

DIGITIZATION AND INFORMATIZATION OF PROFESSIONAL MANAGEMENT OF CONSTRUCTION PROJECTS

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Abstract There is digital divide between construction industry and other industries; and within the industry the digital divide exists between developing countries and developed countries. To find ways to bridge the digital divide is a significant issue for the further development of construction industry. This paper explores the meanings and functions of Development Management Information System (DMIS), Project Management Information System (PMIS), Facility Management Information System (FMIS), Project Information Portal (PIP), Project Extranet, Project Specific Web Site (PSWS) and Application Service Provider (ASP) – a web based management platform. It further suggests that development and applications of DMIS, PMIS, FMIS and PIP are critical approach to the promotion of digitization and informatization of professional management of construction projects.

keywords: construction projects, development management, facility management, information system informatization, project management, ASP, PIS, PSWS

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1. Background

There has always been a gap between those who can make effective use of information technology and those who cannot. Now, more than ever, unequal adoption of technology excludes a good number of people from reaping the fruits of the fast-growing economy. The term 'digital divide' refers to the gap between those who can effectively use new information and communication tools, such as the Internet, and those who cannot. Although no consensus has been reached so far on the extent of the divide and on whether the divide is growing or narrowing, researchers are almost unanimous in acknowledging the existence of a divide of some sort at this point in time. The following statement quoted from Mr. Jia-bin Duh, Cisco China President, tells us more about the digital divide.

Cisco Systems, the worldwide leader in networking for the Internet, has been chosen to participate in an important APEC (Asia-Pacific Economic Cooperation) initiative to bridge the digital divide. Cisco is committed to helping governments around the region bridge the digital divide. This commitment, underlined in our Cisco Networking Academy Program, the largest e-learning laboratory in the world, will be strengthened through our participation in the HCBP. This initiative by APEC is a strong endorsement of the importance of the Internet and the role that it will play in the regional and global economy. (BEIJING, November 21, 2001 (Xinhuanet))

There is digital divide between construction industry and other industries. Within the construction industry the digital divide exists between developing countries and developed countries. In comparison with other industries the construction industry has a relatively low level of penetration in computer applications. Compounded by the problems of insufficient funds and inappropriate management, the development of digitization and informatization of professional management of construction projects has been made difficult. An important and key issue for the further development of construction industry is to find ways to bridge the digital divide.

While it is beyond the scope of this paper to address all the problems related to digitization and informatization in the entire construction industry, such as general management problems with construction companies, this paper concentrates on a discussion of digitization and informatization construction project management in the whole project lifecycle.

The term ‘professional management of construction project’ used in this paper includes professional management on the side of investors, developers, designers, contractors, suppliers and operators in the whole project lifecycle, as is shown in the following formula whereas DM stands for development management, PM stands for project management and FM stands for facility management.

$$\text{professional management of construction project} \ni \left[(\text{DM, PM, FM/Investor}); (\text{DM, PM/Developer}); (\text{PM/Designer}); (\text{PM/Contractor}); (\text{PM/ Supplier}); (\text{FM/Operator}) \right]$$

Professional management of construction project is further illustrated in Fig.1-1 in relation to the project lifecycle.

Fig. 1-1

2. Development and Application of Information System for Development Management, Project Management and Facility Management

2.1 Development Management Information System (DMIS)

The development management of a construction project is professional work to prepare for the project development planning and the related management activities in the project decision phase. The decision phase of a construction project is very important for both investors and developers. There are a number of similar projects in the world, e.g. airports, freeways, metros, bridges, stadiums and exhibition centers, to name just a few. Therefore, the organizational, economic, managerial and technical Information of completed projects are useful

for new capital projects under development. However, few software products for development management are available in the market.

2.2 Project Management Information System (PMIS)

Investors, developers, designers, contractors and suppliers have used PMIS to control their own projects for more than two decades in developed countries. “PMIS - a system used to chart activities and data and used to track progress and information flow in a project that is most frequently computerized, but not always.” “PMIS - the gathering, recording, filtering and dissemination of pertinent information for members of a project team.” (Wideman Comparative Glossary of Project Management Terms).

The author of this paper and his research team developed a PMIS for the first line of Shanghai Metro in 1990. The main functions of this system are cost control, time control, quality control and contract administration. We didn't have access to the internet at that time. The system was available only to the project management team of Shanghai Metro Corporation. Since 1990 China has built up a number of infrastructure projects and residential buildings; but PMIS has been used only in a few cases.

2.3 Facility Management Information System (FMIS)

There are different interpretations of the term facility management, since organizations provide services related to FM from various viewpoints. The International Council for Building Research Studies and Documentation (CIB) has its explanation on the meaning and tasks of FM. According to them, FM comprises two important parts: property management and operational management. Property management consists of financial management, space management and user management. Operational management is composed of maintenance management and modernization management. There are many products of FMIS. ARCHIBUS/FM is just one of them. “ In its sixteenth generation, the ARCHIBUS/FM product line includes tightly integrated products for managing the costs, forecasts, and workflow associated with your properties, leases, space, fixed assets, telecommunications, maintenance, and moves.” “ Our 100,000+ users manage 1.4 million buildings containing 16 billion square feet. They continually help us improve our benchmarking, best practices, and usability. ”;“ ARCHIBUS/FM is sold and supported by a global network of 1,600+ business partners who have

adopted ARCHIBUS/FM as the only truly open solution on the market. These highly experienced resources, who operate in 100 countries” (ARCHIBUS) In contrast, there are much fewer users of ACHIBUS in mainland China.

2.4 Integrated Research of Information System

There are many integrated research projects of information system for management of construction projects. For instance, at the University of Sydney a prime research for the PM Research Group is on Life Cycle Project Management in which Integrated Facility Engineering (IFE) is developed as an experimental system. It has the following integrated main modules (PM-WORLD):

- (i) Smart Project Management Information System (SPMIS)
- (ii) Visual Design Management System (VDMS)
- (iii) Soft Issues Management Systems (SIMS)
- (iv) Dynamic Simulation Modeling System (DSMS)
- (v) Construction Management Information System (CMIS)

DMIS, PMIS, FMIS and other information system for management purpose support investors, developes, designers, contractors, suppliers and operators in their performance of DM, PM and FM in different project phases, as shown in Fig.2-1. To promote this information systems lays the basis for digitization and informatization of professional management of construction projects.

Fig. 2-1

3. Development and Application of Project Information Portal (PIP)

The new information-processing environment and electronic distribution of information have brought new challenges and increased the need to address the issues of rational and effective management of construction projects. Among investors, developers, designers, contractors and operators of the same project there is a close

relationship between information providers and information receivers, which is shown in Fig. 3-1. In particular, the information relationship between investors, developers, designers and contractors is very important for the successful completion of a construction project.

Fig. 3 –1

There are different terms belonging to project management portal, e.g. Project Specific Web Sites, Project Web Site, Project Hub, Project Extranets, Project Portal, Web Based Project Management, Web Based Project Communication and Web Based Project Collaboration.

3.1 Functional Analysis of Project Information Portal (PIP)

A number of PIP related products indicate their main functions as follows:

- Internal:

- project target control (investment/cost control, time control, quality control),
- project communication between project management team members, and between project management team and internal organizations,
- project document management (internal),
- project collaboration between project management team members, and between project management team and internal organizations.

-External:

- project communication with other project participants ,
- project document management (external) ,
- project collaboration with other project participants.

3.2 Case 1 – Extranet Based Project Information System (PIS)

If investors developers and other project participants have only LAN, that may mean they do not have a webspace provider. Then extranet based PIS can be used, as is shown in Fig. 3-2 (Peter Loshin, 1998).

“The goal is to enhance communications between the architects, owners, consultants and contractors in order to reduce errors, omissions, and coordination problems in construction documents.” “The PIS will be a fully web enabled system. Full access to the PIS will be made available to all participants through commonly available HTML browsers and Public Internet Service Provider accounts. All project documents must be accessible through the Web Browser Interface.” “The contractor will be able to have access to design drawings for developing installation, coordination, and shop drawings. The architect will receive regular updates to project plan from the contractor showing the as – built conditions.” (Robert C. Schulz (<http://www.integrated-aec.com>)).

Fig. 3 -2

It is easy to use PIS in the establishment of the information processing environment and there is less additional cost for using products and facilities from any third parties.

3.3 Case 2 – Project Specific Web Site (PSWS)

Investors and/or developers have a webspace provider and owns a web site for their project. Other project participants, including architects, engineers, contractors, subcontractors, suppliers and operators, are able to get and transfer information and to communicate with each other and with investors and/or developers through internet and PSWS, as is shown in Fig. 3-3.

Fig. 3-3

“ PSWS is a secure closed communication environment utilizing the internet to link the major players of a construction project together.” “Communication between project participants has always been one of the most important elements contributing to the success of a project. By using a centrally located server tied to the Internet, all the participants can come to a central location to gather, record, and exchange information. More than just E-mail, the PSWS offers an intuitive graphical inter-face that can be assessed with the web browser.” “The benefits of the system include reduction in communication bottle-necks, elimination of telephone tags, reduction of travel expenses, shortening of review cycles, reduction of communication costs including overnight charges and pager bills , strengthening of relationships among users and among project partners and integration of project partners” (E-builder in Sustainable Design - Project Specific Web Site).

“ PSWS is a centralized electronic file system. Under the current system, the different sides treat their files a little like a hand in poker. ‘I will keep all these transmittals stashed here so I can slam the guy if we go to court.’ A mutual file system eliminates the poker face and has everyone staring at the same hand. It appears to push the lawyer's influence a little farther out of the building process. Under a system like PSWS, various workers seem to be on the same team with the project as the captain of the team. Everybody is working toward the same end, the betterment of the project.” (E design Online)

The author of this paper and his team were responsible for developing and maintaining a PSWS for Nanning International Conference and Exhibition Center project in mainland China. From this web site the major participants of this project are able to come to the central location for exchange of information, including basic information of this project, design drawings and related document, tendering documents, construction documents, contract documents, letters and memo s, meetings, cost control, time control, quality control, announcements, building materials and equipment and facility management.

3.4 Case 3 – ASP – Web Based Management Platform

Some application service providers (ASP) provide web based platforms for project management. Some websites are listed here for your reference. Buzzsaw (<http://www.buzzsaw.com>), Projecttalk (<http://www.projecttalk.com>), BuildOnline (<http://www.Build-online.com>), E-Builder (<http://www.e-builder.com>)

Users of such ASP platforms include owners and developers, architects and designers, building products, manufacturers (who sell products online), engineers and consultants, general contractors, reprographers, specialty contractors, suppliers and distributors and other professionals, as is shown in Fig.3-4.

Fig. 3 -4

Buzzsaw.com, an Auto desk business, provides online project collaboration and print management solutions during all phases of the building lifecycle, manages, distributes, prints and shares all project related documents and drawings in one secured location. Bauzzsaw.com has the following modules: Project Workspace, Bid Manager, Construction Management and Project Folders.

Service of Buzzsaw.com contains AEC Books and References, Bid Manager, Construction Management, Reports Design Tools, Dual CAD Viewer, Financing Internet Access, Materials Catalogs, Online Classes, Online Meetings, Orange Pages™ Directories, Outsourced IT and Computing Printing Tools, Project Hosting, Unified Inbox and Web Camera.

“ ProjectTalk is an online project management and collaboration tool of Meridian Project Systems. Founded in 1993, Meridian Project Systems is a leading software and e-business provider for the construction industry. Powered by Prolog, ProjectTalk is the most comprehensive, cost-effective project management and collaboration service available today.” “ Prolog Manager is recognized as the world’s most comprehensive project management application, with over 30,000 users in 5,000 companies worldwide. Having it available as an Internet subscription service through ProjectTalk gives building professionals who do not wish to purchase software and infrastructure the same tools, data, service, and rich functionality as those who do, in one destination site.”(Projecttalk.com).

Construction industry is becoming more and more global, with development teams distributed throughout the world. Such ASP platforms for investors and/or developer function to

- manage the entire construction programs from any computer with an internet browser and manage all projects regardless of who the contractors are in undertaking the work;
- provide powerful collaboration and project control tools;
- imagine collaboration with architects, construction managers, contractors and all other project stakeholders - all in one place - and then running a detailed project budget report or a query on potential change orders across each project in construction programs .

To managing a design development effectively, review and distribution are more critical than anything. The functions of such ASP platforms for architects and engineers are follows:

- allow collaboration tools to manage both documents and data critical to design production and construction administration responsibilities;
- track any documents including drawings and project photos;
- monitor project data including requests for information, submittals, meeting minutes, punch lists and field inspections.

Both software and hardware are important for the promotion and implementation of digitization and informatization of professional management of construction projects; however, organization-ware and education-ware are more important. The organization-ware has contents to define and analyze organizational structure, task and management function of each division, work flow, data structure, code system and data flow whereas the education-ware contains knowledge in the field of development management, project management, facility management and IT.