

# A survey of the Internet application in the AEC industry

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**Abstract:** The Internet is becoming increasingly more valuable in the field of architectural design so that what we conventionally called CAD might soon be changed to Internet aided design (iAD). In order to have a clear vision of what IAD will be or could be, we should first examine what is currently available. This research focuses on an investigation of selected Web vendors, which are typical and most influential in providing Internet related services for the AEC industry. By comparing and analyzing their functionality, services provided, business models, technology and financial situation, we have seen that Internet application in the AEC industry is still in early stage, especially in the area of on-line engineering consulting for architects.

**Key words:** Internet aided design; Web services; Web vendors in the AEC industry

In order to carefully examine and compare the selected Web vendors, a series of specifications were designed for a survey, including audience, services provided, business model, geography and language, ownership and technology in the format of a comparison table, followed by a detailed explanation and analysis. Finally, we present our own observations based on the results of the survey. Through this process, we can reach a representative understanding of the Internet applications in the AEC industry.

In deciding which vendors to include in the survey, three factors were taken into consideration: influence, representation and commercial value. The Web vendors should have enough influence in the AEC industry in terms of scale and usage. They should be typical in representing the major categories of contemporary service-based Web vendors. Finally, these Web vendors should have clear business models. Our final selections were not necessarily based on the best vendors nor intended to cover all vendors

There are three major types of Web portals in the field of Internet applications in the AEC industry. The first is a comprehensive project hosting, which basically provides project management from design to construction and in some cases, to post-occupancy. The functionality is comprehensive, including on-line design and consultation, collaboration and life cycle project management. Fig.1 shows one of the most

popular Web sites for engineering consulting in the AEC industry, web4engineers.com, which basically is a portal for engineers including not only static information but also systematic Web-based dynamic services including software application on subscription base, vendor products and libraries, online meeting and project management.



Fig.1 www. web4engineers.com

The second category is to provide on-line design and consultation services, including information searches, Web-enabled applications, and on-line engineering consultation. However, it has not been popular for the practice due to technology infrastructure limitations and safety considerations. The third category is specialized in one or very few functions, such as collaboration, printing, drafting, and CAD libraries. Ezmeeting.com has been one of the pioneers in this area. Fig.2 shows its basic function composition.

## 1 Comparison and Analysis of Functionality

An object-behavioral approach has been adopted

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to compare and analyze the functions or services of the Web vendors. Here the objects refer to the people who use the services or the services themselves and the behavior refers to the object's response and feed-back after the interaction with the objects. Tab.1 displays all compared objects. In this section, we will examine the following aspects: the audiences, services provided, business models, technology, served geography and language, and finally, ownership.



Fig.2 www.ezmeeting.com

Tab.1 Vendors and services

Specifications vendors	Audiences		Services provided			Business model technology	Geography and languages	Ownership and launched date
	Primary	Secondary	Collaboration	Design and consultation	Construction			
Bricsnet .com	Architects, engineers, contractors, building managers	Vendors, developers, owners	Sharing documents and drawings, redlining, message, discussion forum	Design information: vendors and materials, CAD libraries, off-line design tools	Building and operation management	E-store: software and supports, other retail products related to AEC, time-based fee central server	International: (7 languages) North America, Europe, Asia	Public, IPO 1999 in Europe founded in 1986
Comprehensive project hosting Buzzsaw .com	Architects, engineers, contractors	Vendors, developers, owners	Sharing documents and drawings, redlining, on-line conference	Project management, design information	Bidding, printing	Time-based fee on each service, central server	International: (English) mainly in North America	Private, USA launched in 1999 (Autodesk is one of the owners)
Viecon.com	Architects, engineers, contractors	Vendors, developers, owners	Sharing documents and drawings, redlining, on-line conference	Project management, design information	Bidding, printing, building management	Time-based fee on each service, central server	International: (English) mainly in North America	Private, USA (a subsidiary of Bentley)
Design and consultation Web4engineers .com	Architects, engineers	Contractors, vendors, developers, owners	Sharing documents and drawings, redlining, message, discussion forum	Design information, Web-enabled applications		Rent Web-enabled software applications on per-use and timing fee bases central server	International (English)	Public, a subsidiary of Netguru, USA launched in May, 2000
Gdl.graphi-soft.com	Architects, designers	Engineers		Archicad-based objects access on-line, publishing on Web		Free central server	International (English, European)	Public, Hungary
Collaboration Ezmeeting .com	Architects, engineers, other designers	Contractors, vendors	On-line conference, CAD file viewing and editing, sketch			Software licensing, advertising FIP Model	International (English)	Private, USA

1.1 The audience and behaviors

In the building industry, many professionals are involved in a variety of processes from design through construction to post-occupancy. Many activities are interrelated. This complexity and fragmentation have been the major reasons for the lower efficiency of Internet applications in the AEC industry compared to the manufacturing industry<sup>[1]</sup>. Fig.3 shows the parties and their behaviors in the building processes. They are the key considerations for which audiences are targeted and the related services that can be provided by Web vendors.

From Tab.1, we can see that the Web vendors for comprehensive project hosting deal with almost all of the audiences for services provided. However, the primary audiences are architects, engineers and contractors who actively take part in collaboration

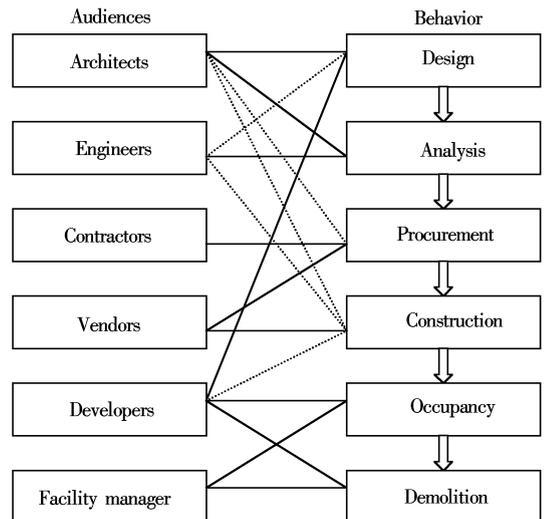


Fig.3 Relationship of audiences and behavior in building process

during design and construction periods, whereas, vendors, developers and the rest of partners in building

industry are secondary audiences in most cases. As we mentioned in the previous section, the vendors who provide design and consultation services draw their attention mainly from architects and engineers and the rest become secondary users. In some specialized Web services, such as printing and CAD libraries only serve certain users.

Tab.1 shows that none of the audiences, whether they are primary or secondary users, are served for the entire process. In other words, only partial services are provided by comprehensive project hosting vendors. For example, architects and engineers, as primary users, are mainly interested in design and analysis processes but not in construction and post occupancy. This limits the usage of Internet applications to some degree compared with the manufacturing industry, in which almost all the major audiences, such as designers and consulting engineers have an interest in the entire process of production. Fig.4 and Fig.5 show the difference in the relationship of designers and the process of activities in building industry and manufacturing industry.

In the building industry, architects and engineers are somehow apart from the final process of building construction because the documents and the shop drawings, which directly guide construction, are produced by contractors. By contrast, in the manufacturing industry, designers and engineers are directly responsible for the whole process of product manufacturing<sup>[2]</sup>. This difference may be one of the reasons that the manufacturing industry has made far greater progress than the AEC industry in the field of

Internet applications.

Current Web content and how it is used have not changed the nature of the AEC industry, rather it follows its complexity and fragmentation. One positive aspect is that contemporary Web vendors have attempted to cover all major parties and activities in their services.

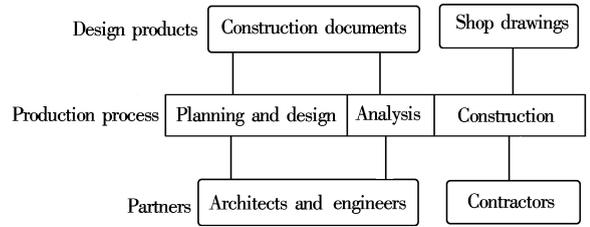


Fig.4 Relationship of design activities and building process

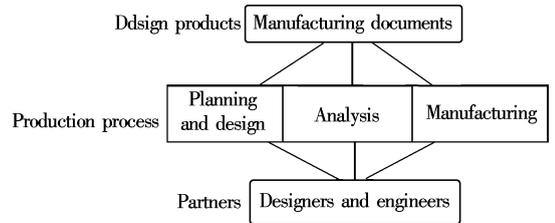


Fig.5 Relationship of design activities and manufacturing process

1.2 Services provide

There are three major types of services provided by the Web vendors from comprehensive project hosting to specific tasks: collaboration, design consultation and construction and management. These three services are frequently independent or overlap. Fig.6 shows the relationship between services and building process.

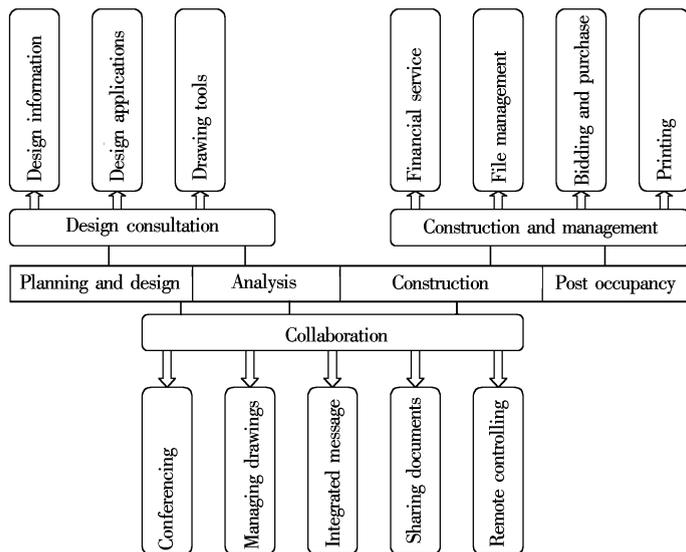


Fig.6 Detailed services provided by Web vendors

Among the three categories, on-line collaboration is the most mature and advanced in the AEC industry. There are a number of reasons for this. First of all, the most powerful tool of the Internet technology is a way for people to share information and communicate with each other. Hence, on-line collaboration becomes the natural result by using the Internet. The second reason is that the applications in the manufacturing industry have demonstrated a successful example for the AEC industry to follow.

Construction and management are the second to on-line collaboration in practice and some research progress has provided feasibilities in this area, such as Web-based construction scheduling<sup>[3]</sup>. A project life-cycle management model has become popular in the AEC industry covering the whole construction process and in some cases, even served for post-occupancy as facility management.

On-line design and consultation is the least developed tool among the three types. Most of the comprehensive project hosting vendors only provide off-line design tools and applications. A few of them are beginning to develop on-line applications, in which, software is running on the server side rather than on the local client side. One of the reasons is that the information technology itself (both hardware and software) is not mature enough to have online applications. The second reason comes from the traditional thinking and way of work. People think it is safe and reliable to work on design and other applications on their local systems and communicate with other partners by using the results from client side applications. There has been a tendency that more and more on-line applications running on server side will replace the stand-alone personal computer's function as the technology develops, such as microsoft.net, which is aiming to provide an Internet platform to replace its Windows operating system products.

### 1.3 Business models and financial situations

One of the key issues for the survival of dotcom enterprises is how to make a profit in running their businesses. According to our survey, most of the vendors are still struggling for profit. Compared with general public portals, such as Yahoo and MSN, which get their revenues mainly from advertisement, vertical portals or more industry specific Web vendors have more options to develop revenue generating services.

In general, there are several business models for Web vendors in the AEC industry. For comprehensive

project hosting vendors, the business model is also comprehensive. Revenues come from several resources, such as time-based fee or project-based fee, commissions from serving the material vendors and contractors in participating in the projects, and E-store of software and supports and the AEC related retail products. Of course, advertisement is also another income source.

For specialized vendors who provide design and consultation, income mainly comes from renting their Web-enabled software applications on per-use and time-use basis. In this case, users do not have to incur costs for updating their software and installing large amounts of information on their local systems. For other single service vendors, their revenue comes from the services provided on single use or amount bases, such as printing or messaging. For on-line bidding, the income comes from commissions. Some of the vendors provide partially or entirely free services for certain users, such as architects and engineers in design and product information, whereas the vendors can either get profit from advertisement or from an inter-media fee paid by other product or service vendors

Most of the vendors have launched their services within the last four-to-five years. However, most of them are still struggling for survival. In fact, during the past couple of years, as the dotcom bubble bursts, only a few of the Internet vendors still exist and most of them have vanished. For those, who are still running their businesses, either they have parented with some of the software giants for milk or narrowed their services for specialization. For example, one of the most popular online management vendors, buzzsaw.com has been merged with Autodesk company. Fig.7 shows the comparison stock behaviors during the past four years of the three selected IT companies, Autodesk, Aol and Yahoo.

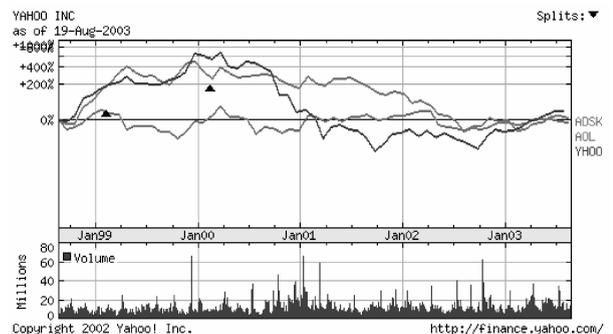


Fig.7 Comparison of the stock behavior for IT selected companies

From the charts we can see their financial

situations during the Internet burst period of time, which reflect some of the characteristics of their business models and future development. For these three companies, Autodesk is the most stable because its software products have been its core business for many years, instead of Internet related services. Meanwhile AOL is similar to Yahoo for their Internet portal services. However, in the worst period of time during 2001 and 2002, AOL performed much better than Yahoo because AOL merged with traditional media Giant, Time & Warner, attempting the joint venture of both traditional and new economy tools. Yahoo is a purely Internet service provider, and it has been hurt very much as well. But recent developments have shown its hope in a new business model and revenue generation for providing more online services by converting traditional services into Web-based models.

#### 1.4 Technology

For technology, three major models were observed. One is a project-based central server usually run by a construction company or design firm depending on the nature of the project. The second is a central based project-hosting server providing services for many different projects worldwide. This is the most common in AEC industry. The third is an FTP model, or file transfer protocol, which does not rely on central server and Web browsers.

The FTP model has evolved from early peer-to-peer networking among academic and government research centers. It was mainly concerned with security issues to avoid central server and central switch nodes. Today, FTP has made things easier than pure peer-to-peer systems by providing public directories for work partners to retrieve files. Because of its peer-to-peer property, the advantages of using the FTP model are easier and more powerful in real time. They permit spontaneous interaction in sharing and collaboration among limited partners<sup>[4]</sup>.

The central server and browser-based model has become overwhelmingly more powerful as a dynamic Internet technology develops in providing more interactive services and more complex applications on the server side. Compared with the FTP model, one of the advantages is that the central server model can have more people join in real time meetings and collaboration. Another advantage is to be able to manage comparatively large amounts of information for project management.

#### 1.5 Geography and languages

According to our survey, most of the vendors are internationally oriented. However, English is the most dominant language and most of the services are hosted in North America and Europe. Some of the vendors cover parts of Asian and Pacific regions.

It is difficult for Web vendors to provide truly international services mainly due to the diversity and complexity of national and regional differences in building technology and building codes. Here, again, we see the advantages of the manufacturing industry, in which it is much easier for Internet applications because of established international industrial standards and companies with many international locations or sub-contractors.

#### 1.6 Ownership

Ownership of Web vendors in the market is either private or public. An interesting observation is that some of the founders are also CAD software providers, who have recognized the importance and future market value by extending and integrating their services into this new area. For example, Autodesk is one of the owners of Buzzsaw.com, whereas Viecon.com is a subsidiary of Bentley. Both of them are major CAD vendors in AEC industry.

### 2 Observations

After completing the first stage of this survey, we include some of our observations in the form of a series of questions, which hopefully could be answered in future research:

- 1) How can we integrate the complex and diversified contents and properties of AEC industry to make more efficient Internet application or do we follow the current nature of the AEC industry and implement small improvements?
- 2) How to integrate client based CAD software with Internet applications to greatly utilize the advantages and avoid the disadvantages for both systems?
- 3) What applications can be developed on the Internet platform for design and consultation rather than just communication and collaboration for AEC professionals?
- 4) Are there other business models for Web vendors? Market forces and technology issues may be the limitation for recent results.
- 5) How can we learn from the manufacturing

industry in using Internet technology and integration of design process and data?

6) Does a new model of communication and integration require a new model of design delivery in the AEC industry?

The final question may be the most important of them all. Will the creative use of new technology suggest a different approach, or will it simply support current models of delivery?

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# 互联网技术在建筑及工程中的应用

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**摘要** 互联网技术在建筑与工程中的应用已越来越受到重视,为了理清该领域的发展状态,以便为建立新的 iAD 模式奠定基础,该研究有选择性的对比较典型和在建筑工程领域中有较大影响的网络服务供应商进行了调查和分析;包括种类、功能、服务对象、营运模式、金融状态、地理、语言的因素.从中我们发现互联网技术在建筑与工程中的应用处在起步阶段,并没有被广泛地运用到实际中去.

**关键词** 互联网辅助设计; 网络服务技术; AEC 领域中网络服务供应商

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