

## **Innovative application of Information Technology in China Construction Engineering Management: status quo, question and some advice**

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### **Abstract**

**The Layout Compendium of the Information Technology in Construction Industry from 2003 to 2008** was announced by the ministry of construction in Nov., 2003. This indicates the government drives the whole construction industry to apply information technology designedly. This paper describes the application status quo of information technology in china construction engineering management, and compares it with the advanced information technology in construction engineering management and analyzes the question and cause in China construction engineering management. Combined with the characteristic of Chinese construction engineering, this paper gives some advice, above all, one of the most important is to utilize government influence to drive the whole industry improvements, especially management systems and e-Government services should be improved as soon as possible. Then is to set up information gathering, share and exchange mechanism and the IT standard in construction industry, last is to apply advanced management technologies, such as Web-based central information management system and IFCs-based BIM for the whole construction engineering process, and to realize the construction engineering life-cycle management which is a tool for construction sustainable development.

### **Keywords**

Information technology (IT); China construction engineering management; BIM, whole life-cycle management.

### **1. Introduction**

The evolution of information technology (IT) is having a profound impact on all industries all over the world. The construction industry is also currently experiencing a paradigm shift from traditional paper-based to digitally based information exchange. To keep up with the development of the innovation application of information technology in the construction industry in the developed country, The Layout Compendium of the Information Technology in Construction Industry from 2003 to 2008 was announced by the ministry of construction in Nov., 2003. The Chinese construction industry is now going through such a radical change. This paper only discusses innovative application of information technology in construction engineering management in China. Because IT has been evolving very rapidly and its use

increases continuously and the dispersive character in construction industry, it is difficult to assess the current use of IT in the construction engineering management.

## **2. The Current Status of the Application of IT in Construction Engineering Management in China**

Currently all reconnaissance and design enterprises of A and B level are applying 2D CAD, few design firms are using 3D CAD; CAC (computer aided constructing) is applied widely. E-biding and e-tendering are trying out. Network technology is penetrating this industry. The survey in 2003 showed that 67% of big and middle construction enterprises use OA and 79.5% of those established intranet (Zhang J P. et al, 2004).

### **2.1 Unattached Management Systems**

In big engineering project in China, most participants use their own management software, for example, contractor apply own projector management information system, supervise firms has supervision management information system, design units have own designing project management system in the site, these systems are unattached separately. Now most systems are foreign systems which have been localized such as P3 ( Primavera Project Planner ) , P3e (Project Planner for the Enterprise ) , Sure Trakh and Texim. Others are domestic, such as PERT-intelligent project management system developed by Beijing Morrowsoft Company and GHPMIS project management information system. PERT system was used in Three Gorges project construction which makes value--RMB 0.12 billion and Qinshan nuclear power plant, also it was used in foreign project such as Tehran underground in Iran.

### **2.2 Collaboration Management Systems (Platform) or Intranet Management**

With the development of collaboration platform and market demand, some engineering project establish intranet or apply web server and collaboration software to manage constructing or designing phase to realize part information sharing of part work fluid. Few engineering such as Three Gorges project construction manage material and planning through the use of PDAs with always-on GPRS connections.

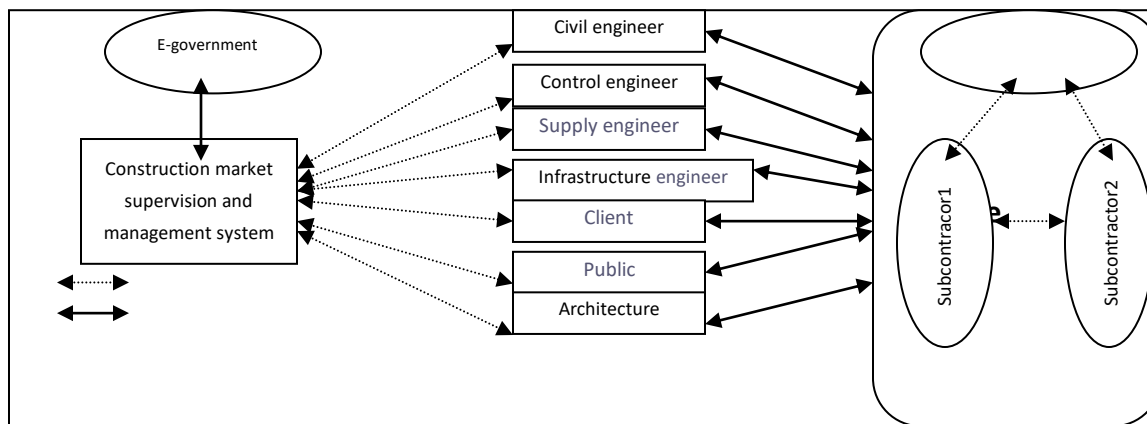
EPIMS (Electronic Project Information Management System) developed by Tsinghua university has been used in Beijing Olympic gymnasium project management since 2003. It realized collaborative management of contractor and 5 sub-contractors in the course of building.

Only few big firms are applying collaboration management platform in the enterprise level, for example, China State Construction Engineering Corporation has established constructing and building collaboration platform based on databases of construction project, material and sharing resource. China State Construction Engineering Corporation applies this platform to realize multi-project collaborative management.

In supervising and managing the industry market, some area established construction market supervision and management system or construction engineering bargaining centre information management system, which can manage enterprises, employee and the biding and tendering of engineering project. This system has been used in Chongqing, Zhengzhou and Shenzhen now. Moreover, the whole construction market is pushing IC management systems in China.

So, as a whole, in China, only part enterprises apply a certain part of IT separately, and even use them as typewriter and plot tools. The users pay more attention to part functions, but ignore compatible development

for the whole project. Information systems are unattached separately; information transfer mostly remains paper-based over the whole life cycle (figure1). In a word, IT only provides certain means for construction engineering management, the use of IT in construction engineering management remains primary phase (Changbin, Liu 2004).



### 3. The Trend of IT in Construction Engineering Management

Construction is one of the most information-dependent industries compared to other sectors, so construction engineering management is how to control and use information successfully (Changbin, Liu, 2004). Thus the evolution of information technology (IT) will undoubtedly centralize on information. The trends of IT in construction industry indicate recently that how to integrate information for construction projects and how to serve best for construction life cycle management.

#### 3.1 Web-Based Information Management Tools are Used to instantly Share and Communicate between Project Participants.

Recently, the use of IT is how to increase collaborative working which becomes more important in construction supply chains, so the trend of IT in construction engineering management is based on Web. Some ASP (Application Services Provider) establish information exchange or collaboration platform based on Web server for engineering management, which make each unit get information everywhere and every time.

BIW Information Channel™ in UK is a web-based supply chain integration communication platform, using it changes the fashion of information flow from accepting passively to obtaining as to demand. It improves efficiency and veracity of information utility. At June 30, 2004, the total number of BIW Information Channel™ users had reached 34,517, from 3,747 different companies. Collectively, these users have been working on around 2,000 projects with a total capital value estimated at around GBP 15 billion (CIMdata Co., 2004).

Autodesk Co. in USA provides Buzzsaw-online project collaboration which enables member to communicate, share, and track project information and drawings throughout the project teams.

### 3.2 To Keep up with Sustainable Development, the Direction of IT in Construction Engineering Management is How to Realize BLM (Building Life Cycle Management).

The hot issue is e-engineering (or e-collaboration) , which means that building plans, time schedules, calculations, technical specifications and other project data are shared between the parties involved in a project (architects, engineers, contractors, sub-contractors etc.) electronically on an unified platform to work just-in-time work(JIT).

Because BIM without standards is proprietary and ultimately not interoperable (Dianne Davis, 2003), today BIM (Building Information Modeling) based on IFCs platform is getting a lot of attention in the world AEC industry. BIM, which is a computer model of a building, links a three-dimensional, geometric description of the architectural elements to information about their properties and behavior. IFCs (Industry Foundation Classes) are model-based standards created by IAI groups and the only construction information standard recognized by ISO (International Standards Organization) (Dianne Davis, 2003). Now they have been set up in Australia, France, Germany, Japan, Korea, North America, the Nordic countries, United Kingdom and Singapore. BIM based on IFCs offers IT business solutions for the whole construction process (including design, build, own, manage and dismantle), and eliminates information dissever and disorder in different construction phase, so it can be seen as a core of e-collaboration to realize BLM. In USA, main software corporations such as Autodesk, Bentley Systems, and Graphisoft have systems of BIM based on IFCs, and these system have been used in projects, such as RTKL Associates Inc., Mestergruppen AS and A3 Architects, which lead to substantial savings in operating costs. So, IFCs-based BIM on Web will speed to integrate the information and process over the building life cycle. BIM-based BLM platform on Web will contribute to the construction sustainable developing (See figure 2).

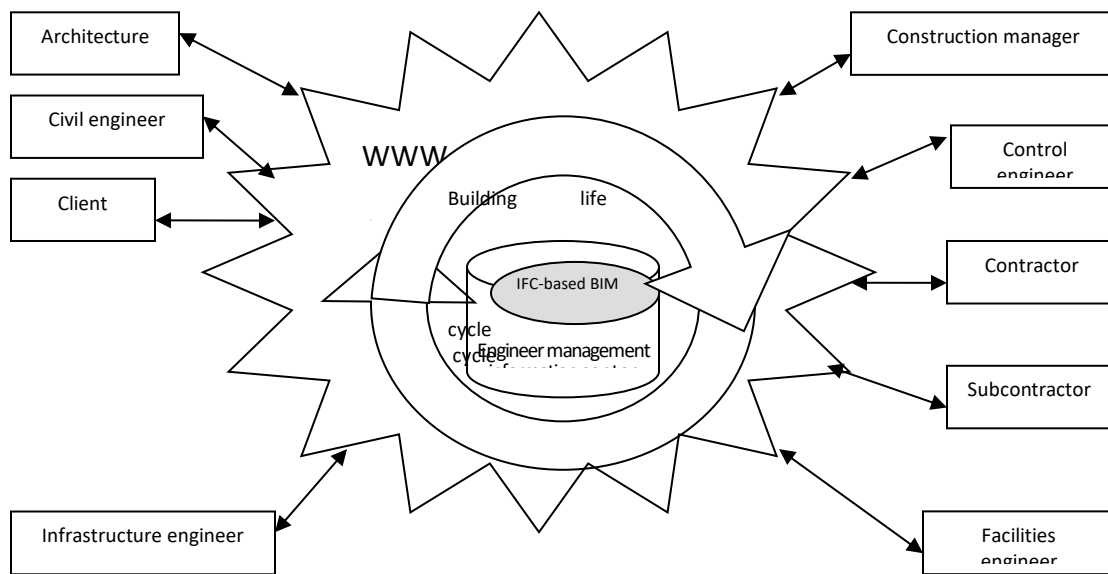


Figure 2: BIM-based BLM platforms on Web

### 4. Questions and Reasons in the Use of IT in the Construction Engineering Management in China

There are some questions in the use of IT in construction engineering management. First, information technology does not be applied widely; secondly, information islands remain ubiquitous; at last, the key

technology is absence. The reason leads to these questions as follows: First, connatural ideas to reject changing exist in working and studying universally. To be effective, any technology requires its users to change how they do things, but nobody wants to change natively. Second, system, information and workflow standardization, and mechanism about information exchange and updating have not established. Standards are critical for building integrated databases and interactive applications that are web-enabled. Now there are not uniform construction information code and normative system port in China. Because information code, workflow and system interface port in the whole construction processes are different from each other; the design information produced can not be used in constructing and operation management. Then, the current construction management system in China dose not matches with work paradigm which information technology demands. Design, building, operating management and dismantle are separated from each other. Last, investments are not enough and complex people are absent.

## **5. Proposals**

### **5.1 Intensify the Drive Effect of Government in the Use of IT in Construction Engineering Management adequately**

Government at all levels is a major client and industry regulator and legislator, so they have a responsibility to use its position to drive the whole industry improvements in the use of IT in construction engineering management. Firstly, government demands large-scale engineering project to apply advanced technology such as online information management system and BIM in the design or facilities management phase. Secondly, government quickens construction management system reform to make it keep up with the course of the use of IT. Effectively using IT needs a lean business environment where the supply chain will be restructured and integrated. BLM model is to be the all round service provider (from design to financing and operations of a building) instead of just the construction of buildings, Such as Design & Build, this is called Re-engineering. Last, in G2B (Government to Business), e-Submission system is demanded to drive industry professionals to keep up with e-government. Furthermore, government integrates e-government system and construction market supervision and management system to realize the function of government management, which drives the use of IT in construction engineering management effectively.

### **5.2 Set up Information Gathering, Share and Exchange Mechanism and Standards on the Application of IT in Construction Industry**

Standards are critical for building integrated databases and interactive applications that are web-enabled and BLM-needed. When IFCs and other standards for AEC/FM interoperability are more mature and better implemented, an integrated design, construction, operation and maintenance process throughout an entire building life cycle is likely to happen (Robert L.K. Tiong, et al, 2005) Now there are not uniform construction information code systems and interface ports in construction industry in China. Each operation information code and workflow in the whole construction processes is different from each other; the design information in design system can not used in the systems of constructing, operation and facilities management. IFCs (Industry Foundation Classes) draw by IAI (International Alliance for Interoperability) became one of international standard in ISO international conference in Korea in Nov., 2002, and many countries in North America, European and Asia are researching and applying it. They are opening standard, we can adopt and research these standards and develop it according to our need.

### **5.3 Encouraging National Research to Grasp the Direction, Research and Research user Work as a Whole.**

The use of IT in the construction industry lags behind other developed countries. To avoid us reinventing the wheel, we should study and adopt advanced technologies, such as IFCs-based BIM which can integrate construction process, and improve them to suit our demand in the course of use gradually.

Universities, colleges and institutes should work in unison to establish better ways to engage and collaborate with the construction industry with the prime objective of bringing forward innovation.

Research and research user as a whole not only help to technology transform to productivity, but also provide one finance mode.

#### **5.4 Giving Publicity to People and Training**

Today, the construction industry in China is undergoing impact of IT, the work and study paradigm are suffering shift, but the holistic diathesis of people is far lower than ones in developed nation, so to poise to experience such a radical change, strengthening education and IT training is essential. A major shift from this training philosophy is necessary. At first, IT training is given to the people of decision making and helping to decision. Because the business case for IT investment in construction is normally prepared by the IT manager of an organization for decision making by senior management, but IT managers frequently lack a full understanding of the organization's business and are often not involved in the senior management decision-making of the company, Senior management who do understand the business are usually ill at ease with the emerging information technologies. Then, IT training is given to the domain personnel who practise architecture, engineering, quantity surveying or construction, because these people's skill and knowledge infect directly the use of information technology in construction engineering management, Skill shortages hinder the development of better construction practice and solutions but if they have found it accessible and easy to use, they will be more open to further IT solutions. Then there is a need for education institution to produce some national training curriculums of IT and special knowledge, and making them to provide for certain essential the platform of educate and training, to extend to producing people who are well-versed in both IT and business operations, because they will design IT solutions and workflow processes that enable companies to run these functions remotely. In another word, the China University's concordat should be further investigated and developed to make careers in construction research more attractive. Last, Propagandizing diffusely changes people's consciousness with every medium such as TV, network, proseminar and exhibitions, and to encourage innovating and changing work and study paradigm.

#### **5.5 Creating One multi- Source Financing System**

It is essential to create one multi- source financing system which includes government, enterprises privacy and foreign investment. For example, obliging some bankroll from commonweal service fund and absorbing domestic and international social sponsor to establish the industry development fund on the application of IT every year, which help to research key technology. Big information system can apply the finance mode of Build Operate Transfer (BOT), which the blue print provider charge all or part investment to build and operation, then transfer the system to the owner.

### **6. Conclusion**

The uses of IT in construction engineering management improve the quality and velocity of engineering, and reduce building cost. IT has been evolving very rapidly and its use increases continuously, e-Engineering, e-Submission and web-based BLM is the direction of IT in construction engineering management.

While having cognizance of the important of IT in construction engineering management and the gap from developed country, if only we research and absorb and develop these technologies and standards, and reform the management systems and innovate the idea, the use of IT in Chinese construction engineering management can keep up with developed country.

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