the common attitude and mindset over environmental issues.

CONCEPTUAL MODELLING OF A PROPOSED SYSTEM

In order to overcome the drawbacks in conventional waste-exchange systems and improve their efficiency, a new waste-exchange system model needs to be provided. The approach of modelling the new system is to add
necessary services into the current system model and to make it more realistic and efficient. The new system is entitled 'Demolition Material Management System' and abbreviated as DMMS.

Identification of DMMS feasibility

By traversing through the information flow of current waste-exchange systems, it was found that lots of problems are caused by deficient communication between suppliers and purchasers of waste materials before the waste is actually created. Because the site of demolition activities is very likely to be cleaned up immediately due to the preparation of a new construction project, waste materials can only be kept in the site for a very short period. It is certainly hard for both the waste material producer and purchaser to find each other in a narrow time span. Also, the waste materials are unlikely to be reworked to satisfy the potential purchaser because there are no negotiations before the transaction and thus no requirements to be complied with. Instead of information exchange happening after waste materials are produced, information needs to be delivered before the waste is actually produced. As a result, negotiations are enabled between the material producer and the material purchaser for a rather long time period. This gives great flexibility and time to both parties. They therefore can change their own plans to suit the situation of each other, and produce detailed specifications for the demolition activities. With a longer time to prepare and plan elaborately, the demolition project, construction project and transportation can be adjusted to connect to each other tightly.

This model gives flexibility and convenience to the material producer and purchaser; however, there are also some potential obstacles with its implementation. The demolition material producer has to estimate the amount and classification of the waste produced before the project is undertaken. This imposes some difficulties to the material producers who do not have a construction engineering background. The proposed system will address this problem with the assistance of intelligent applications and other aided technologies. The material producer should only be asked to provide simple information regarding the project, including the dimension of the building and the materials used. The material producer then gets the estimated data of the demolished materials that the demolished project produces. Same as other waste-exchange systems, DMMS is also built on the Internet using the form of an interactive web page.

Identification of DMMS functionality

Different from most conventional waste management systems, DMMS deals with both construction and demolished waste, particularly the latter for the purpose of the promotion of deconstruction. Generally speaking, compared to demolition waste, construction waste is relatively easy to be reused or recycled due to the singleness of waste materials. Instead of the conventional second-hand construction material exchange, DMMS aims at the generation, exchange and disposal of demolition materials. The providers of demolition materials may seek the potential purchasers of second-hand materials and the construction projects before the implementation of demolition so that the purchasers may involve in demolition activities and the demolition may be oriented to the reuse or recycling of demolition materials. In addition, DMMS supports the information exchange of demolition projects and construction projects in the long term so that a demolition project may be scheduled with construction projects which need demolition materials and vice versa.

In the proposed system, the main participants take part in four categories of roles acting as demolition project providers, demolition materials purchasers, general web visitors and system managers. Their main roles are defined as follows:

• Demolition project providers:
  a. To provide demolition project and call for partners.
  b. To seek demolished material purchasers.

• Demolition materials purchasers:
  a. To provide demolition materials' destination.
  b. To seek demolition structures and join demolition activity.

• General web visitors:
  a. To navigate education modules.
  b. To discuss using bulletin boards.
  c. To browse system information.

• System managers:
  a. To develop and update the system.
  b. To communicate with members and visitors.
For the purpose of information accuracy, membership is required before providing demolition or demand information. Besides the systems managers, general web visitors may participate in DMMS positively such as navigating the education module, discussion using bulletin boards, or browsing system information. The current URL for demonstration of DMMS is: http://www.deakin.edu.au/~skp/dmms/.

LOGICAL MODELLING OF THE PROPOSED SYSTEM

System structure

After the identification of the major changes to the current systems, a logical design of the whole system is provided. Similar to most web-based database applications, the system uses three-tier client-server architecture (Goscliniski and Zhou 1999). As shown in Figure 1, the database server manages the databases that describe the projects, materials and user profiles. The web server acts as both a client and server. The server side script program is a part of web server, and is given the privileges of retrieval, modification, insertion and deletion of database by the system program. It is also given the privileges to run applications located on the server if necessary. On the other hand, it generates and sends back HTML (HyperText Markup Language) codes for the client side according to the result from the database or other applications. The web server acts as a client when it requests a service from the database server, which is to access the data. On the other hand, it acts as a server when it sends back a web page to a client side.

Figure 1: System structure

The client side program runs inside the web browser, which is the most available tool to access the Internet (Kurose and Ross 2001). Its application entities include HTML, Java Script and Java Applet. HTML gives the appearance and formation of the web page, while Java Script helps in formatting the Web page and validating the data inputted by the user. These two elements communicate to the server using get and post methods from the HTTP protocol. They form the main application parts of the database access, including the demolition project provider inserting a project into the database, the material purchaser inserting a material demand into the database, and all users retrieving the project information from the database.

While the HTML form is insufficient to describe the object to be submitted to a web server, Java Applet performs an important role. It provides genuine graphical user interfaces to users contrasting the raw HTML forms. Java Applet is also dynamic in one single web page without the needs to refresh the page. More importantly, the support of standard protocol allows Java Applet to retrieve information from the server side script program and transmit information user inputs at the client side back to the server side script program (Möller and Schwartzbach 2002). This feature is very useful while the system needs users to draw a simple sketch of their buildings to be demolished. The characteristics of a drawing are sent to the server, and the whole drawing is saved in the server as an image file. This customer drawing approach will help the users to gain the knowledge of the building that is retrieved from the database under the search.
Database design of DMMS

A database is the core of most information systems. It provides a convenient and transparent way to access raw data. As shown in Figure 2, the data in DMMS are mainly divided into four tables. The user table is used to store the authentication information for users. As users are registered with their contact information, the contact information is also stored in this table. One user can hold multiple projects, and the table of a project is used to hold the information of its type, its available time span and its location. A project table also holds the data related to the project, such as the dimension of the building and its structural factors. A demolition project provides multiple kinds of materials, and a material can appear in multiple projects. As a result, a new table called product is generated, which keeps references to both the project table and the material table, and the amount of the materials in a particular project.

In the practical implementation of the system, the database design grows to a more complex issue. A project has many child tables because different data are held to represent different types of projects, while they are still sharing some attributes such as the location and available date. Other tables might also be created. The system will allow users to upload multiple photos to help to describe the project, thus the photo table is needed to store the information of the filename and directory of the image file related to a particular project. Among these tables, material tables are predefined and maintained by the system administrator according to the market information. Information in other tables, such as projects and products, are generated during the practical use of the system.

Figure 2: Database entity-relationship diagram in DMMS

Data flow in DMMS

There are several data flow processes. A database table that is to describe the features of all kinds of materials is predefined in the database server and accessible only to the system administrator. Other tables are accumulated from the operation of the system. Because the conventional web page form submission can only transfer simple text-based information or an existing file to the server (Strahl 2002), a web-based drawing tool is developed to allow users to draw graphics and submit them to the server (Pun et al. 2003). The information is acquired, and the drawn graphics are saved in the server that can be viewed by other people in the future.
Figure 3 shows the data flows implemented in DMMS. The information retrieved from the graphics can be the dimension of the building to be demolished and its structural features. After obtaining all physical dimension characteristics and descriptive engineering characteristics, all data are put into an intelligent calculation system. The parameters used in this intelligent system might be gained from past experience and scientific calculation. This system then outputs the volumes and types of all demolished materials. Volumes are then transferred into weights according to the physical features of the particular material. Unit values, including the unit price for a new material and suggested unit prices for second-hand materials, are used to produce the value of the materials, both categorized and summarized. Information about the values is shown on the web page. This enables a user to make a selling and purchase decision based on value. Information about products, which is the amount of particular materials produced in a project, is saved in the database to support the search and list activities.

Figure 3: Data flow diagram
SYSTEM IMPLEMENTATION AND DISCUSSIONS

System development environment

Due to the limitation of resources, the selection of tools, systems and programming languages is tightly related to the circumstances. HyperText Preprocessor (PHP), which is a mature programming language for the server side, is chosen for the development of the server component of the system. The database is stored in an Oracle database server. The Java Applet is developed in Java Developer Kit (JDK) 1.4.

Layout and functions of DMMS

The web page is divided into three frames. Upper frame does not carry any actually function. It gives the title banner to the page. The left side frame is the main menu area. The content regarding the particular menu items appears in the right side frame.

The first and default menu item is a notice board. It gives up-to-date information about the change of the web page to the users. The member area is the core of the system and links to the main sources of the database. If a user has not logged into the system, the login screen will be shown to authenticated member by their username and password. A user also has the choice to register as a member, requiring contact information. After logging into the system, submenu items are shown. Options are available to allow a member to change their personal contact information and password.

Adding a project provides a wizard style procedure to members, and allows them to add a project into the database step by step. The data needed for the process includes the type of the project, the location of the project, the earliest available start date and the latest date, the photos that help to describe the project, the dimensional features and structural features of the project, and an user custom drawing tool, which allows a user to draw lines and shapes to further describe the project. Figure 4 shows the interfaces when a user provides information of a demolition or construction project into DMMS.

Figure 4: Interface of demolition project information acquisition

Once all necessary data are collected, the potential materials produced or needed are categorized and quantified. These numbers are possible to be modified by the user, considering a user may gain more precise data through other mechanisms. The data are then stored into the database. A user is able to remove projects from his or her list when the exchange is completed or the materials are no longer available. A user can also modify the quantity for a particular item or items from the list.
The search function is also an important part of the system. Users can search the catalogue using single or combined criteria including the demolition date, the project location, the type and amount of materials. There are also predefined categories for quick access. While viewing listed search results, only a member who has logged into the system can see the contact information regarding every project. The Useful Information section gives a user, a member or a non-member lessons on environment-friendly construction and demolition activities. Help is also available, which shows a user how to use the web page and possible questions and answers. Finally, a bulletin board is constructed to allow users to discuss issues on material reuses and recycling. It also provides a channel for the system manager to answer questions from users.

CONCLUSIONS

Current waste-exchange systems are impractical and inefficient due to the information flow in their designs. A new system structure and design for exchanging wasted materials are proposed in DMMS. Different from the current systems, DMMS allows a user to provide information before the waste materials are actually produced. The research identifies the components of such a new information system, its potential defects and possible solutions for them. A prototype of the system is provided and implemented. Technologies applied in the system such as multimedia information acquisition and intelligent system are also verified.

Although waste reduction in the construction industry involves lots of human factors such as attitude and knowledge, a user-friendly, realistic and efficient waste information exchange system can well support and educate environmental care in our industry.

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REFERENCES


ABSTRACT
A broad literature review reveals a large amount of research has been conducted in the area of Management Information Systems (MIS) in the construction industry. However, most of the existing softwares of MIS are data/document storage systems connected to a database, and they represent low-level computer-based systems for data storage and retrieval processes. High-level software with ability to analyse data and share knowledge are rare in the building industry. This paper examines possible next generation software for project management in building and construction, which focuses on the implementation and sharing of expert knowledge. The logic design of the prototype of a knowledge-based management information system for building construction is presented.

Keywords: information system, construction management, project management, knowledge-base

LITERATURE REVIEW OF MIS IN BUILDING INDUSTRY
Due to the advancement of IT technology and business globalization, more and more management software systems emerged in the last decade for the building industry. These software systems serve a wide range of areas within the construction industry.

Early in 1980s, Rasdorf and Herbert (1988) presented an information management system which helps to keep track of information flow on a construction job site. Shortly after that, Lee (1991) discussed a five-step process for implementing a computer scheduling system. The system can help contractors plan and track their projects, eliminate losses, and increase job profits. Russell (1993) described a computerized approach for collecting and processing site information which builds on the traditional superintendent's daily site report. Ganeshan et al. (1994) presented a multimedia system for organizing construction documents.

After these early developments of information systems for the construction industry, a database was seen as a choice to overcome some of the limitations imposed by conventional filing systems, such as uncontrolled redundancy, inconsistency, difficult data sharing, and modification inflexibility. Mazurolle and Alkass (1993) proposed a Database Management System (DBMS) in a project control process to store information on each delay when it occurs. Hiroshi and Nobuoh (1993) described a filing system of construction pictures and its integration with a database.

Hamilton (1991) pointed out that using a relational database improves record management processes such as tracking the progress and location of shop drawings within a firm, listing present and past projects, maintaining correspondence, calculations, telephone records, and memoranda. Bowler (1994) examined the importance of a relational database management program (RDBMS) in the engineering office and discussed the use of databases for technical, project management, business development, and administrative applications. Choo and Ballard (1999) created a database program called WorkPlan to systematically develop weekly work plans.

Shahid and Froese (1998) addressed a so-called comprehensive project information system. These systems can help process and administer a wide range of project information and documentation such as drawings and specifications, correspondence, tendering documents, and progress tracking, etc.

Almost parallel to the development of the database-driven information systems, the construction industry gradually identified needs for computerised decision support tools to improve their effectiveness in various stages of construction projects. Decision support systems can be seen as more advanced information systems. In 1995, Couzen et al. presented an early attempt in this area: an executive information system for construction contract bidding decisions. After a few years, Brightman et al. (1999) at the University of Strathclyde worked with managers from a number of construction firms and their work led to the creation of a Construction Alternative Futures Explorer (CAFE), a computer based package which provides a means of structuring and analysing soft data, about possible future business environments.

Rule-based expert systems and artificial neural networks are two major systems for developing intelligent decision support systems. Li and Love (1999) presented a computer based mark-up decision support system called InMES (integrated mark-up estimation system) that integrates both rule-based expert systems and neural networks. This system can be used to assist contractors in making decisions on whether or not to submit a bid for a project considering the estimated mark-up.