

CORPORATE PORTALS AS EXTRANET SUPPORT FOR THE CONSTRUCTION INDUSTRY IN HONG KONG AND NEARBY REGIONS OF CHINA

SUBMITTED: September 2005

REVISED: November 2006

PUBLISHED: March 2007 at <http://itcon.org/2007/12/>

EDITOR: A. Serpell and S. V. Barai

Edwin H. W. Chan

Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

email: bsedchan@inet.polyu.edu.hk

Cutson Liu

Department of Computer Engineering and Information Technology, The City University of Hong Kong

SUMMARY: *This paper presents the corporate portals for the construction industry with an aim of solving the collaboration problem in the construction industry in Hong Kong and nearby regions of China. Customized and personalized corporate information, search service, collaboration tools and web services are provided for achieving such an aim. Discussions are provided as to how corporate portals can be used as extranets to support the construction industry. A questionnaire survey with local construction professionals was conducted. From this research result, it is realized that the corporate portals will particularly fit to the needs in the construction industry. In addition, the requirements of the corporate portals are identified. The design and setup of the corporate portals for construction industry are proposed. We believe that the corporate portals are particularly effective and useful for the construction industry in Hong Kong and nearby regions of China.*

KEYWORDS: *corporate portal, extranet, construction industry collaboration, China.*

1. INTRODUCTION

The construction industry is complex and multidimensional. Ofori (2000) suggests that whole construction industry should "...embrace the development of: materials; project documentation and procedures; human resources; technology; contractors; and institutions, both public and private." The construction industry provides plenty of scope for business interactions and strategic alliances both in domestic and international markets.

Commercial driving forces fanned by sophisticated communication technologies have brought about a close network for the construction industry all over the world. The power of Internet is refining the construction industries. Internet facilitates "increased connectedness" to make it easier to communicate between individual and organization around the world. In an increasingly integrated global economy, Internet not only forces companies to participate in more construction projects but also the large-scale construction projects that are international events involving parties from multi-nations (Chan et al 2005). Those projects are called international construction projects. International construction projects are those projects in which contractor, the lead consultant, or the employer is not of the same domicile, and at least one of them is working outside its country of origin (Mawhinney 2001). Major construction projects of developing countries are often carried out in joint ventures with, or solely by, construction companies of developed countries. International projects are normally fast paced but required a longer time span, and there are more parties involved. Collaboration is particularly critical problem in international construction projects because collaboration between the parties requires a clear project definition. However, each set of objectives under the definition may be subject to changes as the project evolves.

Corporate portal is an IT strategy to aggregate a selected subset of information into a central location by using Extensible Markup Language (XML). From corporate portal, employees in an organization or between the organizations can be easily access information that is relevant to their roles or business and personal requirements and in the process work more effectively with each other. This results in greater level of collaboration (Internet World Stats, 2005). As we have mentioned before, the collaboration is particularly critical problem in the international construction projects, it is no doubt to realize that the corporate portals will particularly fit to the

needs in the construction industry.

In this paper, the architecture of portal for the construction industry is constructed. In the next section, the characteristics and problems in the construction industry in Hong Kong and nearby regions of China and the introduction of corporate portal are presented firstly. The result of a survey with local construction professionals will also be presented. Then the design of corporate portals for construction industry in Hong Kong and nearby regions of China is constructed in Section 3. Finally the paper is concluded in Section 4.

2. THE CONSTRUCTION INDUSTRY AND CORPORATE PORTALS

2.1 The Critical Problem in the Construction Industry: Collaboration

As the temporary multiple organization (TMO) structure and the maximization of self interests evolve, the fragmentation has developed over the last few years in the construction industry (Cherns and Bryant 1984, Newcombe 2000, Walker 1996). Indeed, this situation is worsened by the increasing competitive and complex construction activities, factors including market force, technology push, organization culture, globalization and quality-within-budget make the issue of integration of various phases of construction process more critical than ever (Graham 2000, Mitropoulos and Tatum 2000, Schimming 1993). The increasingly integrated global economy leads the construction companies to participate in more and more international construction projects.

Collaboration is particularly a critical problem in the international construction projects because it involves many parties such as contractor, the lead consultant, or the employer is not of the same domicile, and at least one of them is working outside its country of origin. Major construction projects of developing countries are often carried out in joint ventures with, or solely by, construction companies of developed countries. Al-Sedairy and Rutland (1994) identify a number of distinctive features of projects in developing countries that related to collaboration issues:

- cooperation and coordination required between many government agencies and national and international bodies,
- product and service suppliers often from different countries and
- main control centers outside the developing country which causes communication problems.

For the Architectural-Engineering-Contracting (AEC) industry in Hong Kong and nearby regions of China, the mobility of practitioners is particularly demanding in terms of practicing in different physical locations while fully connected. Consultants from Hong Kong may have to be posted in different locations in the nearby regions either to attend to site problems or to benefit from the low cost office support. Some of the tedious and laborious parts of project information production may be subcontracted or carried out by foreign office in China for lower cost. It is very important that the practitioners have access to all the latest project information while physically located at different places.

In the 19th century, the Internet was born and there was great impact to the world (Internet World Stats, 2005). The Internet can facilitate the communication in and between the organizations but the description of Internet by Sikes (2000) was *“The Internet is simply a library, instant access to everything, good and bad. The Internet is the telephone, the Internet is a circle of friends, the Internet is billboards, the Internet is radio, the Internet is television, the Internet is books, the Internet is journals, the Internet is discussion in a bar, the Internet is a church bazaar. The Internet is anything. It’s nothing but a medium.”* In the construction industry, the information available to an organization itself and between organizations are numerous. The internet may not solve the problem of collaboration but is a facilitator (or medium) that enables collaboration to take place.

2.2 THE CORPORATE PORTALS

Public portal was firstly launched by Yahoo called My Yahoo! in July 1996. The users can customize their profile and interests in a single page with up to date information channels corresponding to them without browsing and searching. It provides the revolutionary experiences to web users. Yahoo’s users skyrocketed to more than 50% for the next three months after it was unveiled. Public portals are just for personal usage rather than business usage since organizations need more relevant information from their internal and external information, employee’s collaboration, and access to existing applications. Corporate portals were born to satisfy these requirements.

A corporate portal is a web-based platform to access with security a broad range of information, services,

applications and expertise. It can be functioned as an extranet it serves both internal and external users. Internal users can be employees in the organization and external users can be the client in the project. Portal content, services and applications can be customized and personalized to the need of different users or user groups. Architect and engineer can have access to information and applications that are not made available to clients or contractors. Different posts for the employees in the organization have access to different propriety information and employee-specific applications that are kept hidden from and out of reach of all other users. This leads people interact directly in and between the organization to conduct authorized business or gain necessary information without having to deal with a company representative.

There is a lot of research to suggest strong, long-term commitments to corporate portal technology in every industry, particularly among large organizations. International Data Corporation estimates that half of all organizations and nearly 60 percent of large organizations will deploy a corporate portal in 2001 (Morris et. al. 2000). Further, META Group predicts that by 2003, 85% of the Global 200 will have deployed a corporate portal (Phifer, et al 2001). It is important to note that corporate portals are typically viewed as core infrastructure and therefore organizations in every industry and government are deploying the technology (Phifer et al , 2000). In the Fig. 1 from the White Paper of Plumtree Software (2001), it is shown that portal adoption by industry is relative uniform.

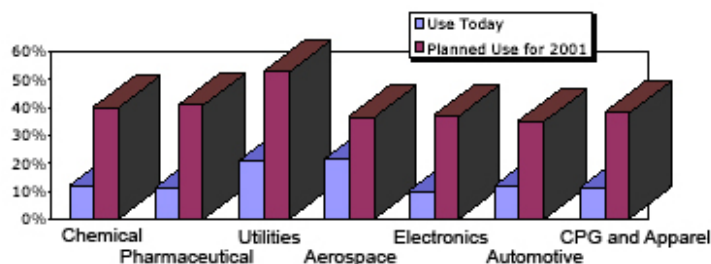


FIG. 1: Portal Adoption by Industry is Relatively Uniform (Plumtree Software, 2001)

The market share estimates among analysts shows that Plumtree and IBM are the two major contenders, with Plumtree first in market-share in 2001 (Plumtree Software, 2004). According to International Data Corporation, Plumtree led the portal software market in 2001 with 12% share (McDonough and Morris, 2001). Gartner published a DataQuest report the same month showing Plumtree is in leader role, but not by a significant margin: Gartner calculated 7% portal software market-share for Plumtree, IBM and SAP (Correia and Biscotti, 2005). In 2002, Delphi Group took different approaches for the market-share question (Palmer, 2001), 500 organizations were surveyed to determine which portal products had actually been deployed. This approach led to significant different results that Plumtree doubles its led at 15%, and Microsoft SharePoint, Oracle and IBM WebSphere rating second, third and fourth at 10%, 9%, and 8% respectively (Correia and Biscotti 2005). Table 1 summarizes the above findings.

TABLE 1: Portal Market-Share Estimates

Vendor	IDC	Gartner	Delphi
Plumtree	12%	7%	15%
IBM	9%	7%	8%
SAP	7%	7%	6%
Oracle	6%	Below 5%	9%
Microsoft	Insignificant	Below 5%	10%
CA	11%	Below 5%	Below 2%

The White Paper (Plumtree Software 2001) presents the reasons for the organizations to deploy the corporate portals. The top two “very important” reasons are: reduce time spent searching for information (81%) and improve employee collaboration (76%). It confirms that easier access to information/applications and improve the employee collaboration are the main driving forces for the deployment of the corporate portals.

2.3 Research Results in the Construction Industry

In the previous two subsections, the brief introduction of the construction industry in Hong Kong and nearby regions of China and corporate portals are presented. In this section, the needs of constructional professionals in Hong Kong and nearby regions of China will be studied. In the last two decades, European construction and consultancy companies, especially British, have been very active in Hong Kong mainly because of the extensive and massive scale development of the Airport Core Program. Many Hong Kong companies and organizations, including construction professionals have participated in the international industry projects, especially with the new market in China. In the last decade, over 50% of the workloads of Hong Kong construction professionals are in connection with mainland China, particular in the regions nearby Hong Kong (Chan and Mok, 2002). With China's entry to the WTO in December 2001, there is an increased of the international industry projects that involve Hong Kong companies and organizations in China construction market. Although Hong Kong companies tend to prefer the more developed coastal regions, infrastructure development opportunities are plenty in most parts of the Chinese mainland, because of the direct and flow-on opportunities generated by the 2008 Olympics, 2010 Asian Games and Shanghai World Expo., and the major types of Hong Kong's exported services include project management, contracting and engineering consulting (HKTDC 2006). Whilst Hong Kong construction professionals may have to be physically situated in mainland China, it would be an invaluable asset for them to be able to maintain constant contact with the latest international practice information through traveling or virtually connected with the latest information technology. Hence, Hong Kong and the nearby regions of China have to be considered as a unique economy of the construction industry and the information technology plays the important role to connect people in the different regions of diverse living standards. As Abduh & Skibniewski (2002) stated: *"Regardless of how attractive the use of the Internet technologies in the construction industry may seem, the efforts of implementing such technologies should be preceded by the assessment of its utility in a specific application scenario"*. Therefore, there are scopes for improvement to the existing IT services model to include areas that concern the construction industry in the region, which is now influenced heavily by the expanding and fast-growing China's construction market.

2.3.1. Survey on the needs for extranet

Limited by the restricted access for collecting data in mainland China, we believe the needs of constructional professionals in Hong Kong can reflect the needs of the construction industry in Hong Kong and nearby regions of China, as the key players in the industry always involve professionals from Hong Kong. A questionnaire survey in the form of a structured, face-to-face interview was conducted by the author of this paper to identify the needs of construction professionals to the project extranet (Chan et al, 2005). Since corporate portals can be functioned as extranet, the research result is useful to identify the needs of construction professionals to the corporate portals.

In formulating the questionnaire, it was intended to make the questions as unambiguous as possible and to provide for as many YES / NO or Rating (the most important) questions as possible. This encouraged the interviewees to respond within a reasonable time frame and to provide truthful answers. The research team was very fortunate to receive the supports from various professional institutes, including the Hong Kong Institute of Architects (HKIA), the Hong Kong Institute of Engineers (HKIE), the Construction Industry Institute (CII), and the Hong Kong Construction Management Association (HKCMA) to provide contacts of their members. A list of 60 potential candidates was devised, from which the research team was able to 'filter' appropriate interviewees. At the end, a total of 32 interviewees were selected and approached, including project managers, architects, quantity surveyors, engineers, contractors, suppliers, and construction organizations. The selection of interviewees was largely based on the practitioner's experience with the construction practices, in particular their experience with project extranets. Other selection criteria include:

1. Practitioners who have at least three-year experience with construction IT; and
2. Practitioners who have at least five-year experience with construction project management and administration

2.3.1.1 Discussion on Data Obtained From Interviewees

Benefits of Project Extranets

All the interviewees expressed interest on project extranets and agreed that there are a host of benefits associated with project extranets. The top 5 noticeable benefits identified by the interviewees are: improving team communication (78% of the 32 interviewees agreed); improving distribution of information (71%); increasing productivity (52%); and providing a collaborative environment (52%). This result perfectly fits to the reasons for the organizations to deploy the corporate portals that are presented in the last section. The top two “very important” reasons are: reduce time spent searching for information (81%); improve employee collaboration (76%). From this research result, it is important to realize that the corporate portals will particularly fit to the needs in the construction industry.

Considerations and Factors for Selecting Project Extranet

The interviewees also expressed the important selection factors for the selection of project extranet. The top 5 most important are: system simplicity and ease of use (71%), security system (65%), speed of information transfer and delivery (61%), system reliability and flexibility (61%), and training requirements (48%).

Important Functions to be included in Project Extranet

The contents and the functions of a project extranet should be so designed in order to facilitate effective team work and project communication, hence to allow: 1) fewer meetings through internet communication and collaboration; 2) savings in document filing/copying; 3) reduce errors and wastage; 4) recycle information; 5) make available the latest industry news and knowledge; 6) review project performance; and 7) reduce overall project expenses and life cycle costs. These are the underlying functions of a project extranet. In addition, a total of 7 supplementary functions have been recommended by the interviewees to be included in a typical construction project extranet are: e-tendering (65%), Electronic Data Interchange (EDI) (58%), e-procurement (55%), online product catalogs with suppliers or those "in the trade" (55%), online training programs (52%), online newsletters (48%), and online forum (48%). As each project is unique, the project management must weight the benefits and costs incurred in implementing these functions.

Factors contributing Successful Project Extranet

The findings obtained from the interviewees help to draw up with a list of factors contributing to successful implementation of project extranets, include factors: client support and involvement (84%); successful integration of existing business systems (71%); on-going review and continual improvement (61%); demonstration and training to all the team members (55%); and choosing the right project extranet system (45%). The factor “client support and involvement” is considered extremely important as the client makes the final decision and provides financial resources to the project. The factor ‘successful integration of existing business systems’ is one that project management must take seriously as there is no one panacea to suit all situations, and therefore attention must be paid to ensure a project extranet is compatible to the existing project management systems.

3. DESIGN OF CORPORATE PORTALS FOR CONSTRUCTION INDUSTRY

Based on the research results that described in the last section, the corporate portals can address the needs of the construction industry. Fig. 2 illustrates the key participants involved in the corporate portals for construction industry.

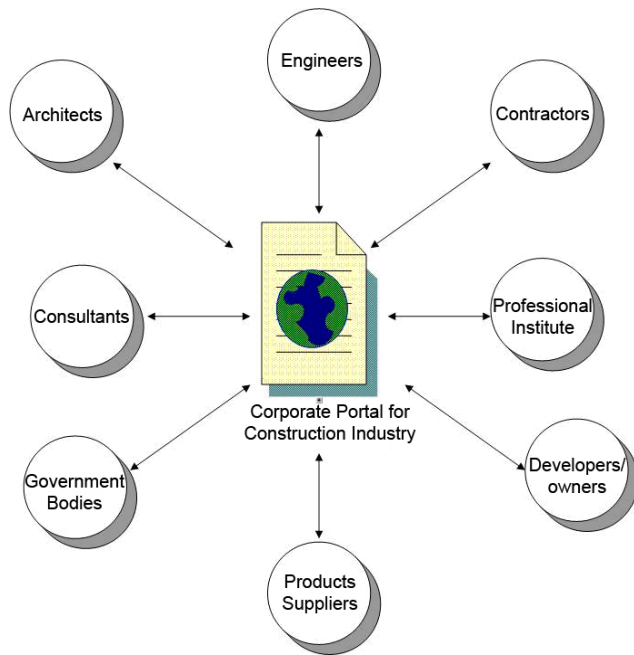


FIG. 2: Proposed key participants in the corporate portals for construction industry

3.1 Functions for Corporate Portals for Construction Industry

The views of the interviewees of an effective project extranet system form the basis for the design and construction of corporate portals for construction industry. The following are the main functions as shown in Fig. 3.

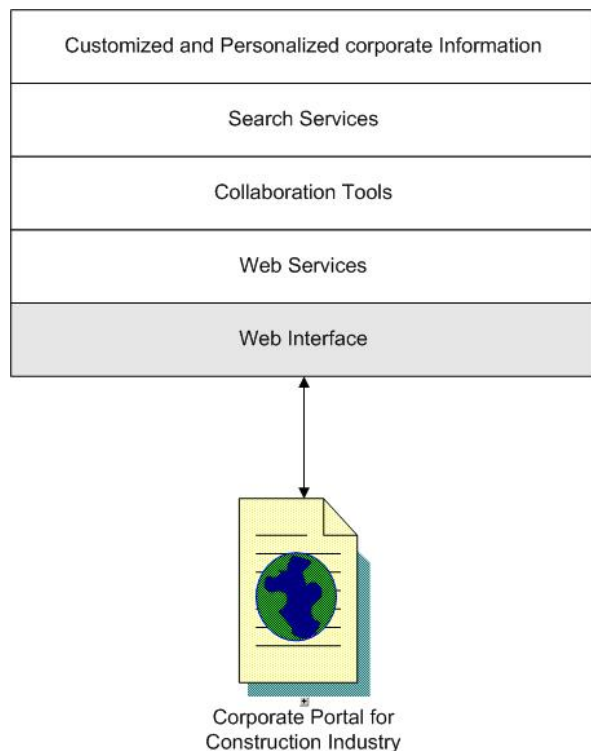


FIG. 3: Functions for corporate portals for construction industry

Customization and personalization to corporate information

As mentioned before, a corporate portal is a web-based platform to securely access a broad range of information, services and applications. It needs to serve both internal and external users. It is important to realize that different

users or user groups must have different content of information and different types of services and applications. For example, assume there are two groups of people that are in charge of different construction projects (say, project A and project B). The group of people that are in charge of project A must receive the information about project A but cannot receive the information about project B. The content management is the key issue to provide this function. Content management systems will provide automated, workflow-oriented, approval routines for the content. Once there is a document (for example, CAD document) that all the modifications are agreed by all the correspond staffs, the content management system will launch this document along a pre-defined specific approval route. In addition, the users can also customize their available information, services and applications from the company. For example, a contractor will only want to receive the latest development about law.

To have customization and personalization to corporate information for the user, user ID and password-based user authentication or some form of "cookie" can be used. Secure socket layer (SSL) can also be implemented to increase the degree of authorization in corporate portal.

The interviewees highlighted the important selection factors that influence the selection of project extranet. The top two most important factors are: system simplicity and ease of use (71%) and system security (65%). The customization and personalization to corporate information can increase the system simplicity and ease of use as project extranet cannot. User ID and password-based user authentication or some form of "cookie" in the corporate portals can also meet the security factor.

Search services

Since the corporate portal contains a broad range of information, a powerful and smart search capability is one of the most important requirements for a good corporate portal. The search results can be sorted in different criteria like the relevance and years. The relevance of search and search result is also critical. Internet search engines such as Google, Inktomi and Alta Vista are now ready to license their search engine technology to be used for corporate portals.

In the corporate portals for construction industry, engineering and building searching can be a useful service. This serves to provide references in relation to the contractual and legal matters in the construction process. For example, construction-related practice notes, technical memorandum, ordinances, codes of practice can be search in this function. In the result of survey, the one of top five noticeable benefits for project extranet that were identified by the interviewees is improving distribution of information (71%). This search function in corporate portals can provide this benefit.

Collaboration tools

Bulletin boards, web-based email system, online forum, online white board and chat rooms with instant messaging are essential collaboration tools that are offered by the corporate portal. In addition, customized calendar for different groups of users like employees, engineers and contractors who involve in different projects, is a useful and practical service to increase the collaboration in the company. Real-time multimedia conferencing like net-meeting is also necessary to facilitate cost-effective meeting, especially for the international construction projects.

Web Services

Web services are services offered through the Web. In a typical Web services scenario, a business application sends a request to a service at a given URL using the SOAP protocol over HTTP. The service receives the request, processes it, and returns a response. An often-cited example of a Web service is that of a stock quote service, in which the request asks for the current price of a specified stock, and the response result is the stock price. This is one of the simplest forms of a Web service in that the request is filled almost immediately, with the request and response being parts of the same method call.

Web services will have significant impact on the corporate portals. They can expand the business services available through a portal. They will give the direction to the development schedule for new applications and encourage more functionality to be added to the applications. If the applications being offered through your corporate portal are aimed to wide external users, then they should be packaged as Web services. The nature of Web services are self-describing and self-advertising. This will ensure that those applications are now readily visible and available to authorized entities that include other applications or Web services. Now your corporate portal will become a bi-directional gateway for offering and accepting Web services.

Electronic data interchange (EDI) can be one of web services in corporate portals for construction industry. It can

enable speedy transfer of project data (for example, drawings, images and documents) between project members.

3.2 Design and Setup of Corporate Portals for Construction Industry

With the detailed understanding on the needs of the construction industry through the questionnaire interviews and based on the above proposed functions for corporate portals, the design and setup of corporate portals for construction industry are proposed in this section.

Platform

The most commonly supported operating systems to setup a corporate portal are:

- Windows 2000
- Windows NT
- Sun Solaris
- Red Hat Linux

Windows NT and Windows 2000 are the most popular operating system. However, the successful and highly damaging attacks by hackers and virus creators on Windows system have hampered the creditability of Windows system when it comes to security (Abduh and Skibniewski 2002, Bury 2003). On the other hand, since Linux platform is open-sourced, its flexibility on programming is higher than windows system. In addition, the cost for a Linux OS is cheaper than the windows system.

Extensible Markup Language (XML) [13]

In February 1998, XML was formalized by the World Wide Web Consortium (W3C). XML provides a programming language and platform-independent scheme for data sharing for different applications and organizations in a consistent and extensible manner. XML can present the meaning and content of data. It can eliminate the barrier of different commercial applications and the data from one application can be interpreted by another application, even if the two applications are from different, competing vendors. XML thus can solve the incompatibility issues and enhance the data interchange between different applications. The following XML example shows a price list with the name and price of two DVD players.

```
<priceList>
  <dvd>
    <name>Sony</name>
    <price>5000</price>
  </dvd >
  <dvd>
    <name>Panasonic</name>
    <price>6000</price>
  </dvd>
</priceList>
```

The <dvd> and </dvd> tags tell a parser that the information between them is about a DVD player. The two other tags inside the <dvd> tags specify that the enclosed information is the DVD player's name and its price per pound. Because XML tags indicate the content and structure of the data they enclose, they make it possible to do things like archiving and searching. With XML, you can write your own tags to describe the content in a particular type of document. Another aspect of XML's extensibility is that you can create a file, called a *schema*, to describe the structure of a particular type of XML document. For example, you can write a schema for a price list that specifies which tags can be used and where they can occur. Any XML document that follows the constraints established in a schema is said to conform to that schema.

Probably the most-widely used schema language is still the Document Type Definition (DTD) schema language because it is an integral part of the XML 1.0 specification. A schema written in this language is commonly referred to as a DTD. The DTD that follows defines the tags used in the price list XML document. It specifies four

tags (elements) and further specifies which tags may occur (or are required to occur) in other tags. The DTD also defines the hierarchical structure of an XML document, including the order in which the tags must occur.

```
<!ELEMENT priceList (dvd)+>
<!ELEMENT dvd (name, price) >
<!ELEMENT name (#PCDATA) >
<!ELEMENT price (#PCDATA) >
```

The first line in the example gives the highest level element, priceList, which means that all the other tags in the document will come between the <priceList> and </priceList> tags. The first line also says that the priceList element must contain one or more dvd elements (indicated by the plus sign). The second line specifies that each dvd element must contain both a name element and a price element, in that order. The third and fourth lines specify that the data between the tags <name> and </name> and between <price> and </price> is character data that should be parsed. The name and price of each DVD player are the actual text that makes up the price list.

Another popular schema language is XML Schema, which is being developed by the World Wide Web (W3C) consortium. XML Schema is a significantly more powerful language than DTD, and with its passage into a W3C Recommendation in May of 2001, its use and implementations have increased.

ASP, JSP and PHP

The corporate portals are web-based platform and the content is in non-static. ASP, JSP and PHP set out to simplify the creation and maintenance of web pages with dynamic content. ASP is Microsoft's active server page that was introduced with Microsoft's IIS Web Server 3.0 around 1997. JSP which stands for JavaServer Pages is the Java equivalent of ASPs. PHP is an open source version.

MySQL

In constructing a database for the corporate portal, a structured data collection and retrieval system is needed and an Open Source Database known as 'MySQL' is used. It is one of the most popular Open Source Database systems designed for speed, power and precision in mission critical, heavy load use. MySQL is a relational database management system that stores data in separate tables rather than putting all the data in one big store room. This helps to improve speed and flexibility. MySQL is free open-source software, available for use and modification to suit individual needs. The MySQL software can be down loaded free from the Internet. The following list describes some of the key characteristics of the MySQL database software.

- **Security:** the password system is very flexible and secure, and allows host-based verification. Passwords are secured by encrypting all password traffic connected to a server.
- **Scalability and Limits:** MySQL can handle large databases, with some databases capable of handling 50 million records, 60,000 tables and 5,000,000,000 rows.
- **Connectivity:** Clients have choice to connect the MySQL server by using TCP/IP sockets, Unix Sockets (Unix), or Named Pipes (NT).
- **Stability:** Constant assessment of the MySQL to ensure bugs are closely monitored and fixed in the latest version.

4. PROPOSED STRUCTURE OF CORPORATE PORTALS

Based on the above discussion, the proposed structure of Corporate Portals for the Construction industry in Hong Kong and nearby regions of China is shown in Fig. 4.

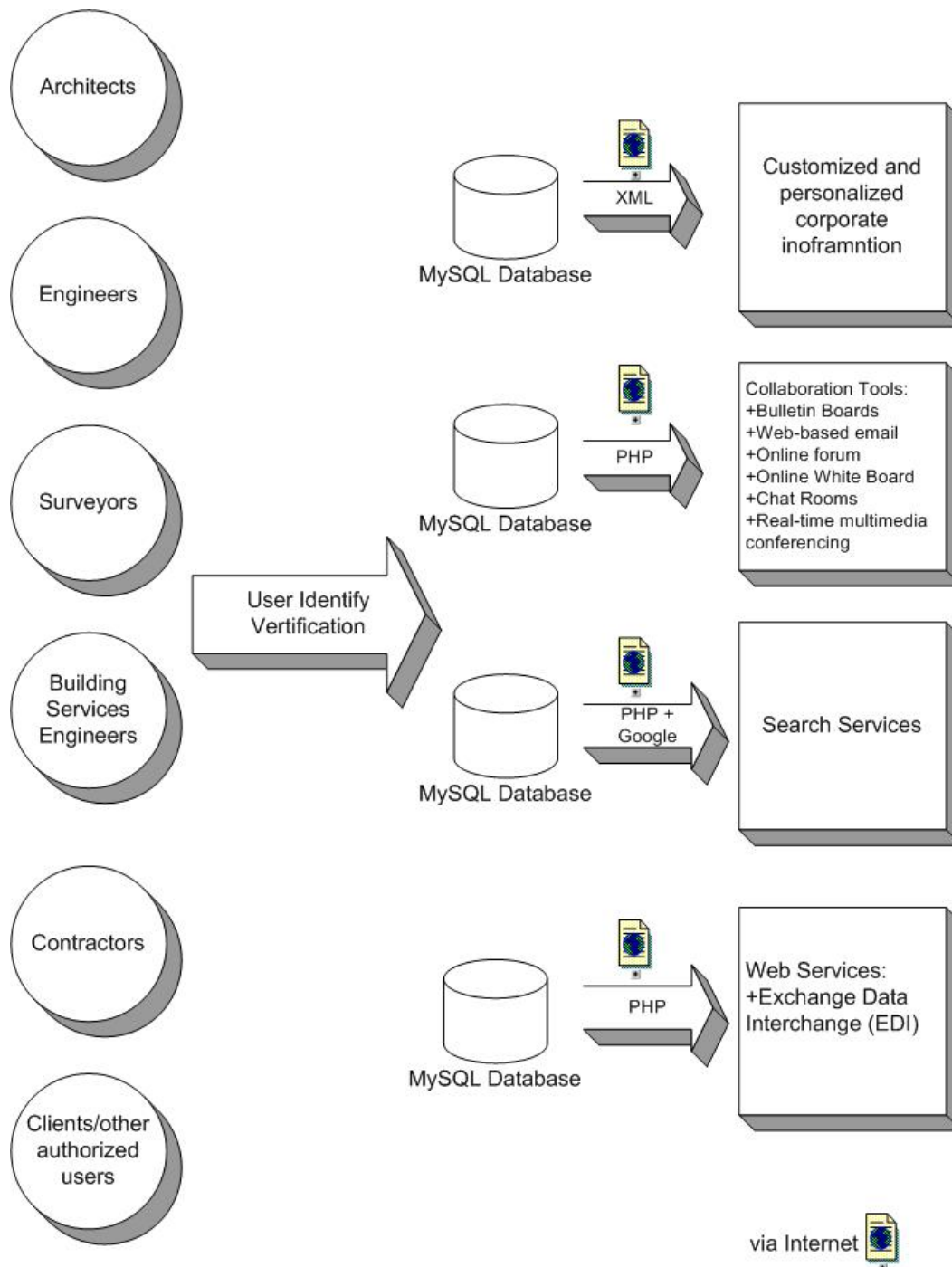


FIG. 4: The Proposed Structure of Corporate Portals for the Construction Industry

5. EVALUATION OF THE CORPORATE PORTALS

To evaluate the corporate portals for the construction industry, 6 face-to-face interviews were conducted. The interviewees were selected based on the following criteria:

- At least five-year experience with IT industry; and
- Hold Hong Kong degrees in computer studies or relevant subjects from Hong Kong tertiary institutions.

With the interviewees' extensive experience in IT, their views on corporate portals for the construction industry in Hong Kong and nearby regions of China are valuable. The interviews aim to evaluate the following two issues:

1. Which functions can provide the benefits: There are five benefits from corporate portals that we have mentioned in section 3.1. For this evaluation focus on the two benefits of “increasing collaboration” and “increasing productivity”, which were selected by the interviews as the the most important benefits to corporate industry. Based on the two benefits, we ask the interviewees which functions can provide the benefits.
2. The deployment success factors for corporate portals for the construction industry: We ask the interviewees to identify the most important factor to deploy the corporate portals for the construction industry.

5.1 The Benefits of Corporate Portals for the Construction Industry

All six interviewees (100%) believe that collaboration tools can improve the collaboration and therefore the productivity in the construction industry. They believe that as the degree of collaboration required in the construction industry is very high, the benefits of corporate portals for the construction industry is most significant in this aspect. Three of the interviewees point out that the search service in corporate portals will increase productivity as the information can be collected easier with the portal. On the other hand, two of the interviewees point out that web services like Electronic Data Interchange (EDI) in corporate portals will also increase productivity as it enables speedy transfer of large amount of project data in the construction industry. Only one interviewee points out that customization and personalization to corporate information can increase productivity.

5.2 Deployment Success Factors for Corporate Portals for the Construction Industry

1. The relevance of search result in search service
Two of the interviewees strongly believe that the relevance to a search key is very important to search the information via search service in corporate portals. If the relevance to a search key is higher, the search time will be decreased and therefore the productivity can be increased.
2. The usage rates of collaboration tools
Three of the interviewees point out that the problem for collaboration tools in corporate portals is their usage rates. If the usage rate is low, the aim of using the collaboration tools for increasing collaboration will not be functional. The employees also experience barriers to share their knowledge in the collaboration tools because professionals of different disciplines in the construction industry traditionally believe their own knowledge is unique and with the adversarial contractual relationship among all the parties, information legally advantageous to oneself will not shared with others.
3. Customized and personalization of corporate information
One interviewee points out that customized and personalization of corporate information will not be useful if the amount of available corporate information is small. Corporate information is customized and personalized so as to distinguish and categorize from the large amount of general corporate information. If the available corporate information is small, the effort to customize and personalize corporate information may be wasted.

6. CONCLUSIONS

The corporate portal proposed in this paper for the construction industry is a web-based platform to access with security a broad range of information, services, applications and expertise. It serves both internal and external users like architects, engineers, contractors, and related construction professionals in a construction project environment. From the result of a questionnaire survey, it is found that the corporate portals can address the needs in the construction industry of Hong Kong and nearby regions of China. The requirements of the corporate portals have also been identified. Customized and personalized corporate information, search service, collaboration tools and web services can be provided in the corporate portals for the construction industry. Among all the benefits, corporate portals can solve a critical problem of collaboration in the corporate industry. It is believed that the corporate portals are particularly effective and useful for the construction industry in Hong Kong and nearby regions of China, which is large in physical distance and diverse with economic backgrounds that require high level of collaboration without physical meeting of the participants.

7. ACKNOWLEDGEMENT

The work described in this paper was substantially supported by a grant from the Hong Kong Polytechnic University, HKSAR. The authors are grateful to all the experts who had taken part in the interviews.

8. REFERENCES

- Abduh M. and Skibniewski M.J. (2002). Utility of Internet-based Applications in Construction. *International Journal of Construction Management*, Vol. 2, No 1. pp 65-81.
- Al-Sedairy S.T. and Rutland P. (1994). Project management as a way forward in a developing country. *Global Project Management Handbook* (Cleland, D.I. and Gareis R. Eds.), USA: McGraw-Hill, Inc., 5-4 to 5-6.
- Bury C. (2003). Extranet: principles. (<http://whatis.techtarget.com/definition>). Accessed September 2006.
- Chan E.H. & Mok P. (2002). e-Base Knowledge on Statutory Requirements for Property and Construction Professionals in Hong Kong. Hong Kong: Pace publishing Ltd. (<http://www.pacebase.com/e-base/>).
- Chan E.H., Suen H. and Chan S.L. (2005) An Integrated Extranet System: e-AEC for Architects, Engineers and Contractors in Hong Kong and China. *Journal of Construction Research*. Vol. 6 No 2. pp 253-271.
- Cherns A.R. and Bryant, D.T. (1984). Studying the Client's Role in Construction Management. *Construction Management and Economics*, No 2. 177 – 184.
- Extensible Markup Language (XML). (2005). World Wide Web Consortium (W3C) XML activity and information. (<http://www.w3.org/XML>), Accessed September 1, 2006.
- Graham P. (2000). Building Education for the Next Industrial Revolution: Teaching and Learning Environmental Literacy for Building Professions. *Construction Management and Economics*. No 18. pp 917-925.
- Hong Kong Trade Development Council (HKTDC). (2006). Profiles of Hong Kong Building and Construction, (<http://www.tdctrade.com/main/si/spcons.htm>). Accessed September 2006
- Internet World Stats. (2005). Internet Usage Statistics -The Big Picture. (www.internetworldstats.com/stats.htm). Accessed September 20, 2005.
- Correia J. and Biscotti F. (2005). Market Share: AIM and Portal Software, Worldwide 2005. p2. (http://www.gartner.com/DisplayDocument?ref=g_search&id=492790). Accessed September 2006
- Mawhinney Mark. (2001) *International Construction*. Oxford ; Malden, MA : Blackwell Science.
- McDonough B. and Morris, H. (2001). Corporate Portal Survey. p.2. (www.dad.be/library/pdf/plumtreeIII.pdf). Accessed August 2006.
- Mitropoulos P. and Tatum C.B. (2000). Forces Driving Adoption of New Information Technologies. *Journal of Construction Engineering and Management*. Vol.126, No 5. pp 341-48.
- Morris, Henry et. al. (2000). Enterprise Portal Market Study Findings Summary. International Data Corporation: USA (February 2000).
- Newcombe P. (2000). 'Partnering, with Particular Reference to Construction', *Arbitration Journal*, Vol. 66, No 1. p29.
- Ofori, G. (2000). Globalization and construction industry development: research opportunities. *Construction Management and Economics*, No. 18, 257-262.
- Palmer N. (2001). The Hidden Cost of Portal Ownership. p78. (<http://www.mongoosetech.com/news/05-21-01.html>).
- Phifer, Gene, GartnerGroup. (2000). Management Update: Do You Know What the Term 'Portal' Means? (October 18, 2000).
- Phifer, Gene, GartnerGroup. (2001). Portal Products: A Market in Distress (March, 2001).
- Plumtree Software. (2001). An Overview of Corporate Portal Technology and Deployment: Survey Results from Organizations that have Deployed Corporate Portals. The White Paper (March 2001). (<http://www.dad.be/library/pdf/plumtreeIII.pdf>). Accessed September 2005.

- Plumtree Software. (2004). The Corporate Portal Market in 2003. The White Paper (February 2000). (<http://www.virksomhetsportalen.no/cparticle205843-32131a.html>). Accessed September 2006.
- Schimming B.B. (1993). The Coming Competition Forum. Civil Engineering. No 53. p 6.
- Sikes A.C. (2000). Fast Forward: America's Leading Experts Reveal How The Internet Is Changing Your Life. New York: William Morrow.
- Walker A. (1996) Project management in construction. London: Blackwell Science.