

**PRESENTING INTERACTIVE PRODUCT INFORMATION**

**ON THE WORLD WIDE WEB:**

**THE CASE OF ON-LINE BUILDING PRODUCTS**

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**Thesis for the degree of the Ph.D. submitted to the University of Edinburgh**

**2001**



I confirm that this is my own work, has been composed by myself, and does not include work submitted for any other degree or professional qualification.



Dedicated to my son Mete Alp Ofluoglu  
and my wife Gulin Ofluoglu

## ABSTRACT

Building product information, the technical information about building components, materials and finishes used in buildings, has traditionally existed in paper-based media. Due to the increasing integration of computers into building practices and various shortcomings of the paper-based media, product information has also been made available in electronic media such as floppy disks, CD-ROMs and lately, World Wide Web sites.

It appears that the Web, apart from being the latest, is perhaps the most promising platform to disseminate building product information. The Web presents new opportunities in organisation, presentation and distribution of product information.

A number of manufacturers and suppliers have chosen to promote their products on the Web due to the efficiency and the growing business value of the medium. Many companies, some of which are also the publishers of paper and CD-ROM based catalogues, have introduced on-line catalogues. The Web, along with other Internet services such as e-mail and File Transfer Protocol (FTP) is gaining a greater acceptance in the architectural community. A considerable number of architectural firms take advantage of on-line product information.

In spite of the increasing use of the Web as a product information source, there is not much research on how architects and other building professionals use this source, which problems they encounter, what changes they would like to see, what opportunities and challenges this emerging media holds. As yet, there has not been much research examining these issues.

This study tackles these issues. It contributes to a greater understanding of the relationship between design and information, particularly electronic information. There are issues to do with:

- Ways of accessing, sorting, browsing, editing and selecting information.
- Challenge of the emerging and changing medium of the WWW.
- Coping with information explosion and increasing media options.
- Virtual offices and distributed systems.

These issues will be addressed by focusing on the specific problem of product information. The research consists of three phases:

The first phase involves conducting a web-based survey among mainly architectural practitioners. The primary objectives of the survey are to collect information as to how architects are using web-based building product information, and to explore the strengths and weaknesses of existing building product Web sites.

The second phase of the research is to develop a prototype utilising the data collected from the survey. The prototype called Interactive product Selector (IPS) is a highly interactive Web-based environment developed using the combination of CGI/Perl, Java, JavaScript and VRML technologies. The IPS acts like a decision support system offering an intuitive user interface, visual product support, the ability to self-navigate products in three-dimensions, the means to make comparisons between different building products.

The third phase is the user testing of the IPS. The system was presented to architectural practitioners to obtain feedback. The significance of this phase was that it helped identify possible uses for the IPS and raised new issues with on-line product information in general beyond the ones addressed in the survey.

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## CHAPTER 1: INTRODUCTION

The Internet has become a major medium for doing business. It constitutes a giant marketplace comprising hundred millions of users and generating billions of dollars of sales. The commercial activities taking place on-line are commonly referred as electronic commerce or e-commerce.

The most exciting e-commerce activities occur on that portion of the Internet known as the World Wide Web. The Web offers an important improvement in reaching new customers and increasing the speed of business transactions while reducing the per-transaction cost<sup>1</sup>.

There are a number of successful and innovative commercial applications on the Web. Perhaps, the most commonly known example is Amazon.com<sup>2</sup>, a major retailer for books and audio-visual media on the Web. The company, which was established to operate solely on the Web in 1995, has reached a customer base of millions in a short time, and its value in NASDAQ stock market has climbed up to a level that is higher than many well-known, established companies<sup>3</sup>. The rapid growth of Amazon.com lies in its unconventional techniques to reach customers and to have a continuing dialogue with them<sup>3</sup>. The growth of Amazon.com also encouraged other bookstores such as Barnes and Noble<sup>4</sup> to offer on-line services<sup>5</sup>.

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<sup>1</sup> Jutla, "Making Business Sense of Electronic Commerce," *Computer IEEE*, pp. 67-75.

<sup>2</sup> <http://www.amazon.com>

<sup>3</sup> Amazon keeps a profile of its users and makes product suggestions based on their previous selections and purchases. In Amazon, ordinary consumers act like critics making comments on products. This, in turn, assists other consumers in their selections.

<sup>4</sup> <http://www.barnesandnoble.com>

<sup>5</sup> The fortunes of so-called dot coms seems to wax and wane, and at the time of printing the stock value is at a low.

The Web also provides a platform for entirely new products and services that were not feasible before. Some of these are: Bargain finder<sup>6</sup> by Andersen Consulting that searches the Web for best deals about audio CDs; PriceLine<sup>7</sup> that allows consumers to purchase services and products in their suggested prices, and Virtual Vineyards<sup>8</sup> that acts as an on-line intermediary between consumers and small wineries.

Many established companies take advantage of the Internet to expand and improve their existing off-line services as well. Some of these companies are: Federal Express (FedEx)<sup>9</sup>, a traditional courier service in the USA, allows customers to track packages online from a departure point to a destination site using an air bill ticketing number; Dell<sup>10</sup>, a computer manufacturer, conducts 50% of its sales over the Web<sup>11</sup>; McGraw-Hill<sup>12</sup>, a well-known publishing company, puts the content of some of its beta books on-line in order to obtain feedback from readers before publishing.

As it appears, new e-commerce opportunities on the Web radically change traditional ways of conducting business activities. What about the implications of the Internet revolution and e-commerce on architecture and the building industry?

One important implication we see is that many more firms have begun to take advantage of the distributed practice, which was previously overwhelmingly utilised by large firms and corporations. Any firm with an Internet connection can share resources and expertise on-line, and transfer documents and drawings much faster than before and at a nominal cost. The simplicity of on-line collaborations enables firms to expand their scope of work. Today, a growing number of firms choose to work with international clients and are involved in overseas projects.

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<sup>6</sup> <http://bf.star.ac.com/bf>

<sup>7</sup> <http://www.priceline.com>

<sup>8</sup> <http://www.virtualvin.com>

<sup>9</sup> <http://www.fedex.com>

<sup>10</sup> <http://www.dell.com>

<sup>11</sup> Dell Corp., "Dell Company Facts," [http://www.dell.com/us/en/gen/corporate/factpack\\_000.htm](http://www.dell.com/us/en/gen/corporate/factpack_000.htm)

<sup>12</sup> <http://www.books.mcgraw-hill.com/betabooks.html>



The Internet's becoming a business reality also has an effect on the design of CAD systems, the major design and drafting tools for design and architectural firms. In order to respond to the changing nature of architectural and building practice, many CAD vendors revised their products. Recent versions of most CAD software are internet-enabled, i.e. equipped with tools for publishing, viewing and exchanging CAD data on the Web.

Today, the Web along with e-mail and File Transfer Protocol (FTP) is one of the most widely used Internet services in the architectural community. The number of architects with on-line access steadily increases, and many of these firms have Web presences as well<sup>13</sup>. Web pages of architectural firms are being used for a variety of purposes such as a marketing platform, collaborative medium and to illustrate a firm's awareness of technology. A small number of firms also use the Web as a direct product sales platform. The type of products sold in this way generally ranges from office souvenirs to books and house plans. On the other hand, providing on-line architectural and design services directly to consumers is a lot less common. The nature of services offered in architectural firms is an obstacle in performing on-line commercial transactions with consumers. Design and architectural services are generally too costly to be sold as readily as consumer products such as books and CDs<sup>14</sup>. Another and perhaps more important reason is that a successful working relationship between a client and architect, in many cases, necessitates face-to-face communication, loyalty and previous experience.

Nevertheless, one area in architecture and building practice in which e-commerce has flourished is the building products industry, a major construction sector generating billions of dollars worldwide<sup>15</sup>. Building products are the

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<sup>13</sup> Hase-Shannon, "Use of Product Information and the Role of the Internet Among AEC Professionals," *Rose Research Report*; DeGennaro, "Re: Architects With Web Pages."

<sup>14</sup> Novitski, 1999, "Consumers are Buying Goods on the Internet in Growing Numbers: Will E-commerce Doom Retail Architecture," *Architectural Record*, p.234.

<sup>15</sup> The figure is \$40 billion annually only in the USA (Brown, 2000).

commodities of building, and building product information is, perhaps, the most common type of design information available on the Web. An increasing number of building product manufacturers and catalogue publishing companies utilise the Web as a new marketing and sales medium to present information about their products to a wider audience at a minimal cost.

The following section will briefly discuss the role of building products in design and construction and examine the suitability of the Web as a medium to disseminate building product information.

### **Building Products**

Building products are the materials, components and finishes used in buildings. They are the key elements in buildings that can determine the structure, quality and regional characteristics of buildings<sup>16</sup>.

The selection of building products is an important design decision. It can greatly affect the performance, form and cost of a building<sup>17</sup>. In order to make an accurate selection of building products, it is essential to access an adequate amount of information. This information, which is called product information or product literature, is the technical information about building components, materials and finishes used in building construction. Product information enables architects and other building professionals to make informed choices about alternative products and helps them specify and refer to a range of product qualities and technical requirements that can deal with product performance, energy efficiencies, installation details and standards.

Building product information has traditionally existed in paper-based media that includes hard-copy catalogues, brochures and trade journals. Due to the increasing integration of computers into building practices and various shortcomings

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<sup>16</sup> Dean, *Materials Technology*.

<sup>17</sup> Ario\_lu, "A Procedure for Selecting Building Product," *International Journal for Housing Science & Its Applications*, pp. 49-55.

of paper-based media, from the 1980s, product information has also been made available in electronic media such as floppy disks, CD-ROMs and, recently, World Wide Web sites.

It appears that the Web, apart from being the newest, is perhaps the most promising platform to disseminate building product information. The Web presents unprecedented opportunities in the organisation, presentation and distribution of product information:

- A Web site is an inexpensive way of publishing information as the cost of production and distribution is minimal. Consequently, information can be updated frequently. Especially the aspects of product information that require the most recent information such as new products, changes in product configurations and prices can be best provided on the Web.
- A Web site is accessible 24 hours a day, from anywhere in the world. The ability to access product information globally and in a great variety widens the horizons of designers.
- The Web is a highly interactive hypertext/hypermedia<sup>18</sup> environment. Information can be layered using multiple links, known as hyperlinks, according to a user's immediate and secondary needs, and the relevance of related properties and other information. Many interactive and highly sophisticated programming languages and presentation methods such as CGI/Perl, Java, JavaScript, Shockwave, Flash and VRML can improve users' visual and technical understanding about products. Animations, three-dimensional graphical presentations and user-directed, interactive browsing enhance the ability of the designer to assess the suitability of a product.

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<sup>18</sup> Hypertext is defined as non-linear or non-sequential text, i.e. writing and reading in "a more human way," that is, jumping from one thought to another, connecting ideas with appropriate links (Conklin, 1987). Hypermedia combines various information media consisting of, not only textual information, but also graphic and other audio-visual data.

## Problem Statement

Due to its efficiency, a growing number of manufacturers and suppliers have chosen the Web to promote their products. Many companies, some of which also publish paper and CD-ROM catalogues, have introduced on-line catalogues. As it appears, the building product industry is undergoing an important transformation.

A considerable number of design and construction professionals also take advantage of on-line product information<sup>19</sup>. One indication of this is, perhaps, the growing list of product site links on the Web pages of architectural firms<sup>20</sup>.

Despite this growth trend, perhaps, the major problem with Web-based product information is that, as of mid-2001, still a relatively small number of firms have chosen to promote their products in this way. Surely, the benefits of an electronic marketplace increase as more companies join the system<sup>21</sup>. One explanation of the underuse of the Web as a product information source is that the Web is still very new, and many manufacturers/suppliers do not have sufficient knowledge about this emerging medium. This is expected to change, as more manufacturers/suppliers understand how the Web can contribute to their businesses.

The problem with which this thesis deals is the inadequate information organisation and presentation methods deployed in building product sites on the Web. It appears that many of the companies providing product information on the Web use this medium merely for displaying existing information from paper-based publications without much structural change to the way they organise and present information. The result is linear, static Web pages mainly consisting of text and low-resolution, two-dimensional graphics. These presentation methods are particularly

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<sup>19</sup> Throughout the thesis, the terms on-line product information and web-based product information are used interchangeably to refer to the same thing.

<sup>20</sup> See the "The Sample" section in Chapter 4 for more information.

<sup>21</sup> Bakos, "A Strategic Analysis of Electronic Marketplaces," *MIS Quarterly*, pp. 295-310.

insufficient for dealing with the changing nature of consumers and the kinds of products offered today.

Consumers today are well informed. They have a greater control over the search process and would like to make comparisons between different products<sup>22</sup>. They do global searches looking for suitable products around the world. They have high expectations from the shopping environments they visit. For example, while in the real world consumers typically ask a shop assistant if they cannot find an item. On the Web, they immediately move to another site in pursuit of a suitable product.

Consumer products are also much more complex than those in the past<sup>23</sup>. For this reason, selecting the right product is not an easy decision. Most products are equipped with many advanced features and functions. For instance, even simple household items have a number of microchips inside. There are refrigerators that can receive commands over the Internet and utilise the Net for off-site troubleshooting<sup>24</sup>. Customers read thick user manuals to gain the technical knowledge necessary to understand how these complex products function. Products can also have numerous attributes such as colours, sizes, shapes and accessories, making the decision process even more difficult. In addition to complexities with products themselves, the choice of available products for similar jobs can be overwhelming. There can be dozens of similar products produced by different manufacturers for the same purpose. Comparing these products can be a difficult and time-consuming task.

The linear and static presentations as deployed in building product sites on the Web today are inadequate for responding to the needs of consumers and fully representing the qualities and richness of today's products. They do not fully utilise the advantages of the medium in which they are presented. There is a need for more effective methods to present building product information. These methods should

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<sup>22</sup> Hoffman and Novak, "A New Marketing Paradigm for Electronic Commerce," *Project 2000 Working Paper*.

<sup>23</sup> Danuer et al., "3D Product Presentation Online: The Virtual Design Exhibition," *Proc. VRML 98 Conference*.

<sup>24</sup> Gazio\_lu, "Akıllı Buzdolabına Televizyon Kumandası," *BTNet Haberler*, <http://www.btnet.com.tr/haberler/haber.asp?hbr=406512>, June 1999.

improve the understanding of consumers about products. They should address the following:

- Information seekers should have greater control. They should participate in searching, making decisions and shaping the outcome.
- Products should be described visually in three dimensions where possible (with the possibility of extension to the other senses).
- Tools for making comparisons between different products should be provided.
- Product information should be restructured by taking advantages of the Web, which is a hypertext/hypermedia medium that supports hyperlinking and rich multimedia data.

Interactive methods of presenting information provide one means of meeting the expectations of consumers and suitably representing the qualities of products. Interactive presentations offer an individualised and two-way flow of information between information transmitters and readers. Information receivers can engage with the content and navigate through it in their own ways. Interactive environments encourage participation and allow fair exchange, plurality of viewpoints and direct contacts between transmitters and receivers.

The Web accommodates a number of interactive solutions, and interaction is one of the most liked aspects of the Web<sup>25</sup>. Typical forms of Web interaction are discussion forums, live chat rooms, bulletin boards, audio and video conferencing environments, auction pages, game sites and user polls.

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<sup>25</sup> NetPoll, "Internet Users have Great E-xpectations," *M2 Communications Ltd.*



Some of the best uses of interaction on the Web involve the presentation of consumer products. Several good examples of interactive sites are: NikeId<sup>26</sup> that enables consumers to design their own shoes, PresentPicker<sup>27</sup> that suggests gift ideas based on the occasion and personalities of buyers, CDIY<sup>28</sup> that allows consumers to create their own compilation CDs, idTOWN<sup>29</sup> that gives buyers the opportunity to design their watches, iPrint.com<sup>30</sup> that sells customized stationery, mugs and T-shirts, and Alwaysinstyle<sup>31</sup> that advises on various beauty products based on how visitors describe their appearances<sup>32</sup>. The common characteristic of these sites is that they offer highly individualised information according to the needs of consumers.

In the context of building product information, however, interactive methods of presenting information are largely unexplored. There are only a few sites of this kind<sup>33</sup> in spite of the potential benefits. By visiting an interactive building product site, one can access individualised product information based on his/her specific needs. S/he can browse through different attributes associated with products as simply as clicking on products. When combined with three-dimensional models, interactive sites can be particularly helpful in providing very accurate product presentations and offering the capability of viewing products in different situations.

### **Research Objectives**

This study looks into existing building product information media and methods for presenting information. It identifies the opportunities and challenges associated with them and recommends a new way of presenting product information by utilising the interactive features of the Web.

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<sup>26</sup> <http://nikeid.nike.com>

<sup>27</sup> <http://presentpicker.com>

<sup>28</sup> <http://www.cdiy.com>

<sup>29</sup> <http://www.idtown.com>

<sup>30</sup> <http://www.iprint.com>

<sup>31</sup> <http://www.alwaysinstyle.com>

<sup>32</sup> McManus, "As You Like It," <http://www.sean.co.uk/customisation.htm>

<sup>33</sup> For more information of these sites, see "Interactivity on the World Wide Web and Its Implications" in Chapter 3.

This new convention encourages user participation in on-line product selection processes for more accurate and informed product decisions; utilises three-dimensional and interactive technologies for better product assessment; and suggests distributed access to on-line product data for enhancing the currency of data and lowering data maintenance. These concepts were implemented on a prototypical Web environment called Interactive Product Selector (IPS) included in this study. The IPS constitutes a platform to try out some of the ideas introduced in this study and to improve the understanding with them.

In the broader picture, in focusing on the specific problem of product information, this thesis contributes to a greater understanding of the relationship between design and information, particularly electronic information. There are issues to do with:

- 1 Ways of accessing, sorting, browsing, editing and selecting information.
- 2 Challenges presented by the emerging and changing medium of the WWW.
- 3 Coping with information explosion and increasing media options.
- 4 E-commerce and distributed practice.

### **Methodology**

This research project consists of three stages:

- 1- Conducting a survey on the use of Web-based building product information
- 2- Developing a prototypical Web environment (IPS) that utilises the data collected from the survey
- 3- User testing of the IPS.

#### **Stage 1: The Survey**

The primary objectives of the survey are to collect information as to how building professionals, mainly architects, are using Web-based building product



information, and to explore the strengths and weaknesses of existing building product Web sites. The survey also gives a glimpse into the trends in Web use that we will see in the near future.

The survey consists of five sections: The first section called "The Firm" includes questions to obtain information about the general characteristics of the participant firms (i.e. number of staff they employ and the scope of services they offer); the second section called "The Utilisation of Network and Web Technologies" consists of questions related to the type of network and Web technologies used in the firms; the third section called "The Utilisation of Building Product Information" contains questions related to the use of different product media by the firms; the fourth section called "The Utilisation of VRML Software" explores the use of VRML software; the fifth and the last section is "Other comments and feedback," which is self-explanatory.

In designing the survey questionnaire, different surveys such as the AIA's Firm Surveys, various RIBA surveys and other building product related surveys by trade journals have been reviewed and used.

Due to the budget, time and geographical constraints and as a means to further exploring the medium, the survey was conducted on the Web. As will be explained below, this medium also allowed a unique opportunity to design an interactive survey.

The survey sample was composed of the firms that have Web pages, assuming that somewhat more insightful results can be gained from these firms, as they already use the Web for various purposes such as marketing, communicating and collaborating. These firms have a general understanding of the strengths and weaknesses of this new medium. The Web pages of some of these firms even contained links to building product sites.

825 firms worldwide were selected from various architectural indexes and pages of professional organisations on the Web. The sample size represented the majority of architectural firms with Web pages as of 1998. Firms in the sample frame varied in size, type of services they offer and country of origin.

Before inviting the firms, a pre-test survey was conducted in between the 1 February and the 1<sup>st</sup> March 1999 with 82 firms. The survey was slightly modified after the pre-testing according to the feedback from the respondents. On the 1<sup>st</sup> April 1999, invitation e-mails were sent to the remaining 743 firms. 221 firms were not reached because of undeliverable and incorrect e-mail addresses.

The Web address of the survey questionnaire was sent to those who were interested in participating. For those who did not reply, two follow-up mails were sent, respectively on the 15<sup>th</sup> April and the 1<sup>st</sup> May 1999.

127 firms participated in the survey. The response rate was calculated as 24.3%, after deducting the unreachable firms. Among the survey participants, American (73.2%) and British firms (12.5%) were in the majority.

One unique aspect of the survey was that it was interactive. While completing the survey, participants were allowed to view other respondents' comments. This approach has been taken to enable survey respondents to stimulate ideas, express themselves better, to make sure they understood the questions and to suggest some other important issues that may have been omitted in the questionnaire. After sending the survey form, the participants were also able to view the aggregated graphical results in real time. Many participants found this approach 'innovative,' 'informative' and 'helpful'<sup>34</sup>. The interactive nature of the survey offered an incentive for the invited firms to participate in the survey.

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<sup>34</sup> See Chapter 4 for more information on the survey methodology.

All of these features of the survey were built using a CGI/Perl script. The Perl script used in the survey was adapted from the BigNoseBird.Com's Survey Script<sup>35</sup>. The original script was extensively modified to accept multiple choice questions and long text answers, to allow survey participants to see others' responses and to present the aggregated survey results in an attractive format.

One advantage of electronic surveys is that survey data can be used immediately without the need for manual re-entering and processing. In this survey, the text file that contained the user responses was directly imported to Microsoft Excel format to be analysed in SPSS statistical package and Microsoft Access.

### **Stage 2: The Prototype**

The second phase of the research deals with developing a prototype called Interactive Product Selector (IPS). The IPS works in conjunction with the product information survey presented in the previous chapter. By utilising the survey information, the IPS demonstrates a way to deal with some of the problems associated with existing building product sites and also accommodates various issues raised by the survey participants. Overall, the IPS provides an opportunity to test some of the concepts introduced in this study on a real example.

The IPS is a highly interactive Web environment developed using a combination of different Web-based interactive technologies including CGI/Perl, JavaScript, Java and VRML. It serves as both a virtual showroom and a decision support system presenting office furniture from various manufacturers and helping practitioners select the products in which they are interested. The system was designed to work with office furniture due to the fact that there are a number of manufacturers offering office furniture, and it is relatively easy to build interactive content for these products. However, the IPS can be altered to display other building products and can work equally well.

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<sup>35</sup> <http://bignosebird.com>

The IPS is intended to support showrooms of manufacturers, building display centres and trade shows where a range of different products can be physically viewed, experimented with and ordered. Although it can function on its own, the IPS would be more effective when used in conjunction with these environments. It can extend the working hours of physical product sites, as the system can be accessible twenty-four hours a day. It helps practitioners shortlist the choices of products and concentrate on a few specific ones in their visit to product places. In this way, the IPS assists building professionals in making more-informed decisions and using their time more efficiently during their visit to product display centres.

As it appears, one can draw similarities between some of the characteristics of the IPS and those of printed consumer catalogues such as Argos and Index, the leading retailers of household items in the United Kingdom. Consumers generally review these catalogues to get an idea about products, and, to a large extent, their decisions are based on the pictures and text explanations of products before paying a visit to a physical store. However, the product information presented in the IPS is much more informative, compelling and interactive than these catalogues.

### **Stage 3: User Testing of the IPS**

The third phase of this study involves user testing of the IPS. This phase has been an extension of the survey investigation. The testing assessed the effectiveness of an interactive Web environment like the IPS, identifying possible problems with it and seeking ways to improve the system. The testing was performed on the 7<sup>th</sup> May 2001 in Istanbul, Turkey where the final stages of this research project took place.

Three architects who are also postgraduate students took part in testing the system. The experimenters were selected by a call of interest posted in Yıldız Technical University, one of the leading architectural schools in Turkey. All of the experimenters were Internet literate and had some experience in using the Web to look for building product information.

An individual session was conducted with each experimenter lasting approximately 30-40 minutes. After a brief introduction about the IPS and explaining how it works, the experimenters were invited to try out the system for themselves. Then, they were asked questions about the various aspects of the IPS.

The experimenters particularly liked the facts that the IPS offers much more interactive content than other product related sites, and unlike the majority of product sites relying solely on bitmap product images, product information is provided in three-dimensions in the IPS. They believed that interactivity and three-dimensional product presentations are very important for accurately depicting products and incorporating users in the product selection process. In general, the system was also found to be easy-to-use. The experimenters provided additional feedback as to how the system can be improved further. For that and more detailed information about the user testing phase, please see Chapter 5.

### **Related Studies and Work**

As on-line building product information is a relatively new phenomenon, it is, to a large extent, unexplored. There are only a limited number of studies.

One of the early works is the Multi Media Product Selector (MMPS) of O'Brien and Al-Soufi<sup>36</sup>. This study, from the pre-World Wide Web era, exploits the idea of one large on-line product database. It proposes an on-line distributed database system that contains product information from different suppliers. The system utilises the X.500 Directory System, an international standard for a global, logically centralised, but physically distributed electronic network directory, to store and manage the product database. MMPS was designed to be accessible for firms with network capabilities, and the product data is kept on-line by the suppliers themselves to preserve data recency and low-maintenance.

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<sup>36</sup> O'Brien and Al-Soufi, "A Multimedia Product Selector System for the Construction Industry," *Information Technology for Civil and Information Engineers*, pp.25-28.

One of the latest studies dealing with on-line product information is Product Library Assistant: an Intranet for Designers<sup>37</sup>, also known as PLA(id). The project was conducted in the Architecture Department at the University of Edinburgh and funded by the EPSRC (Engineering and Physical Sciences Research Council). PLA(id) is a prototypical tool for organising and sharing product information on the World Wide Web. The system has two different versions, each involving different design strategies, technical difficulties and advantages<sup>38</sup>. The first version employing a server/client strategy exploits the use of networks of server and client systems, consistent with various features of the emerging virtual office infrastructure, and supported by the Java development environment (Figure 1.1). In the second version, a “local strategy” exploits the use of locally run applications, distributed through the Web, systems supported by the current Macromedia/Shockwave development environment<sup>39</sup>.

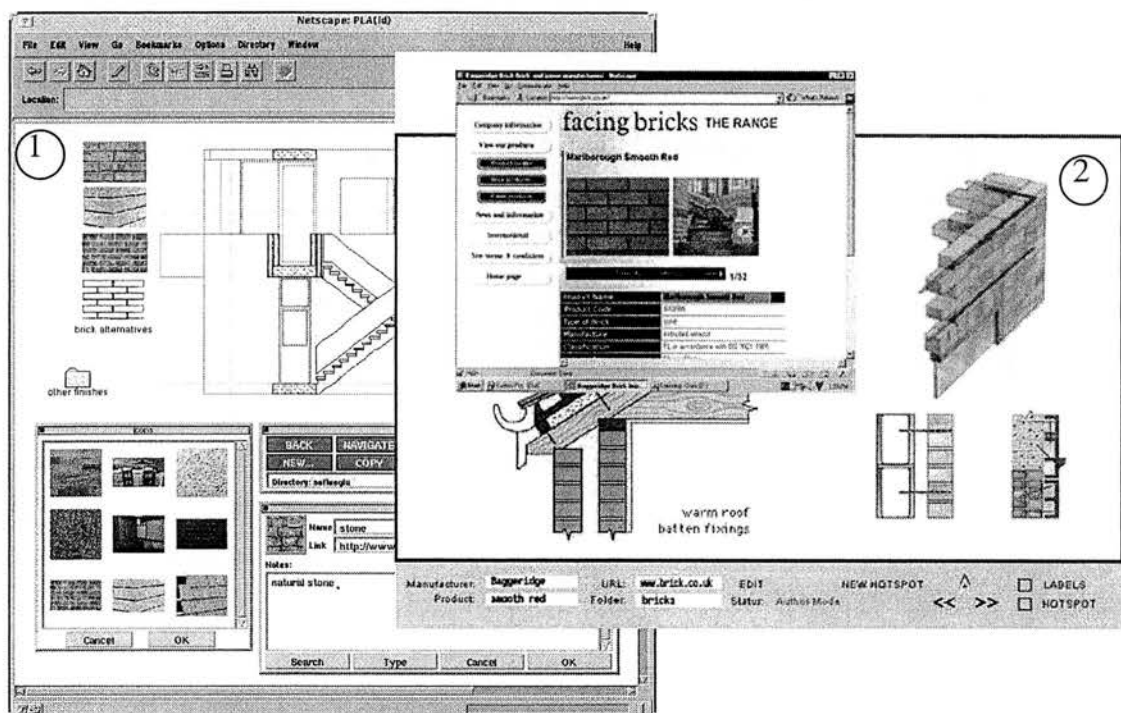


Figure 1.1: Java (1) and Shockwave (2) versions of the PLA(id)

<sup>37</sup> <http://www.caad.ed.ac.uk/Coyne/ProductCatalogReport/>

<sup>38</sup> Ofluoglu et al., “Managing Building Product Information on the Web,” *Proc. of Incite 2000*, pp.856-868 – The paper is provided in Appendix E.

<sup>39</sup> Board et al., *Creating Shockwave Web Pages*.



Another related project implemented in the Architecture Department at the University of Edinburgh in collaboration with Middlesex University is the Augmented Reality Studio Project<sup>40</sup> that took place in between April and June 1999. The project involved the design of a centre for the display of product information and testing the assumption whether there is useful information on the Web that can assist in the design and documentation process, focusing particularly on on-line product information. It consisted of three stages: 1-conducting a product information survey with some of the notable architectural practitioners in the greater London area<sup>41</sup>; 2-designing of a product pavilion; 3-presenting the designs in a Web format that links aspects of student designs to the on-line product information which they used. This project was particularly important as a way of proving that there is a significant amount of useful product information on the Web and to demonstrate the value of the Web as a project presentation and documentation tool.

Another research project on on-line building product information is being carried out at the Construction Research Center at Georgia Institute of Technology in the USA. This project aims at recommending the elements of an electronic product information retrieval system that would support design and construction services provided by architects, engineers, designers and contractors. The Steering Committee on Building Product Information in the Center was established to work as a 'technology watch' group and as a forum for different stake holders in product information: the supply-side manufacturing industry, the demand-side design and construction professions, and the connecting 'product information brokers'. This work includes some prominent architectural and construction companies and various firms in the building product industry<sup>42</sup>.

In addition to the studies above, there are also efforts that incorporate virtual reality (VR) for presenting product data. One of the well-known and highly successful examples is Matsushita's Virtual Showroom in Tokyo, also known as the Virtual Space Decision Support System (VSDSS). The system allows customers to

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<sup>40</sup> <http://www.caad.ed.ac.uk/Coyne/ProductCatalogReport/MiddlesexDesign/>

<sup>41</sup> See Appendix F for the questionnaire used in the interviews.

<sup>42</sup> Augenbroe, "Building Product Information Technology," *Executive Whitepaper*.

custom design kitchen components from over 30,000 different Matsushita products. Then, customers can view and walkthrough their own designs by wearing a head-mounted display and a data glove. This way they can verify whether they have chosen the most appropriate and compatible combination of cabinets, appliances and drawers. One of the unique aspects of the VSDSS is that it allows the Matsushita Company to display a complete inventory of its various products in a limited space, without stocking bulky samples<sup>43</sup>.

VRML as a popular VR technology is also widely used in various research projects. One such project is the Virtual Design Exhibition (VDE)<sup>44</sup> project that utilises VRML in presenting building product information (Figure 1.2). The project introduces a showcase that is an interactive Web environment and that offers an alternative presentation method to flat, static and two-dimensional product presentations. The showcase incorporates building products from seven German companies. It utilises VRML and Java technologies to build three-dimensional models of products and has interactive features that allow users to change various configurations of products, such as colour and surface pattern. Although VDE and the IPS are somewhat similar, there are important differences as well. The IPS is a decision support system, other than its role as a virtual showroom. It gives a chance to users to compare products from different suppliers visually in the same setting and to verify whether the product sizes are compatible with the intended space.

There are also other projects that use VRML as a three-dimensional interface for data in large databases. Some of these projects are the VIM (Visual Interface to Manufacturing) that offers a Web-based system that allows access to VRML data for the manufacture of a miter saw<sup>45</sup>, and the GOOVI-3D project that utilises VRML to

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<sup>43</sup> Bertol, *Designing Digital Space: An Architect's Guide to Virtual Reality*; Nomura, "Virtual Space Decision Support System and Its Application to Consumer Showrooms," *Matsushita Whitepaper*.

<sup>44</sup> Danuer et al., "3D Product Presentation Online: The Virtual Design Exhibition," *Proc. VRML 98 Conference*.

<sup>45</sup> Ressler et al., "Using VRML to Access Manufacturing Data," *Proc. VRML 98 Conference*.



present the three-dimensional models of the city of Frankfurt from its spatial database<sup>46</sup>.

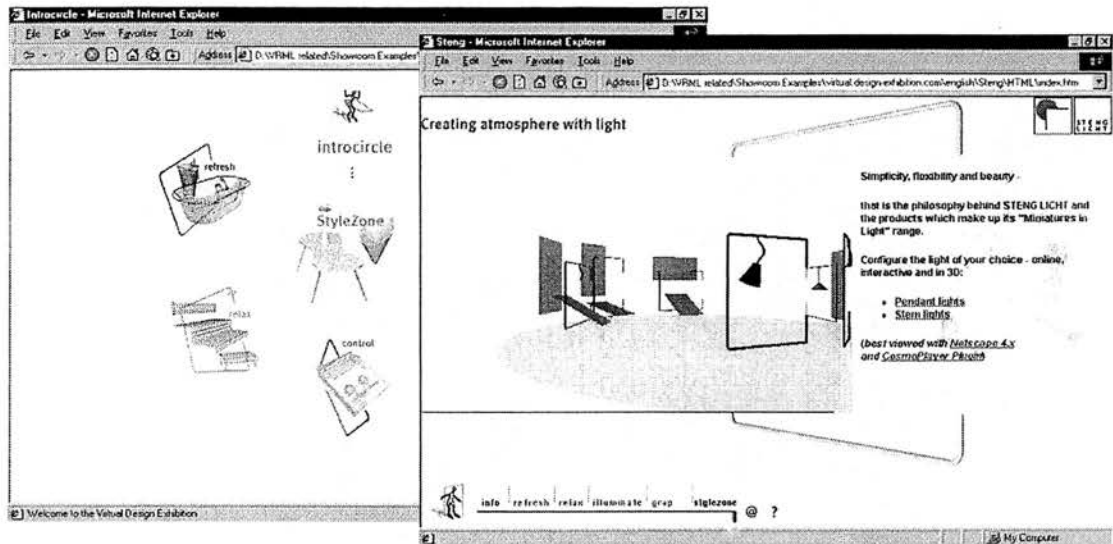


Figure 1.2: The Virtual Design Exhibition (VDE)

## Description of Chapters

This dissertation consists of six chapters. Chapter 1 is an introduction that provides an overview of the study area including the problem statement, research objective, methodology and related studies. Chapter 2 provides a thorough examination of building products and building product information. In this chapter, such important areas as selection of building products, components of product information and existing product media are also examined. Chapter 3 presents the Web as a growing environment to disseminate building product information. The chapter addresses some fundamental issues about the Web, lists strengths and shortcomings of the medium and talks about interactivity and interactive technologies on the Web. Chapter 4 presents the results of the building product information survey. Chapter 5 includes the IPS, the prototypical environment that offers interactive building product information on the Web. The chapter explains

<sup>46</sup> Coors and Jung, "Using VRML as an Interface to the 3D Data Warehouse," *Proc. VRML 98 Conference*.

how the IPS works, which technologies were used in developing the prototype and future developments to the system. This chapter also has a discussion on the user testing of the system. Chapter 6 provides a summary of the research and makes future predictions and recommendations for future studies.

## **CHAPTER 2: BUILDING PRODUCT INFORMATION AND PRODUCT MEDIA**

### **Introduction**

This chapter examines the importance of building products in design and construction. It explains the processes of product selection and specification and describes what building product information is and why it is important. The chapter also lists existing building product information media with a special emphasis on electronic product information, and it highlights strengths and shortcomings of different product media. The relationship between Computer-Aided Design and building product information is also among the topics presented in this chapter.

### **Building Products**

Building products are the materials, components and finishes used in buildings. Materials are natural or synthetic substances that can exist singly or in combination in any building component. Components are assemblies or parts of buildings, e.g. any floor or wall individually or as types or systems: elevators, windows, doors, etc<sup>1</sup>. Finishes are elements or assembled materials placed on the surfaces of components for aesthetic purposes or protection.

Building products are fundamental generators that can determine structure, quality and regional characteristics of buildings<sup>2</sup>. They serve as elements of architectural expression. The purposeful manipulation of building products can give

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<sup>1</sup> How and McGregor, "Architectural Overview of Durability," *Fourth International Conference on Durability of Building Materials & Components*, p.487.

<sup>2</sup> Dean, *Materials Technology*, p.3.

the designer greater control of a building's visual impact. Accommodating or violating the nature of a material can create harmony or visual tension, both of which would be appropriate to a designer's goals<sup>3</sup>. Success of any building, among other things, depends on the ability of designers to make the best and the most imaginative use of the materials they are able to command<sup>4</sup>.

It is, therefore, critical to make accurate building product selections to improve the quality of a building. It is also important to document the product decisions to help their proper application or installation. Product selection and documentation are tackled by architects and other project participants at various stages of the design and project documentation processes. The following pages will examine these tasks in detail.

### **Product Selection**

Product selection is a design decision related to the type of materials, components and finishes that will be utilised in a building. It is an important decision that can directly affect the performance, form and cost of a building and construction<sup>5</sup>.

In the past, product selection was relatively easier, as the choice and properties of building products, and construction techniques were limited. It was an action mainly dependent on experience and the intuition of the building professional<sup>6</sup>. However, due to machine-based mass production methods, new construction techniques, improved transportation, enhanced globalisation and informed clients, there have been changes in the context of building design and

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<sup>3</sup> Patterson, *Construction Materials for Architects and Designers*, p.15.

<sup>4</sup> Adleson, *Materials for Building*, p.2.

<sup>5</sup> Arioglu, "A Procedure for Selecting Building Products," *International Journal for Housing Science & Its Applications*, p.49.

<sup>6</sup> *ibid.*

construction<sup>7</sup>. These changes have implications for the design, supply and installation of building products.

There is a trend to replace craft-based building components that are produced on site with components pre-manufactured off-site and assembled on site<sup>8</sup>. These component-based technologies provide new design possibilities and bring about standardisation in building. They also increase the speed of site operations at exponential rates.

Mainly due to the efficient transportation of goods and the increasing globalisation of productions, local patterns of construction that reflect the nature of local supplies and workmanship change<sup>9</sup>. Higher quality and more economic products can be imported from anywhere. Product variety also steadily increases. A growing range of different products is available from hundreds of different manufacturers.

New building methods and the demands of informed clients increasingly change man-made conditions. The visual, thermal and acoustic standards required for human comfort vary and become more complicated. Highly specialised products are being produced to respond to such needs.

As can be seen, product selection has become a difficult task. Today, architects and other design decision-makers are faced with a wide range of unfamiliar building products from which to choose. Depending on the complexity of projects, they sometimes need to evaluate hundreds of different building products. In doing so, they rely on various criteria.

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<sup>7</sup> Yeomans, *Construction Since 1900: Materials*, p.34.; Gutman, *Architectural Practice: A Critical View*, 1988; Adleson, *Materials for Building*, p.1.

<sup>8</sup> Petreschi, "Technological Change in Building Industry: A UK Perspective," *CACS Construction Bulletin*.

<sup>9</sup> Yeomans, p.34.

### **Criteria for product selection**

There are five main criteria that have an impact on product related decisions, namely: cost, aesthetic quality, durability, supply/availability and replacement/repair<sup>10</sup>.

*Cost* is the financial aspect of a product. Many building professionals consider cost a dominant factor in selecting a building product. They choose cheaper products to be able to lower the overall building cost, to satisfy the clients' expectations and to compete with others<sup>11</sup>. Ideally, it is also important to consider the price-value relationship when buying a product.

*Aesthetic quality* deals with the visual aspects of a product such as appearance, colour, texture and form. For many designers and architects, the visual qualities of products are very important. Many evaluate products based on their aesthetic qualities first and concentrate on other merits such as cost and durability afterwards<sup>12</sup>.

*Durability* means how long a product can last or endure. It provides a long-term benefit gained from the resistance and fitness of a product over time. Selecting durable products can save future maintenance cost. Considering that most clients prefer to avoid spending money on maintenance, durability is a highly desirable property.

*Supply/Availability* is to be able to access products when needed and in required amounts. Obtaining products late can result in consequent delays on the site. Supply and availability can be a problem particularly with imported and/or specialised products.

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<sup>10</sup> MacKinder, *The Selection and Specification of Building Materials and Components*, p.110.

<sup>11</sup> *ibid.*

<sup>12</sup> Aesthetic quality may pertain to all of the criteria, though practitioners seem readily able to isolate it as a separate criteria and equate it with visual sense.

*Replacement/Repair* has to do with the manufacturers' warranty and support for their products. It is important to select products having a long-term warranty and manufacturer support. This can save money and time.

Several sources<sup>13</sup> also pointed out that there are other factors that influence product decisions, some of which are project and user requirements, building legislation, town planning legislation, workmanship, product certification and accreditation results, feedback from products in use and boredom with using the same products over a period of time.

It is also often the case that each building professional has his/her own priorities when selecting a building product. For example, as one survey<sup>14</sup> illustrates, architects consider product appearance very important, while contractors and product manufacturers think that it is a relatively less important factor in selecting a building product.

It should be noted that, some building professionals rely on experience or precedent when selecting products without making their criteria explicit<sup>15</sup>. These professionals have strong preferences towards certain types of materials and components with past successes or performances<sup>16</sup>. Many practitioners feel they do not have the time to search afresh for new products on the basis of criteria.

### **When are decisions made?**

Product related decisions are made throughout the design process. However, the characteristics of decisions change at different stages of the design process.

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<sup>13</sup> MacKinder, *The Selection and Specification of Building Materials and Components*, pp.133-146; Chusid, "Motivate Specifiers to Change Their Habits," *Construction Marketing Today*.

<sup>14</sup> Kolodziejczyk and Granitto, "What Do Customers Want?," *Construction Marketing Today*.

<sup>15</sup> Coyne et al., "Applying Web-based Product Libraries," *Proceedings of EurolA '98*, p.108; MacKinder, p.119.

<sup>16</sup> *ibid.*, p.120.

During the pre-design and schematic design stages, product decisions are quite broad dealing with the general form and appearance. For example, a designer at this stage might want to use stone blocks on walls, but might not have decided the type and specific brand yet. Since decision-makers deal with hundreds of products and possibilities at this stage, they wish to keep options open.

At the design development stage, many design issues are resolved and decision-makers have a better picture of the design. Thus, many products are selected at this stage while some product decisions and product brands might be left unresolved<sup>17</sup>.

The construction documents stage is the time when all product decisions are documented in terms of performance and specifications. This stage is normally considered the end of product selection and specifying.

However, due to supply and application problems, site conditions, or many other reasons, some product decisions might need to be re-evaluated or changed on the site. In that case, if alternative products are considered, they are used. Otherwise, other compatible brands are chosen.

Coordination of product decisions is very important. As each decision can influence the succeeding one, lack of coordination can cause unnecessary cost and time losses.

### **Decision makers**

The increasing complexity in building products requires a number of people to be involved in product selection. Depending on the nature of a project, a range of different building professionals, including architects, designers, draftsmen, project managers, specifiers, quantity surveyors, general and sub-contractors, structural,

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<sup>17</sup> Chusid, "Match Your Sales Approach to the Project Phase," *Construction Marketing Today*.



mechanical and electrical consultants, and product suppliers, can take part in product selection. Clients and/or building owners sometimes also take an active role in product selection, as they are the principal decision-makers in cost related issues<sup>18</sup>.

The architect is one of the key decision-maker in product selection. Architects are often involved in every aspects of product selection. Since they have the initial contact and meetings with clients on a regular basis, they get a chance to discuss building product related issues, and therefore can influence the product preferences of clients. Architect can also take an active role in selecting alternative products on the site when they conduct design/build practices.

Product decision-makers in an architectural firm can vary. Any staff with relevant experience can make product-related decisions. However, principles, partners or job/project architects are usually the primary decision-makers. When principles and/or partners are involved, they play an initial role and often make broad decisions, e.g. deciding to use brick on the facade, but not specifying the types and the brand. Afterwards, they typically monitor the overall progress and check whether the decisions comply with the brief. When needed, principles and/or partners also participate in the detailed decisions or offer expertise at later stages. The job architects and his/her assistants carry out substantial portion of the product related work. They do the necessary ground research for the desired products, develop details and are responsible for all of the remaining product decisions before the specifications<sup>19</sup>.

### **Product Specification**

The specifications are the stage where the product related decisions taken previously are finalised and documented. Through the specifications, architects communicate their design concepts to others and offer help in administering the project. Also, information in the specifications, when combined with drawings and

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<sup>18</sup> Chusid, "Budgeting for Architects' Declining Role," *Construction Marketing Today*.

<sup>19</sup> Mackinder, *The Selection and Specification of Building Materials and Components*, p.127.

other contract documents enables bidders to develop proposals for submission to the owner.

The specifications and project drawings are closely related and compliment each other. The specifications use words to describe the qualities of products and installations illustrated on drawings in detail.

In the specifications, expectations, requirements, qualities, standards and installation details with regard to products are defined in a written format. The specifications also outline other related areas such as workmanship and the construction services that affect the levels of quality to be met in the construction of the project.

In most cases, architects are the ones who prepare the specifications. However, other design and construction professionals such as quantity surveyors, contractors, clients and others can also involve. Similar to the product selection, the major specification decisions that deal with the general appearance and structure of the building are strongly influenced by partners or principles. After that, project architects and junior members of the firm become responsible for more detailed decisions and the documentation<sup>20</sup>.

A number of different formats or conventions are used to organise and present product specifications. Among the most widely accepted ones are the CI/SfB and the UniClass in the UK, and the MasterFormat in the USA. They typically group building products in divisions and sub-divisions. Each division is assigned by a fixed number and title. Division names are used to identify the various types of works specified. More detailed information about the CI/SfB, the UniClass and the MasterFormat can be found respectively in Jones (1991), RIBA (1997) and CSI (1996).

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<sup>20</sup> Mackinder, 1980, *The Selection and Specification of Building Materials and Components*, p.129.

Most architectural firms have some forms of specification library to be used for specifying. This library might have evolved over a period of time and/or obtained through a subscription to a master specification service offered by an industry association. The existing specifications are generally modified to respond to the specific needs of a project at hand.

A master specification often covers most of the information needed to specify. In order to customise these prewritten documents according to the requirements of a specific job, the specifier deletes clauses to leave appropriate text, fills in blank spaces and/or makes additions in appropriate places. Traditionally, all of these tasks were performed by using only paper media or word processor software.

Nowadays, there are a number of different computer packages that automate this task and improve the presentation of the specifications. Some popular specification software and systems used are: in the UK, “Specification Writer” and “Specification Manager” by the National Building Specification (NBS); in the USA, “MASTERSPEC” by the American Institute of Architects (AIA), “SPECTEXT” by The Construction Sciences Research Foundation, “MANU-SPEC” by the Construction Specifications Institute and “SPECSYSTEM” by the AIA/McGraw-Hill.

The specification process is expected to radically change in the future. Growing acceptance of object-oriented technologies by CAD software producers, new data exchange conventions such as the Industry Foundation Classes (IFCs)<sup>21</sup> and the compliance of product manufacturers with these conventions will bring about new possibilities in producing specifications. With this technology, important alphanumeric product data such as standards, performance and requirements will be embedded in product drawings, graphic symbols and standard details. In this way, the task of creating specifications will be automated, as project drawings and

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<sup>21</sup> For more information, see the “object-oriented systems” heading in this chapter.

specifications will be created at the same time. It will be possible to extract or print out the specification data directly from CAD files.

The increasing integration of Web technologies into CAD software will also change the static nature of specifications. Specifiers will be able to link the specifications with the latest product information on Web sites. In this way, the specifications will stay up-to-date, and particularly, the presentation of fluctuating product data such as costs will benefit most from this approach.

### **Product Information or Literature**

As illustrated previously, there is a tendency to produce more building elements and components off the site. The construction process has largely become an assembly operation for these pre-manufactured products<sup>22</sup>. Consequently, product related decisions have become even more crucial, influencing the quality of construction work.

As explained earlier, traditionally architects have relied on precedents and experience in making product selections. In other words, building product selection relied on tacit knowledge and precedents. However, in time, the number of products and the complexity associated with them has reached a level where one person or even a team of designers could not cope. Product selection has evolved to be an information-based task, where its success is dependent on the quality of information acquired. It has become imperative that building professionals refer to outside product information or literature.

Product information or literature is the technical information about building components, materials and finishes used in design, specifications and construction. In brief, it enables architects, designers and other building professionals to make informed choices about alternative products, and to help them understand and utilise a range of product qualities such as standards, performance, energy efficiencies,

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<sup>22</sup> Chusid, "Effective Product Literature," *Construction Specifier*, p.25.

installation details, etc. in design documentation and construction. Product literature also serves as a reference source for designers to justify their design decisions. The following is a list that identifies some of the reasons why architects and other building professionals use product literature:

1. To find suitable products that will satisfy anticipated design and construction goals
2. To learn about alternative products
3. To compare different products
4. To obtain information for specifications and other project documentation
5. To refer to the referential product data in the form of product performance, test results and previous applications.
6. To utilise technical details for product installation and maintenance
7. To collect referential information that might be useful for future projects
8. To stay up to date about new products, techniques and developments
9. To satisfy personal interests and for design inspiration

Product literature can include some or all of the information, data, documentation and media listed below. It should be noted that the content, format and the presentation media of product information can differ depending on its delivery method, i.e. the distribution platform such as print or electronic media.

1. **Product description or summary:** is the brief descriptive information about a product that includes its usage and key features.
2. **Manufacturer contact information:** is the information necessary to contact a product's manufacturer. Snail mail addresses, telephone and fax numbers, and lately, e-mail and Web addresses can be provided.
3. **Physical properties:** deals with the tangible characteristics, overall configuration and makeup of products including size, weight, colour and finish.

4. **Performance data:** mainly has to do with the numeric data reflecting the behaviour of a product under certain conditions. Design pressure, operating force, water penetration, structural test pressure and energy efficiency are some of the types of information provided in this category. Performance data often include the results of tests carried out by the manufacturers, statutory bodies and/or private organisations.
5. **Standards and certification:** are the documentation that can reinforce the performance data or other aspects of a product. They set certain legally permissible limits and are valued industry wide. The British Standards Institute (BSI), the British Board of Agreement, and the American National Standards Institute (ANSI) are main organisations that develop standards in the UK and the USA respectively.
6. **Schedule:** lists quantities, parameters, sizes and materials related to a product. Standard schedules can be provided as an attribute of CAD data or separately.
7. **Installation/maintenance details:** are the information dealing with how a product can be installed and/or maintained. It can incorporate graphic information such as drawings and diagrams.
8. **Operation and control:** are the instructions that explain how a product should be operated and controlled. It is generally used for machinery.
9. **Cost related data:** concerns price and the economics of a product. It is often obtained directly from product manufacturers.
10. **Data/fact sheets:** are usually brief, one-page summaries of a product providing short facts and figures. Data/fact sheets are particularly useful in quickly reviewing key product features and comparing various products (Figure 2.1).

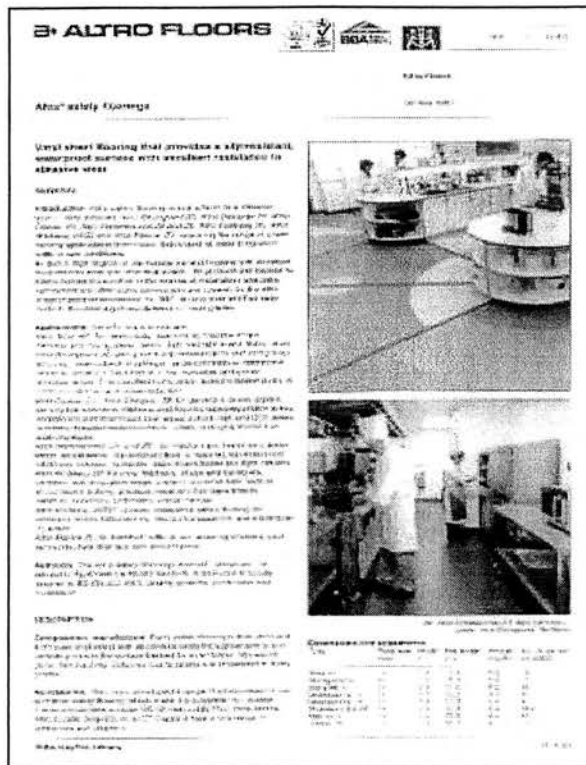


Figure 2.1. - A product datasheet  
(Source: RIBA Product Selector)

**11. Warranty:** is the manufacturers' warranty for a product part, hardware, materials and/or workmanship. The condition and duration of a warranty are often stated.

**12. Specification data:** is the data used in preparing the specifications for a product. It can be used directly or modified. The specification data is commonly distributed electronically or via direct mail.

**13. Visual materials:** involve graphic data such as illustrations, drawings,

photos, charts and diagrams. These are especially useful in visualising a product and comparing it with other products.

**14. CAD data:** is the CAD drawing file(s) of a product. The *de facto* standard for product CAD data is DXF (Data eXchange Format introduced by Autodesk). CAD data is usually provided in CD-ROMs or product Web sites.

Other than above, information about product limitations, recommendations and availability can be widely found in product literature.

Having reviewed the content of product literature, it would be appropriate to talk about various media utilised in the building industry. In a broader sense, it is possible to examine product media in two groups: traditional and electronic.



## 1- Traditional Product Literature and Sources

Product literature or sources that are not electronic or computer-based can be listed in this category. Traditional product literature contains a wide spectrum of subcategories each of which is unique in terms of information content, the presentation and delivery method it offers. While most traditional product literature is presented in print media in the forms of hard copy catalogues and brochures, others choose a drastically different approach relying on personal communication that involve sales representatives and/or trade shows.

### **1.1- Print Media**

These product sources are paper-based and consist of hard-copy catalogues, brochures and trade journals. This is still the main delivery method for product information<sup>23</sup>.

**1.1.1- Hard copy catalogues:** are the most widely used product information sources<sup>24</sup> that are often distributed on a subscription basis and updated annually (Figure 2.2 and Table 2.1). They contain product information from many different manufacturers and suppliers, and for a majority of manufacturers/suppliers, it is essential to take part in these sources to be considered serious players in the building industry.

Product information can be located in hard copy catalogues according to product name, manufacturer/company name and the product's trade name. Hard copy catalogues also use the CI/SfB, the MasterFormat, the UniClass or a similar classification system derived from these. Information can be found by browsing indexed pages.

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<sup>23</sup> Hase-Shannon, "Use of Product Information and the Role of the Internet Among AEC Professionals," *Rose Research Report*; Augenbroe, "Building Product Information Technology," *Executive Whitepaper*.

<sup>24</sup> RIBA Information Services, *The 2000 Survey on Information Services in the UK Construction Industry*.



UNITED KINGDOM	USA
<p><b>THE PRODUCT SELECTOR</b></p> <p>by Royal Institute of British Architects</p> <ul style="list-style-type: none"><li>• over 700 pages</li><li>• over 250 manufacturers and suppliers</li><li>• the CI/SfB format</li><li>• updated twice a year</li></ul>	<p><b>THE SWEET'S SYSTEM</b></p> <p>by McGraw-Hill Companies</p> <ul style="list-style-type: none"><li>• over 2000 manufacturers and suppliers</li><li>• the MasterFormat</li></ul>
<p><b>THE BUILDING PRODUCT COMPENDIUM</b></p> <p>by Barbour Index plc</p> <ul style="list-style-type: none"><li>• over 970 pages</li><li>• over 3,000 products and 6,500 manufacturers and suppliers</li><li>• 22,000 copies are distributed annually</li></ul>	<p><b>THE FIRST SOURCE FOR PRODUCTS</b></p> <p>by CMD Group</p> <ul style="list-style-type: none"><li>• over 750 pages</li><li>• over 25,000 products and 9,400 manufacturers and suppliers</li><li>• 76,000 copies are distributed annually offered for free of charged to active building professionals</li></ul>

Table 2.1: Some of the popular hard copy catalogues in the UK and the USA



Figure 2.2: A paper-based catalogue (RIBA Product Selector)

Practitioners sometimes treat hard copy catalogues as the initial product information source where they can find contact information about manufacturers or suppliers from which they can obtain further product details. As such the catalogues act like directories.

**1.1.2- Brochures:** are short product sources offered by manufacturers and suppliers. They can be obtained from sales representatives, trade shows, building display centres and/or directly from the manufacturers/suppliers. They are generally more up-to-date than hard-copy catalogues and provide more specific information about a product(s) needed. Building professionals generally file product brochures in binders along with other product-related materials.

**1.1.3- Trade journals:** are the most widely used architectural information sources<sup>25</sup> dealing with various aspects of current design practice. Trade journals are also good sources from which to learn about new products and to observe product applications in different contexts.

Many companies use journal advertisements to create awareness of their products<sup>26</sup>. Readers can obtain additional information from manufacturers about the products in which they are interested by filling out reader service cards provided in the journals. Lately, some product manufacturers have also begun to use trade journals as a complementing medium to advertise their Web sites.

**1.1.4- Project information:** Every project generates a considerable amount of information on various aspects of building. During the brief, design and documentation stages, product options are discussed, and the specifications are prepared. Some firms also obtain feedback on the successes or performances of products by talking to other building professionals on the site, and sometimes, to building users and occupants<sup>27</sup>.

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<sup>25</sup> Goodey and Matthew, *Architects and Information*, p.30; Marvin, *Information and Experience in Architectural Design*, p.20.

<sup>26</sup> Anderson, "Choosing the Right Media for Your Products," *Construction Marketing Today*.

<sup>27</sup> Mackinder, *The Selection and Specification of Building Materials and Components*, p.106.

The product information obtained in this way becomes part of a portfolio of precedents for the firm and can be repeatedly used in future projects. This type of information can be very valuable, as it is tailored specifically to the practice of the firm. Several sources indicate that architects have strong preferences towards the products they previously used<sup>28</sup>.

Project product information can be classified as part of other project information and/or stored together with other product literature that can be accessed in office libraries or elsewhere.

### **Advantages and disadvantages of print media**

- 👍 Some practitioners prefer print media over electronic media since they like the physical nature of hard-copy catalogues and brochures, i.e. touching, browsing through, sorting, displaying, sharing, copying and reading pages in a conventional fashion.
- 👎 However, searching for a product manually is not generally efficient. When one does not know the precise vocabulary or type associated with a product, the search can be time consuming using up valuable project time. In addition, the search cannot necessarily produce the most conclusive results and ensure that all the information pertinent to a subject is reviewed.
- 👎 There is also a possibility that print media contains outdated information. Since the production cost is very high, hard copy catalogues and brochures are generally updated once or twice a year.
- 👎 Additional difficulty with using print media solely is that information cannot be used directly in project documents. In other words, all the data might need

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<sup>28</sup> Mackinder, *The Selection and Specification of Building Materials and Components*, p.119; Coyne, et al., "Applying Web-based Product Libraries," *Proceedings of EuroPLA '98*, p.108.

to be regenerated e.g. specification text needs to be retyped or drawings have to be redrawn. All of these can lengthen the project time.



On the other hand, some firms believe that storing product information in binders is good for the image of the firm. They reassure clients that the firm has requisite technical expertise<sup>29</sup>.



One disadvantage of this is that bulky product binders can take up valuable office spaces. This issue is especially critical for firms with a shortage of office space.



Additionally, product binders and other printed materials can only be used by one person at a time as opposed to networked electronic databases that are accessible to virtually every member of a firm. One way to deal with this problem might be ordering or photocopying additional copies of hard copy catalogues or brochures. However, this can be costly and might not necessarily offer the same level of information accessibility as computerised information systems.

## **1.2- Direct Mail/Fax Services**

This is other paper-based documentation that includes fax-back and postcard deck services. In these services, product manufacturers and suppliers directly provide product information to customers. After an initial contact, the detailed product information is sent upon request. Some suppliers find these methods less costly and more efficient, as the information only goes to the interested and more serious customers.

**1.2.1- Fax-back services:** are the most technologically oriented non-electronic product information service. However, information is still transmitted as hard copy.

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<sup>29</sup> Chusid, "Unbinding the Power of Binders," *Construction Marketing Today*.

Fax machines have been used to distribute up-to-the minute and fast product information for years. More recent methods such as computer-operated fax services are extremely efficient allowing access to product information 24 hours a day. These systems store product data sheets, test reports, article reprints and other sales collateral on a hard disk and can be linked to the customer database<sup>30</sup>. Supported by computer software, these fax machines can provide the enquirers with personalised information according to their profile.

**1.2.2- Postcard decks:** In the case of postcard decks, various companies take part in a direct-mail campaign where a number of self-paid and addressed cards of many products are sent to firms according to their interests. By filling in the blanks and sending back the small cards provided, the interested parties can request more information directly from the product manufacturers and suppliers.

#### **Advantages and disadvantages of direct mail/fax services**



Fax-back services and postcard decks are perhaps the most up-to-date and convenient ways to obtain product information. In the case of fax-back services, information is accessible 24 hours a day, and the response time is very short.



However, these services can generate a massive amount of junk mail and faxes. Some direct mail services do not respect the privacy of information about firms. Firm information can be circulated and ended up in the hands of unintended parties, hence resulting in proliferation of junk mails and faxes.

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<sup>30</sup> Chusid, "Fax Speed Can Propel You to Competitive Edge," *Construction Marketing Today*.

### **1.3- Physical/face-to-face Interactions**

These allow practitioners to examine products physically and to ask questions directly to product experts, manufacturers, or suppliers in person. Sales representatives, building display centres and trade shows are considered in this category.

**1.3.1- Sales representatives:** These are the sales personnel that often work for product manufacturers, suppliers and information brokers. They provide first hand personalised information. They can offer expertise on the telephone, visit firms or organise product seminars for interested parties. The contact between the representatives and the clients can be initiated by both sides. Sales representatives are prepared to discuss every aspect of the product they promote. Some of them are even involved in the design process as consultants.

**1.3.2- Building display centres:** These are market-oriented organisations that provide permanent or temporary showcases of building products. Sales and technical documentation and information services can also be offered in these centres<sup>31</sup>. By visiting these places, building professionals can physically examine products by holding or touching them. Apart from building display centres, more permanent product showcases can be found in manufacturers' showrooms.

**1.3.3- Trade shows:** These are often annual events taking place in large exhibition centres. Manufacturers/suppliers are assigned stalls to exhibit their products and offer information. Product mock-ups and other interactive presentation techniques are common at these events. Trade shows generally create product and company awareness and enable visitors to keep up with new products and developments at a single venue.

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<sup>31</sup> Unesco, *Arkisyst Feasibility Study Report*.

### **Advantages and disadvantages of physical/face-to-face interactions**

- 👍 Tradeshow and building display centres are unique face-to-face and interactive events that allow building professionals to learn about products and to communicate with experts and sales people. Unlike other product information sources, in tradeshows and building centres, building products can be examined physically by feeling, touching and through mock-up assemblies.
- 👎 One important drawback of these information sources is that one needs to make time to attend tradeshows and to visit building centres. Having this time in their hectic practices can be problematic for many building professionals. For this reason, they tend not to favour this information source.

### **2- Electronic Product Information Sources**

In this section, electronic or computer-based sources for building product information will be examined. These media include floppy disks, CD-ROMs and Web sites.

The growing integration of computers into building practices and various shortcomings of traditional product information sources have led to the introduction of electronic product information sources.

Computers have become commonplace in architectural offices. Many paper-based traditional architectural and administrative tasks of the past such as drafting, typing and the tabulation of data now heavily rely on computers. Many of today's complex design, drafting and presentation-related activities such as 3D modelling, creation of animations, interactive hypertext/hypermedia presentations and movies can only be achieved realistically through computers. Effective reuse of information



is performed primarily on computers as well. In addition, due to the convenience of Internet and Intranet based communication and collaboration, organisational and inter-organisational correspondences are mainly carried out electronically.

A considerable amount of information produced by architects and other building professionals is electronic, and there is an increasing shift towards the paperless practice, where the use of paper media is minimised.

This on-going transformation in building practice has brought about changes in production and distribution methods of product information as well. Many firms that provide paper-based catalogues have introduced the electronic equivalents of their catalogues. Many new firms have also evolved to only provide electronic product information.

Electronic product information sources display information on a computer screen. Users interact with information content by pointing and clicking. Information is generally organised and presented in hypertext/hypermedia mode, which structures and presents text and graphic information in a non-linear manner, that is, navigating through information by jumping from one subject to another by selecting hyperlinks. One advantage of hypertext/hypermedia is that the user pursues his/her own paths rather than following linear or predetermined links. This method increases the accessibility of information. With hyperlinks, related information in different locations can be tied together, e.g. a drawing can be linked to cost information and related component detail pages.

Electronic product information supports complex searching methods as well. Today's building products are extremely complex; many products can have hundreds of different ordering options and properties. Sometimes finding a suitable product and comparing different products by manual means can be impossible. Electronic product information sources rely on computer-based search methods that present quick and accurate results. Many CD-ROMs and Web sites offer user-friendly menus and/or dialog boxes in which designers or specifiers define product



properties. Product search can be achieved in a variety of ways such as pattern-matching with a manufacturer name, trade name, product name and general keywords. More complex query methods provided by SQL (Standard Query Language) and its subsets also allow Boolean operations that support operators such as “AND,” “OR” and “NOT” with keywords to do exhaustive searches.

Electronic product information sources are also active production tools beyond their referential role. The computer files associated with products are immediately available for use in CAD drawings, specifications and other electronic documentation. Thus, the product data does not need to be regenerated.

Having product information on a CD-ROM or accessing it on the Web allows even small firms to stay competitive and eliminate the need to invest in paper-based libraries. Through firm-wide networks, electronic information can be shared and utilised by a greater number of members of a firm.

Electronic product sources can be a good alternative for offices with storage problems too. CD-ROMs are small media that demand very little space, and as for Web sites, since they are stored in Web servers remotely, they do not take up any space at all. Since information is already organised in a searchable electronic format, the need of maintenance is also minimal.

In contrast to paper-based media that present information using only static media i.e. text and pictures, electronic information sources can combine both static and dynamic media in order to represent products more efficiently. Especially multimedia presentation techniques that incorporate animations, movies, interactive 3D models and hypermedia presentations improve designers' assessments of products and help them make more informed decisions.






Electronic product sources often classify product information in CI/SfB, MasterFormat, or UniClass. However, there is not a widely accepted standard file format for exchanging of electronic product information. Currently, many companies

use *de facto* file formats in providing electronic product information. Most common formats of these are Autodesk's DXF or DWG format for CAD data, Microsoft's XLS format for spreadsheet data and Microsoft's DOC format for text documents. File formats for image files, multimedia and other data vary.

Below different electronic media used in delivering product information are examined:

### **2.1- Floppy disks:**

These are soft magnetic disks that can store up to 1.44 megabytes of data. The distribution of product information through floppy diskettes was a popular method before the widespread use of CD-ROMs. A small number of manufacturers or suppliers still use this media in conjunction with other methods. Some of the advantages and disadvantages of dissemination of information through floppy disks are:

-  The floppy disk media is an economic way of producing a small amount of electronic product data.
-  Although their unit price is quite cheap, floppy disks are not an economic way to store large amounts of data. The cost per megabyte of storage is much higher than other options such as CD-ROMs, zip drives and tapes.
-  Floppy disks have serious storage limitation. A floppy disk can store data up to 1.44 megabytes. Data greater than that has to be divided into multiple disks making its installation a lengthy and elaborate process.
-  Floppy disks are extremely slow media. The rate of data read per second is much lower than that of CD-ROMs and Zip drives.
-  Floppy disks do not have a long life expectancy. The existing data have to

be shifted to new disks at regular intervals. Floppy disks are also susceptible to electromagnetic erasure.



In contrast to other storage media, production of electronic product data on floppy disks does not require any sophisticated gadgets. A floppy disk driver, a standard computer component, can read and write floppy disk media.



Although the statement above is generally true, there is a trend to use the bays allocated for floppy disk drivers for other media providing higher data storage capacity and speed such as CD-ROM drives or zip drives. New series of Macintosh computers such as iMac and several notebook brands do not include built-in floppy disk drives.

## **2.2- CD-ROMs:**

CD-ROM media have been used by catalogue service providers for over 10 years. CDs are optical disks that are effective alternatives to floppy diskettes. They offer great archival and distribution benefits of large amounts of data. A CD normally stores 650/700 megabytes of data that is the equivalent of 250,000 pages, 10 large bookcases or 450 floppy diskettes.

A CD-ROM based catalogue can contain thousands of product images, specification documents, CAD drawings and all kinds of multimedia data. These electronic data can be easily inserted into CAD, Word Processing and Spreadsheet software to work with. Other than product data, the CDs generally come with their own application software that provides an interface to conduct searches, retrieve and display data.

A number of companies produce CD-ROM-based product catalogues, among which the Product Selector Plus in the UK and the Sweet's System in the USA are the most popular (Figure 2.3). In addition to information brokers, manufacturers and

suppliers also take advantage of CD-ROM technology in providing large amounts of data about their products.

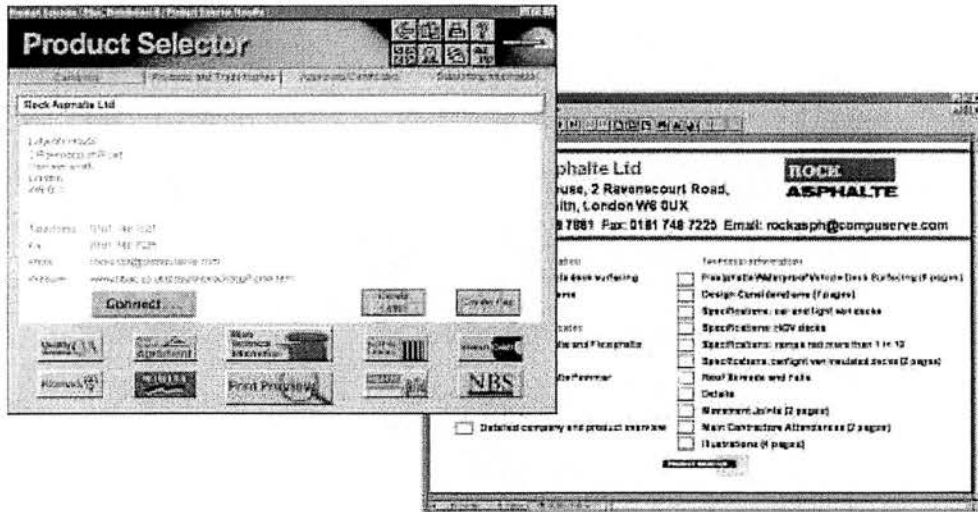


Figure 2.3: A CD-ROM based catalogue (RIBA Product Selector Plus)

Some of the advantages and disadvantages of delivering product information on CD-ROMs are:

- 👍 CD-ROM technology offers a long-term archival value. A CD can have a life expectancy of 100 years.
- 👍 Sharing data on CDs is much easier than using other media such as Zip drives, optical data and tapes. CD-ROM media is an industry-wide accepted standard. CD-ROM drivers, devices necessary to read data from CDs, have become standard peripherals that come with all computers. CD-ROM writers are becoming increasingly common too.
- 👍 CDs can store large amounts of data at minimal expense. Both the cost of CD-ROM media and the production hardware are very low. As of mid-2001, a recordable CD can be obtained less than £1, and the price of a re-writable CD is between £6-£10. The production gadgets such as recordable and re-writable CD drivers are available in the ranges of £150-£250 and are

even standard components with some PCs. However, the Web is becoming a more cost-effective medium with even lower production, distribution and updating costs.

- 👍 At the moment, CDs are still the preferred medium for sending large amounts of data remotely, although high-speed Web connections and DVD media may change that in the near future.
- 👎 One shortcoming of the CD-ROM medium is that it has to be updated, perhaps, once or twice a year. For this reason, the information on a CD-ROM does not necessarily reflect up-to-the minute changes. In this respect, CD-ROM technology lags behind Web sites.
- 👎 Additionally, CD-ROM technology is no longer considered to provide the highest standards in storing and presenting data. As the data types and presentation options associated with product information get more complicated and demanding, there will be a need for more efficient technologies that offer even greater storage capabilities, higher quality of data and better interactivity options.

DVD (Digital Versatile Disc) seems to be a good alternative to CD-ROM technology. It is expected to replace CD-ROM technology in the long run. A DVD disc, which runs on a DVD player, has a huge storage capacity, as much as 13 times that of a CD-ROM. The DVD technology offers a higher quality of video, audio or other multimedia data and presents a more personalised and interactive viewing and/or listening experience.

### **2.3- World Wide Web sites:**

Floppy disk and CD-ROM technologies have been stepping-stones to the on-line services. It is important to mention that the Web was not the first medium to offer on-line building product information. Prior to the Web, some catalogue service

providers had on-line databases and/or Bulletin Board Services (BBS) that can be dialed-in with a modem and accessible on a subscription basis. These services allowed practitioners to review and download the latest product information at the time. However, due to their various shortcomings, none of these on-line services had been as successful and widespread as the product services on the Web. The Web is growing to be a major medium to disseminate electronic product information.

The World-Wide Web (WWW) or the Web is a global hypertext system linking documents and sources on the Internet<sup>32</sup>. It is based on the client-server network model. Information or Web pages reside on Web servers, which are computers running Web server software usually in remote locations; end-users (clients) use browser software such as Netscape Navigator or Microsoft Explorer to access and display these Web pages.

Web pages are written in a simple language called Hypertext Mark-up Language (HTML). There are a number of HTML editors that facilitate the design of Web pages. Anyone can design Web pages, and, with a subscription account, can place them on the Internet. The production cost is very low, and information is available instantly. For this reason, Web pages can reflect up-to-date information.

The Web is also a massive information source containing books, journals, software, databases, TV and radio channels, discussion groups and a number of other resources. It is also a rapidly growing business environment.

Due to its efficiency and the growing value of the medium, a number of companies use the Web to disseminate building product information, and this number is increasing at exponential rates. Web-based product information is mainly provided by either product manufacturers/suppliers themselves or catalogue service providers<sup>33</sup>.

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<sup>32</sup> Pike, *Special Edition Using the Internet*; LaQuey, *The Internet Companion*; Ford, *Spinning the Web: How to Provide Information on the Internet*.

<sup>33</sup> A list of on-line catalogues service providers can be found in Appendix D.

One way of locating building product sites on the Web is to use search engines (such as AltaVista, Yahoo, Excite, etc.), which are tools to perform searches throughout the Internet. Another way is to type the Web address, also known as a URL (Uniform Resource Locator), of a product manufacturer or catalogue provider in the browser. These Web addresses often contain the firm name or the product/service offered by the firm. For example, the URL for the Anderson Windows is “[www.andersenwindows.com](http://www.andersenwindows.com)” and “[www.productselector.co.uk](http://www.productselector.co.uk)” is for the Product Selector by the RIBA. Alternatively, various building sites and indexes can be used to locate product related Web sites.

Manufacturers’ sites can be more useful when a specific type of information is needed about a particular brand of product. Product information offered by these sites also tends to be more up-to-date and comprehensive since manufacturers themselves maintain their sites. Bookmarking these sites in the browser can be convenient for re-visiting them in the future.

For general queries, the sites of product catalogue service providers are used more commonly. Web-based product catalogue sites list product information from various manufacturers and suppliers. They are essential tools for reviewing products of different manufacturers.

On-line product catalogues are generally offered by the same companies who deliver paper-based and/or CD-ROM catalogues. There are also brand new companies that solely provide on-line catalogues (Figure 2.4). The content of product information in on-line catalogues is quite similar to those of paper-based and CD-ROM catalogues, but the information is more up-to-date.

Web-based catalogue sites use one of the following two methods in providing production information: centralised and distributed approaches.

The centralised approach resembles the way information is provided in paper-based or CD-ROM-based catalogues. Information collected from manufacturers and



suppliers is stored and offered from a central location, that is the Web server of the catalogue service provider. Among some of the UK and the American adopting this approach are Product Selector<sup>34</sup>, Architect's First Source for Products<sup>35</sup> and Sweet's System<sup>36</sup>.

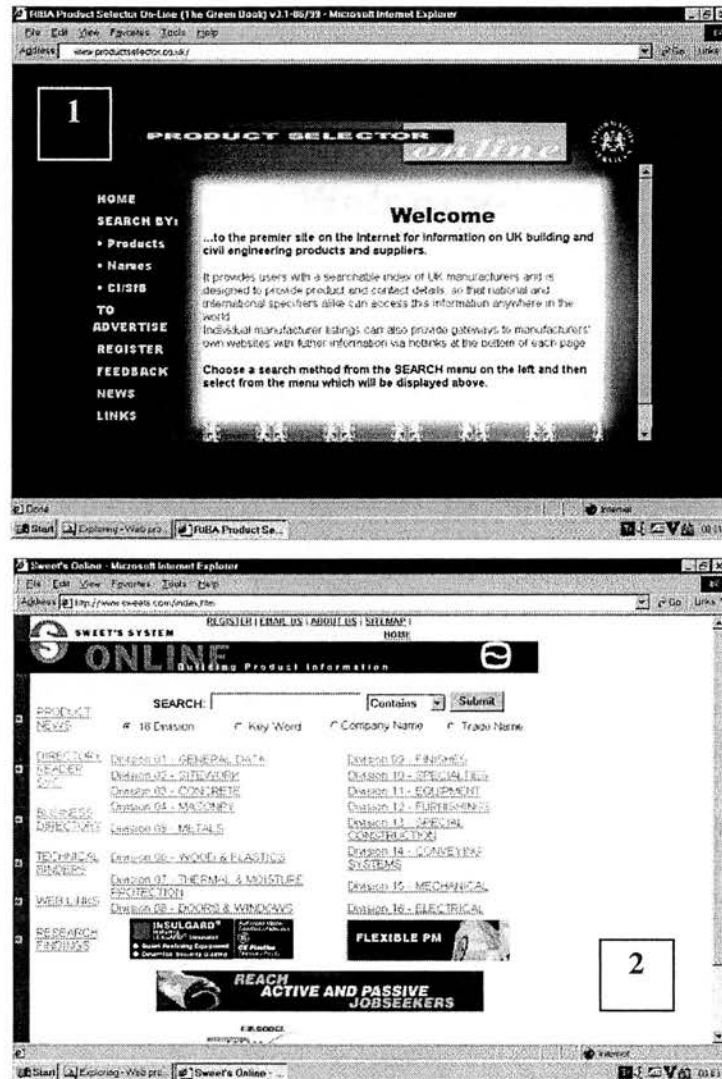


Figure 2.4: Two Product Catalogue Services on the Web

(1- Product Selector by the RIBA<sup>37</sup> and 2- Sweet's System by Mc-Graw Hill<sup>38</sup>)

The advantage of the centralised approach is that it does not rely on manufacturers/supplier Web sites. Possible problems experienced with these sites

<sup>34</sup> <http://www.productselector.co.uk>

<sup>35</sup> <http://www.afsonl.com>

<sup>36</sup> <http://www.sweets.com>

<sup>37</sup> <http://www.productselector.co.uk>

<sup>38</sup> <http://www.sweets.com>



such as URL name changes, server problems and the discontinuation of the on-line presence do not affect the quality of the service. End-users can still find product information and other means of contacting the manufacturers. The disadvantage of this approach is that the Web-based centralised product sites might not reflect the most recent product information in the manufacturer sites, and they have to be updated at regular intervals.

The product information in Web-based centralised product catalogues is often presented according to a standard interface that is specified by the catalogue provider. In other words, catalogues providers define the information content and presentation method, and the type of data provided (Figure 2.5). However, sometimes instead of following a standard format, manufacturers/suppliers design their own pages in spaces allocated for them. The centralised sites can also have pointers to manufacturers' and suppliers' own pages for end-users who seek more detailed product information.

In the distributed approach, the main Web site offers pointers to Web sites of individual manufacturers and suppliers instead of storing product information in a central location. Following the pointers, visitors can directly access remote manufacturer sites. Most product information sites deploy the distributed approach. Finding information is similar to locating a telephone number in a directory. Names and links to the product manufacturers along with brief descriptive product information are displayed (Figure 2.6). Pierpoint<sup>39</sup> by the AIA and 4specs.com<sup>40</sup> are among the Web sites relying on the distributed approach.

One of the advantages of the distributed approach is that product information is generally up-to-date reflecting changes in the manufacturers' Web sites. In addition, the need for site maintenance is minimal. A disadvantage of the distributed approach is that when the link of a desired product or manufacturer is broken, no information can be retrieved.

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<sup>39</sup> <http://www.e-architect.com/products/pierpoint>

<sup>40</sup> <http://4specs.com>



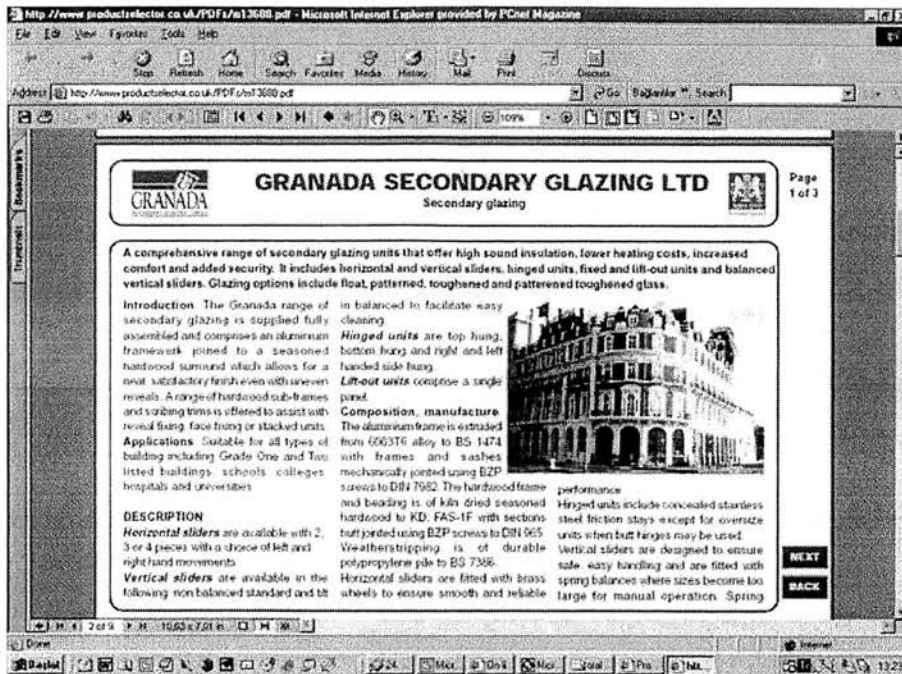


Figure 2.5: The centralised approach (Product Selector by the RIBA<sup>41</sup>)

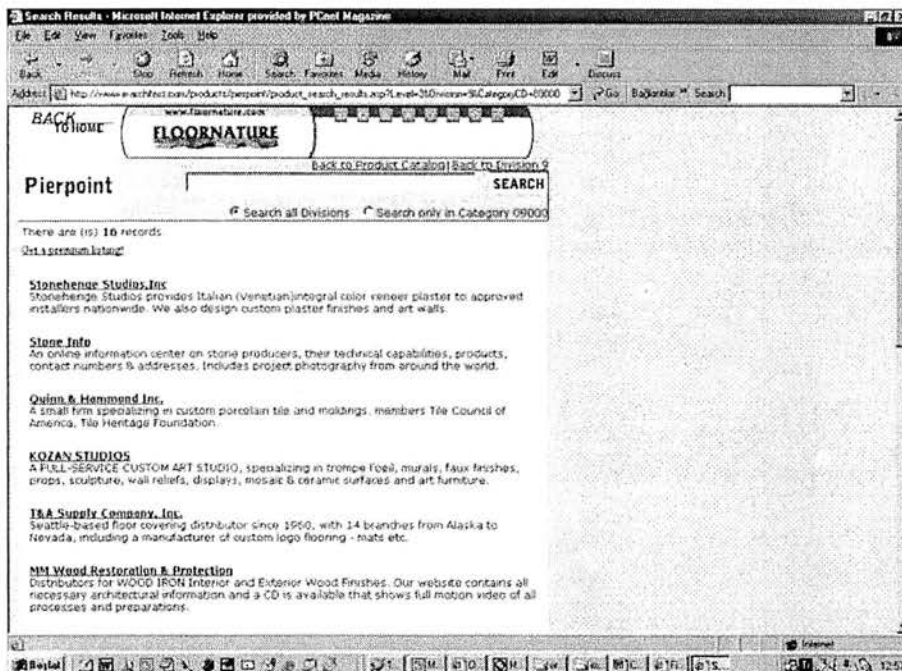


Figure 2.6: The distributed approach (Pierpoint by the AIA<sup>42</sup>)

<sup>41</sup> <http://www.productselector.co.uk>

<sup>42</sup> <http://www.pierpoint.com>

In both the centralised and the distributed approach, information is usually organised according to popular construction classification methods such as CI/SfB and MasterFormat. Users can locate information by following hyperlinks in appropriate categories, or alternatively, they can conduct keyword searches. Methods of keyword search can vary (Figure 2.7). The most common methods are:

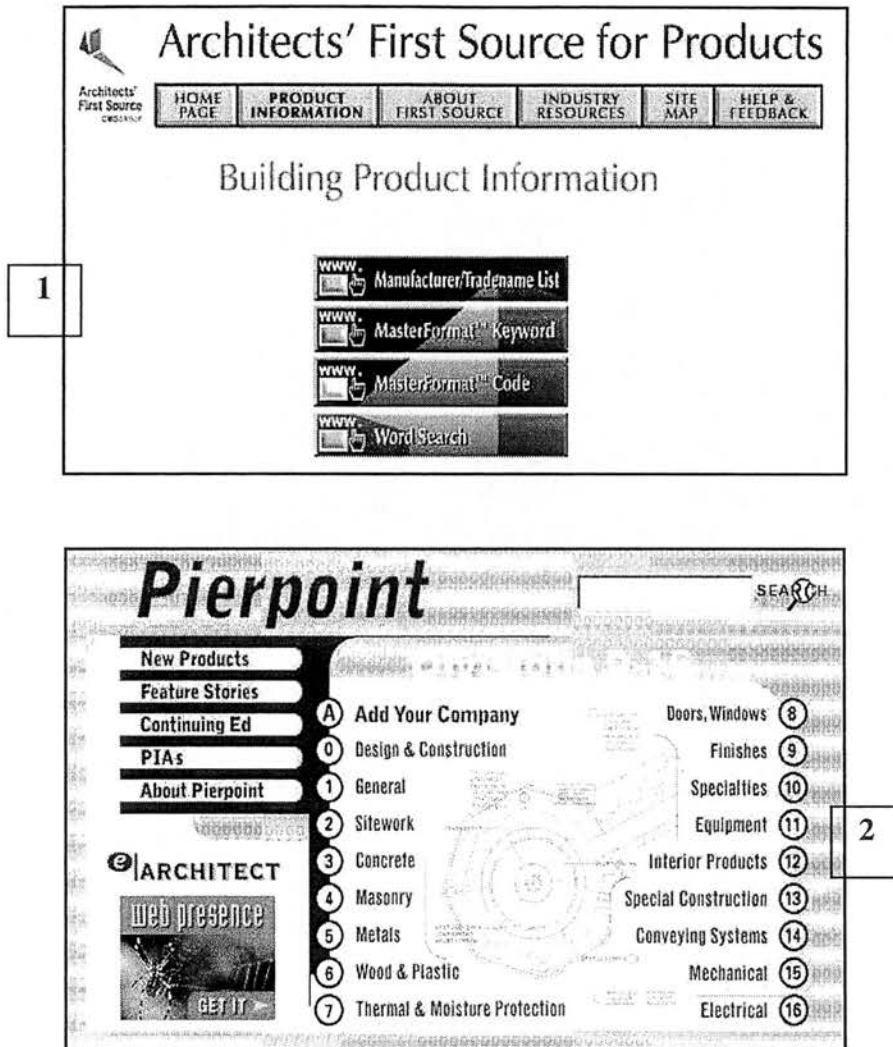


Figure 2.7: Typical search methods in Web-based product information catalogues (1- Architect's First Source by the CMG Group<sup>43</sup> and 2- Pierpoint by the AIA<sup>44</sup>)

<sup>43</sup> <http://www.afsonl.com>

<sup>44</sup> <http://www.e-architect.com/products/pierpoint>

**1- The name or number of the product in terms of CI/SfB or MasterFormat:** As explained earlier, these classification methods assign unique names and numbers for each category and sub-categories of products. Knowing these specific names or numbers can greatly shorten the search time and produce very accurate results. However, it can be difficult to memorise these numbers and names unless a product is used repeatedly.



**2- Product name:** End-users can type a generic name to find out a category of products. Typing very generic names for a product such as “window” cannot be very helpful, as the query produces a large number of hits to go through. More specific terminology such as “wood hinged window” can produce better results.







**3- Manufacturer name:** It is the name of the manufacturer or supplier of a product. It can be used interchangeably with other methods.

**4- Trade name:** These names are supplied by manufacturers to differentiate the range of products they offer from others. Typing the trade name for a product can narrow down product choices.

**5- General query:** A general query might include any of the search methods above. The keyword can be selected from a wide variety of options.

Some of the advantages and disadvantages of disseminating on-line product information are:

-  Web sites are inexpensive ways of publishing information, as the cost of production and distribution, which deals with designing, printing and mailing the material, is very low, and information is made available instantly.
-  A Web site can offer gigabytes of data. The data storage capacity is only limited to the available space on a Web server.

-  Because of the low cost of Web production, product information is very frequently updated. The most recent information in relation to new products, changes in product configurations and cost are best reflected through this media. Because of that, many catalogue service providers of paper-based and CD-ROM medium use the Web as a complementing medium to announce the most recent updates about products.
-  Web sites are accessible 24 hours a day from any part of the world with no additional cost. The ability to access product information globally and in great variety widens the horizons of designers. Accessing Web sites from remote locations also helps designers obtain information without leaving their office, hence saving time.
-  The Web is a platform independent environment that minimises the effort of creating and providing product information and related services. Many Web software technologies support different platforms of computers, e.g. a Web page written on a PC computer can be read and modified on a Macintosh computer without additional work; pages including scripts written in various programming languages such as Java and JavaScript often provide the same performance on different Web browsers and computer platforms.
-  Technical support and feedback about a product can be obtained from experts and other practitioners through Web forms, e-mail, discussion groups and bulletin boards. This type of interaction minimises sales pressure and concerns arising from social acceptability.
-  Having a Web presence can have a positive impact on a company's technology awareness and enhances its image as an innovator and leader.
-  Since information is stored and maintained remotely, Web sites do not take up physical office space and require no maintenance on the side of firms.



The Web is a new environment and offers new ways of organising and presenting product information. It is a highly interactive hypertext/hypermedia environment. Information can be layered for multiple hyperlinks according to users' immediate and secondary needs and/or the relevance of subjects to each other. Many interactive environments on the Web are supported by highly sophisticated programming languages or presentation formats such as Java, JavaScript, Shockwave, VRML and QuickTime VR. These technologies support the visual and technical understanding of products through animations, 3D graphical presentations, user-directed interactive information browsing and various other multimedia techniques. Users can review and compare more products in a short time and essentially make more informed decisions.



However, it appears that many companies providing product information on the Web disregard the interactive aspect of the Web and use existing content from earlier paper-based publications without any structural changes. The result is static pages mainly consisting of text and low-resolution 2D graphics.



On the other hand, one of biggest obstacles in providing pages with richer graphical and multimedia content is the bandwidth problem of the Web. Bandwidth is the amount of data (text, images, audio and video) that can be sent through a connection in a fixed amount of time. Pages with high-resolution images, animations, audio or video clips increase the download time.



Perhaps the major shortcoming of the on-line product catalogues is that the number of manufacturers and suppliers listed in on-line product catalogues are much less than those of paper-based catalogues. This might be due to the fact that the Web is quite a new medium, and many product manufacturers are still unfamiliar with this new platform.



## **The Utilisation of Electronic Product Information in CAD Systems**

Having reviewed electronic product information and its media, it is important to discuss how product information is utilised in CAD systems. As more architects rely on CAD, it becomes important that CAD systems and building product information communicate well. Effective utilisation of product information in CAD can enhance the productivity and quality of design and project documentation.

It appears that software technologies used in the design of CAD systems have been a determining factor in the integration and communication between CAD software and product information. These technologies have had effects on the format of product information offered by product vendors and the way this information is processed by CAD systems.

For this reason, it is important to illustrate what these software technologies are as they relate to product information. It seems that there are two major types of CAD systems offering different ways of interacting with product information, namely traditional systems and object-oriented systems.

### **Traditional systems**

Traditionally, CAD systems have mimicked the hand drafting and conventional working methods of architects where drawing tasks and written project documentation, such as specifications and bills of quantities are handled independently. For this reason, traditional CAD software mainly supported graphic tasks dealing with the creation of layouts consisting of geometric entities such as lines, arcs, circles, blocks and grouped elements for repetitive drawing. These systems neglected the non-graphic, also known as alphanumeric, tasks having to do with project documentation. For these tasks, design professionals utilised various other software, and none or minimal integration existed between graphic and non-graphic project information.

File format standards and conventions were also developed to accommodate conventional methods of working. The most widely used CAD file formats such as DXF (Data eXchange Format), the de facto standard offered by Autodesk, and IGES (Initial Graphics Exchange Standard), an internationally recognised standard, supported geometric representations while neglecting the non-graphic information associated with drawings.

All of these had implications on the format and structure of product information. There has been clear separation between graphic product information such as product drawings and images, and non-graphic or alphanumeric product information such as specifications, schedules and cost information. In most cases, manufacturers and/or information brokers offered graphic and non-graphic product information independently in a non-integrated or unlinked fashion, although both illustrate different aspects of building products, and they are interrelated. This approach is still the most common among product manufacturers.

According to the traditional approach, CAD software is mainly utilised for graphic product information offered as product plans, elevations and details. This information is generally provided in DXF format. Users can directly insert entities or objects from DXF files into CAD drawings. Another option is that they can manipulate the files to be placed in the company's library of CAD components which consists of sets of drawing elements - lines, arcs, circles - grouped together and manipulated as a unit<sup>45</sup>. These components, also called blocks, cells or symbols in various CAD systems, are shared between recurring projects. They can save time and improve productivity in an office.

Some product drawings and details can also contain short non-graphic information in the form of text attributes, which are brief strings of information such as component name, type, model, supplier and catalogue number embedded in components. This information might be used by some CAD and external software to

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<sup>45</sup> Work, "GBMs Make Block Usage Easier," *Design Management Journal*, pp. 19-29.



generate documents for bills of materials, component schedules and cost estimates from tables of component attributes.

Longer non-graphic product information can be used for the tasks of scheduling, costing, procurement and project management purposes<sup>46</sup>. Due to the domination of Microsoft in the desktop software market, DOC (DOCument format) and XLS (Excel Spreadsheet format) formats have become *de facto* file standards in the dissemination of text and tabulated product information. In addition, providing non-graphic information in neutral text formats such as TXT or RTF (Rich Text Format) is also common. Users can incorporate non-graphic information into their word processing, spreadsheet software and/or specialised programs such as specification software.

Utilising graphic and non-graphic product information independently as appears in traditional systems is inefficient. By integrating or linking graphic and non-graphic product information, one can create project documents such as schedules and specifications directly from drawings, and exchange data between different document types. All these contribute to increasing productivity. In addition, in an environment where graphic and non-graphic project information is integrated, data redundancy and inconsistency will be minimal, and this will ensure that various parties involved in the design process will share the same sets of data.

One way of bridging graphic and non-graphic product information in traditional systems involves DBMS (DataBase Management System), which is a collection of programs that enable one to store, modify and extract information from a database<sup>47</sup>. A DBMS can select and extract data required for a particular application and arrange information in a suitable format for schedules or reports<sup>48</sup>. Some DBMS can run independently from CAD software, while others are integrated. Utilising DBMS software users can create component libraries, embed text attributes in components and connect components to relational databases to retrieve non-

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<sup>46</sup> Port, "The Management of CAD for Construction," *SESRC Technical Report*.

<sup>47</sup> Margolis, *Personal Computer Dictionary*.

<sup>48</sup> Port, "The Management of CAD for Construction," *SESRC Technical Report*.

graphic information. However, the graphic representation (CAD) and non-graphic data storage (relational databases) exist separately. Users are required to create, relate and maintain data integrity across multiple tables in a relational model<sup>49</sup>. Although using a DBMS can offer some benefits, one has to exercise great care to avoid data redundancy and inconsistency among data sets.

### **Object-oriented systems**

The shortcomings associated with traditional CAD systems have resulted in the introduction of object-oriented CAD systems. Generally, object-oriented systems provide a more complete, integrated view of information than traditional systems in which graphic and non-graphic information is handled by different systems<sup>50</sup>. Integrated information offers more scope to improve productivity and achieve predictability in building projects<sup>51</sup>. Many CAD vendors see object-oriented systems as the main technique for the next generation CAD systems<sup>52</sup>. It is expected that these innovative systems will have important implications for building product information.

Object-oriented CAD systems rely on objects or models that represent and act like real building elements. These objects can be readily available in CAD systems or can be created by users from scratch. Unlike blocks/cells, objects are more than geometry; they can encapsulate properties and behaviours/relationships like the real world objects, which have characteristics making them what they are and allowing them to react in various conditions.

Properties are encapsulated data describing characteristics of an object. These data typically include dimensional values such as height, thickness, width and other visual information such as materials and finishes. One can manipulate the parameters for the properties through dialog boxes (Figure 2.8) and/or scripting languages

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<sup>49</sup> Herold, "Strangers Living Under One Roof," *End User Guide to IFC*.

<sup>50</sup> *ibid.*

<sup>51</sup> Bacon, "Unholy Alliance," *Procurement*.

<sup>52</sup> Mills, "AreThere Objects in Your CAD Future?," *Computer Aided Engineering*.

offered by the programs. In addition to geometric properties and brief text information, an object can also encapsulate non-graphic information such as specifications, schedules and cost information. This information can be shared among professionals. Since all information about an object is stored within the object, one can automatically generate cost estimates and specifications directly from them. Alternatively, information embedded in objects can be accessed and utilised by external software. Both of these approaches can keep down the cost of human errors and reduce the time allocated to the documentation tasks.

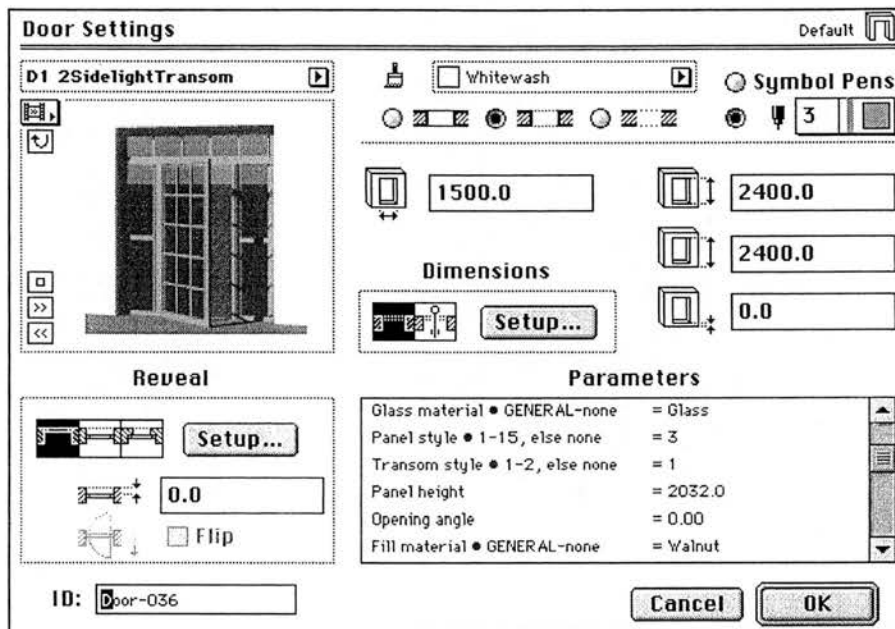


Figure 2.8: The ArchiCAD's dialog box for setting up parameters for object properties

Object-oriented product models can also encapsulate multiple-disciplinary views of the same product. For example, a door model can be shared by architects and quantity surveyors, each extracting different types of information. The same object can be used in different stages of the design process or its life cycle. More properties can be added to the object throughout its life cycle. Using the same object throughout the design process can help preserve data integrity and consistency, and data redundancy can be eliminated.

Behaviours are the unique characteristics of objects defining how they should react to the actions of users and other objects. They can be defined according to

design scenarios, building codes and various conditions. These codes and rules enable objects to act like intelligent and “self-aware” models that know what to do with themselves and understand their relationships with other objects. Violations of these pre-set conditions and rules might activate object(s) to dynamically prompt reactions, confirmation or questions in a CAD system. For example, a designer can create a wall object that has characteristics such as height, thickness, materials and openings. Any change and additions made to the wall type might prompt reactions from objects located on it.

There are also various standards and activities, particularly STEP (STandard for the Exchange of Product model data) and IFCs (Industry Foundation Classes), that encourage the adoption of object technology. STEP, developed by the International Organisation for Standardisation (ISO) is an international standard to provide a mechanism that is capable of describing product data throughout its life cycle, independent from any particular system. STEP is expected to enable a greater ease and accessibility of information exchange between different systems, whether those systems are graphical or alphanumeric, regardless of the software vendors<sup>53</sup>. IFCs, developed by the International Alliance of Interoperability (IAI)<sup>54</sup>, has similar objectives as the STEP and draws on the experience and output of STEP<sup>55</sup>. However, unlike STEP, IFCs is a commercial activity with an emphasis on early implementation. IFCs define a single object-oriented data model of buildings for information sharing throughout a building’s lifecycle, across disciplines and technical applications.

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<sup>53</sup> Cornick, *Computer-Integrated Building*.

<sup>54</sup> IAI is a coalition of organisations associated with the building industry working towards defining and developing an-object oriented architecture that allows information sharing among all stages of a building’s lifecycle.

<sup>55</sup> IAI, “IFCs on the March,” *IAI UK News*.

## **CHAPTER 3: THE WORLD WIDE WEB: A NEW MEDIUM FOR BUILDING PRODUCT INFORMATION**

### **Introduction**

In the previous chapter, different building product information media were introduced. It appears that the Web, apart from being the latest, is perhaps the most promising platform to disseminate building product information. The Web presents new opportunities in organisation, presentation and distribution of product information. This chapter will examine some of the fundamental issues associated with the Web such as how it works, what its major usage areas are, what makes the Web a unique medium, and which strengths and weaknesses the medium possesses. The chapter will also examine interactivity as one of the most important aspects of the Web. Some of the interactive technologies and tools deployed on the Web, and the importance of interactivity in product demonstrations, will be explained in the chapter as well. The chapter will conclude by presenting how the Web affects architectural practice and the design of CAD software.

### **The World Wide Web**

The World Wide Web (or “the Web”) is the fastest growing section of the Internet. It can be described as a collection of hyperlinked documents and sources spanning across the world. It utilises the networks on the Internet in order to store, locate and retrieve data. It also combines other Internet services such as File Transfer Protocol (FTP), Gopher, Telnet and E-mail for enhanced functionality and improved access to a wider range of sources.

The Web offers a multimedia environment that combines a variety of data types in text, audio and video formats and presents a hypertext/hypermedia layer over information and resources available on the Internet<sup>1</sup>. This user-friendly interface facilitates the way users interact with the Internet.

Some of the major uses of the Web are:

**Information access and education:** The Web is a major source for conducting academic research and searching for professional resources. It is a giant information system providing access to thousands of libraries, databases, articles, research papers, newspapers, information about recent news and current events worldwide. One can also participate in on-line courses and seminars through the Web.

**Communication:** The Web provides access to instant and inexpensive communication methods. Various Internet services such as e-mail, FTP and newsgroups are supported by Web browsers, software to navigate and to do searches on the Web. Through special add-on software called plug-ins, Web browsers can also support more sophisticated communication techniques involving video conferencing and Internet telephony.

**Commerce:** Electronic commerce is a growing use of the Web. Some commentators even think that the Web is moving towards becoming a primary means by which consumers see what products and services are being offered.<sup>2</sup> All the goods and services offered by traditional shopping environments and service sector are easily accessible through the Web. Entirely new products and services are also available on this medium. The Web is transforming into a major commercial platform that supports transactions between businesses. An increasing number of businesses are using the Web to buy, advertise and sell products/services to consumers or other business, to make investments and to provide customer support.

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<sup>1</sup> Hefley, "Client/Server Computing for the Networked Common Man," *American Programmer*, pp.15-20.

<sup>2</sup> Hankins, "Electronic Commerce Research Offer Insight into On-line Business Practices," *Signal*, pp. 25-27.



They also utilise the Web for providing organisational and inter-organisational communication, automating and even eliminating some mundane tasks.

**Recreation:** The Web presents a wide range of recreational activities such as playing multi-user games, listening to radio, watching TV, chatting and even dating.

Some of the important characteristics of the Web are:

**1- Global audience:** The Web is a global information system reaching everywhere across the world. A document placed on a Web server in a remote corner of the world can be accessible in a matter of seconds from anywhere around the world.

**2- Immediate distribution of information:** Any electronic document placed on the Web is immediately available for anyone to read. Publishing information on the Web is also an easy and direct process. Unlike other mass publishing media, it does not involve any intermediaries such as editors or publishers. Anyone can prepare and publish information on the Web.

**3- Inexpensive:** Printing colour brochures, books and catalogues and distributing them through traditional methods can be costly. The Web is a cost effective alternative to that. At a fraction of the cost of the traditional methods, the Web gives the complete freedom to publish any type of information in any amount, as there is no central authority on the Internet that regulates information<sup>3</sup>.

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<sup>3</sup> There have been several attempts to regulate information on the Web. A major attempt was by the Communications Decency Act of 1996 in the USA, suggesting that publishing "indecent" and "patently offensive" material on the Internet was a federal offence. The U.S. Supreme Court overturned this proposal and granted the free-speech protection to the Internet. However, there are on-going efforts to censor the "controversial" information on the Web through content rating and client-based filtering. See Beeson and Hansen, 1997. Another important issue with publishing information on the Web is copyright. Copyright and the Internet is still in a state of flux, and many issues are not resolved. According to the U.S. Digital Millennium Copyright Act, almost everything on the Web is protected by copyright law. See <http://thomas.loc.gov/cgi-bin/query/z?c105:H.R.2281.ENR>:



**4- Up-to-date information:** Unlike traditional media such as books and brochures, updating an existing content on the Web is done very easily. For this reason, many organisations and companies choose the Web to present the most up-to-date information about their services and the lines of products that they offer. It is also very common to use the Web for time-sensitive information involving announcements and recruitment.

**5- Easy integration with internal information systems:** Publishing content on the Web is becoming an effortless way of production. Today, many software applications are designed to be Internet aware. Through built-in features or special add-on software, these applications easily create HTML files and other Web readable data. For instance, Microsoft Word enables users to save their documents in HTML format; Bentley MicroStation can export HTML files from CAD drawings; and many software vendors offer Web-based connectivity for internal databases. In addition, various software vendors also develop plug-ins that will make their proprietary file formats viewable on the Web.

**6- Powerful formatting and publishing capabilities:** Since the introduction of the HTML 1.0 specification, HTML was improved to offer formatting capabilities, functionality and flexibility that are somewhat comparable to that of a desktop publishing application. The WYSIWYG<sup>4</sup> HTML editors also facilitate the creation of Web sites. Some of these authoring tools even incorporate FTP functionality to allow file transfer and updates in an integrated fashion within the same package. Various plug-in software and technologies further enhance the capabilities offered by HTML. Many dynamic Web pages take advantage of these technologies.

**7- Multimedia content:** The Web is a truly multimedia environment. It supports a wide variety of technologies encompassing audio, video, image and text data. Having multimedia content on a Web site enhances the interaction and communication between the reader and information, and as a result, makes the browsing experience much more interesting.

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<sup>4</sup> What You See Is What You Get

**8- Interactivity:** This is perhaps one of the most distinctive aspects of the Web making it very different from printed and other audio-visual media. The Web is a highly interactive and dynamic medium. It offers a two-way communication. Readers are active explorers. They can have control over the order and content of information that will be displayed. They can decide on their navigation path and style of search to obtain the type of information they need. Some popular forms of interactivity on the Web involve CGI/Perl, Java, JavaScript, ActiveX, Shockwave, Flash and VRML technologies.

**9- Personalised/individualised information content:** This is one aspect of interactivity. Web sites can offer personalised or tailored information content according to the interests and preferences of their readers. Web sites offering personalised information very often obtain information about users through cookies, which are text data stored on a client's hard drive by a Web browser<sup>5</sup>. Cookies can hold such primary details as personal data, login information, navigation preferences and personal interests. Another way of presenting personalised content is through so-called Push technology. Here, users specify their information preferences through provided options or channels. The Web server seemingly "pushes" information to the user according to user profiles rather than users having to "pull" it from the Web. Push technologies are commonly used for on-line news services such as InfoGate<sup>6</sup> and BackWeb<sup>7</sup>.

**10- Search tools:** The Web offers various tools to locate text, images and other audio-visual data on sites throughout the world. The most commonly used ones are Search Engines and Directories. There are well over a hundred search engines, each having their own particular search characteristics. Search engines generally create their listings using automated search routines that search the Web and index pages. Alta Vista is perhaps the most commonly used search engine. Directories depend on human editors for their listings, i.e. users add pages to the categories

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<sup>5</sup> [http://whatIs.techtarget.com/WhatIs\\_Search\\_Results\\_Exact/1,282033,,00.html?query=cookie](http://whatIs.techtarget.com/WhatIs_Search_Results_Exact/1,282033,,00.html?query=cookie)

<sup>6</sup> <http://www.infogate.com>

<sup>7</sup> <http://www.backweb.com>

provided for them, and human operators sort out this information. Yahoo! is a well-known example of a directory service.

**11- New technologies:** The Web is not tied to any proprietary system. It provides an open environment able to accommodate new technologies designed to exploit it. Many new programming languages and presentation techniques are being developed to make the Web content richer and more interactive.

### **Interactivity on the World Wide Web and Its Implications**

According to a recent poll of Web users, interactivity is among the most liked features of the Web<sup>8</sup>. This section will examine some of the characteristics of Web-based interactivity in detail.

Most traditional mass media such as television, radio and newspapers present information in an orderly and predefined fashion. They offer one-to-many information content, i.e. one source, many recipients<sup>9</sup>. In such media, the information provider specifies the information content and sets the rules as to how and in which order information should be viewed, heard or read. Viewers, listeners or readers, also called receivers, have no control over the information provided. The information content is general for everyone, and the flow of information is almost always linear, i.e. one programme or article following the other.

In addition to the above, the Web offers a one-to-one medium, i.e. information content from a source changes according to users' varied interests and needs<sup>10</sup>. There can be a two-way flow of information between information transmitters and readers. Information receivers can engage with the content in Web

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<sup>8</sup> NetPoll, "Internet Users have Great E-xpectations," *M2 Communications Ltd.*

<sup>9</sup> Coyne, *Designing Information Technology in the Postmodern Age: From Method to Metaphor.*

<sup>10</sup> Hoffman and Novak, "A New Marketing Paradigm for Electronic Commerce," *Project 2000 Working Paper.*

sites and navigate through information in their own ways. This two-way communication constitutes a key aspect of interactivity on the Web. As its dictionary meaning also suggests, interaction is based on the idea of mutual response and reciprocity<sup>11</sup>.

**Interactive** (adj.) 1- mutually or reciprocally active; action upon or influencing each other 2. (of a computer or other electronic device) allowing a two-way flow of information between it and a user, responding to the user's input.

Interactive environments encourage participation and allow equal exchange, plurality of viewpoints and direct contacts between transmitters and receivers. Readers can participate in decision-making and shape the final outcome. For this reason, interactive environments are considered “democratic” media<sup>12</sup>. True interactive information systems facilitate the communication between people<sup>13</sup>.

Unlike stand-alone, personal computer systems, the Web is an inter-personal medium that assists people to exchange information through synchronous and asynchronous communication opportunities. It offers various means that enable reciprocity between readers and information transmitters, and importantly, in many cases, the speed of this reciprocity is almost immediate. Typical forms of Web interaction involves listserv and newsgroups (Figure 3.1), live chat rooms, bulletin boards, audio and video conferencing environments, user polls and Web pages accepting user comments such as those in guestbooks and book review sites. The Web-based interactivity also involves a wide variety of data such as sound, animation and three-dimensional graphics. It also combines various technologies in an integrated manner i.e. one can watch TV, listen to music, read a newspaper and make a telephone conversation.

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<sup>11</sup> Pearsall, *The Concise Oxford Dictionary*; Merriam-Webster Online Dictionary: <http://www.m-w.com/dictionary.htm>

<sup>12</sup> Dysart, “Interactivity: The New Standard for An Engineering Web Presence,” *PM Engineer*, p. 30. - Note that there is an increasing scepticism of this idealism in the social sciences. See Coyne, *Technoromanticism*, 1999.

<sup>13</sup> Outing, “What Exactly is Interactivity,” *Editor & Publisher*, p.7.

The degree of interactivity offered on the Web varies. Highly interactive Web sites provide a great freedom and choice in exploring information in the users' own terms, preferences and order. Readers can prioritise and extract information among vast resources. They can omit unnecessary details and focus on more relevant aspects for the tasks at hand. Information acquired in this way is highly individualised. These environments encourage self-discovery, selectivity and user involvement. In some cases, readers can also become active content contributors. In contrast, less interactive sites offer access to predefined content only. The content of information is by no means tailored to the needs of visitors. These sites utilise basic hypertext/hypermedia tools and languages.

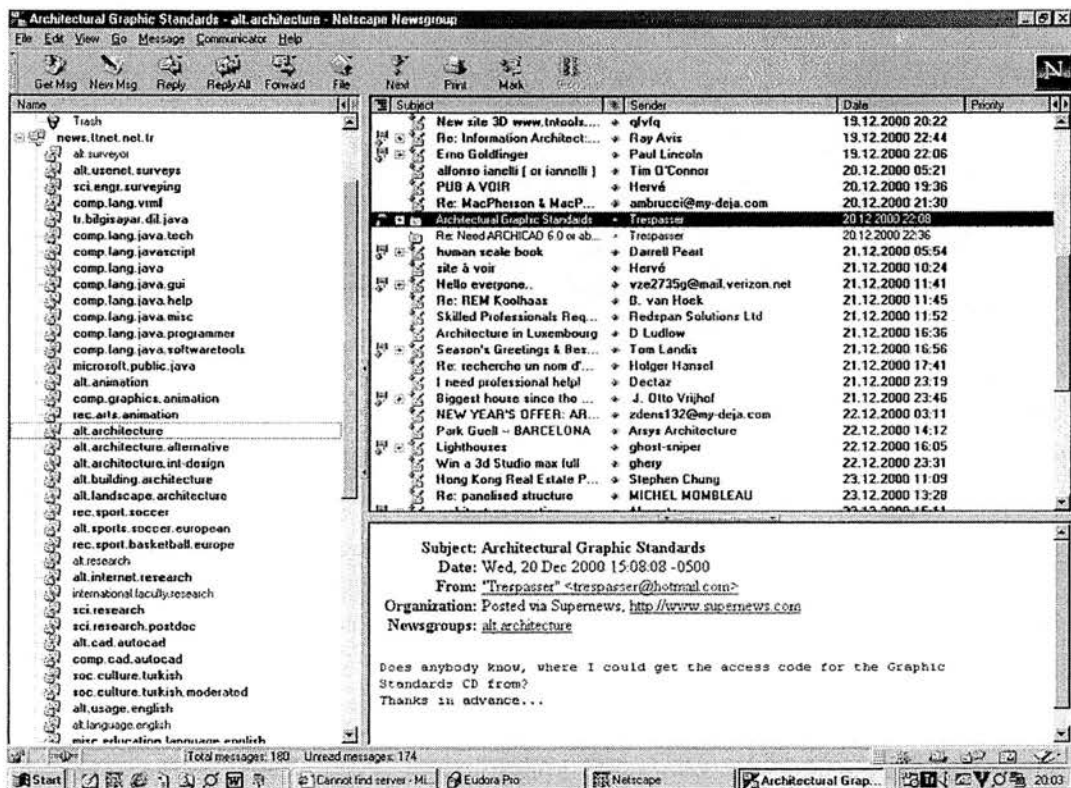


Figure 3.1: The Netscape Browser Interface to Newsgroups

An increasingly popular way of deploying interactivity on the Web is to promote and sell products and services. Interactivity allows firms to be closer to their customers<sup>14</sup>. At the very heart of interactive product sites lies individualisation.

<sup>14</sup> Hoffman and Novak, "A New Marketing Paradigm for Electronic Commerce," *Project 2000 Working Paper*.

Individualisation deals with offering information, products or services that satisfy the specific characteristics and expectations of customers. In the e-commerce world, the term “individualisation” is an emerging trend<sup>15</sup> often used interchangeably with mass customisation and personalisation. Individualised sites offer increased selling effectiveness<sup>16</sup>, as they appeal better to the unique needs of each user.

Individualisation is one way of giving customers choices. According to Piller<sup>17</sup>, customers increasingly express their personality by means of individual product choice. To respond to the different expectations of customers, suppliers create product ranges with an increasing number of variants<sup>18</sup>. Today, the number of automobile models available has increased from 140 to 260; the selection of soft drinks from 20 to 90 over the period 1985 to 2000. The U.S. market alone offers consumers 3,000 brands of beer, 50 brands of bottled water, 340 kinds of breakfast cereals, 70 styles of Levi's jeans and 31 types of bicycles<sup>19</sup>.

It is critical to be able to match the expectations of customers with the range of products at hand in order to retain customers and serve them better. For this, many businesses rely on one-to-one marketing, also known as customer-centric marketing. One-to-one marketing is a marketing method that businesses use to identify the buying behaviours and various preferences of their customers by directly communicating with them. In return, businesses change their services and/or products to better suit the interests, likes, dislikes and buying history of customers. One-to-one marketing can increase sales productivity, as a business is better equipped to anticipate the customers needs in the future. One-to-one marketing is also economic, as it eliminates intermediaries and the cost associated with unproductive advertising and marketing<sup>20</sup>.

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<sup>15</sup> Bakos, “The Emerging Role of Electronic Markets on the Internet,” *Communications of the ACM*.

<sup>16</sup> *ibid.*

<sup>17</sup> Piller, “The Information Cycle of Mass Customization: Why Information is the Critical Success Factor For Mass Customization,” [http://www.mass-customization.de/engl\\_infocycle.htm](http://www.mass-customization.de/engl_infocycle.htm), 2000. - Of course, there are those who argue that this proliferation of products does not constitute choice, but just more of the same. See Coyne, *Technoromanticism*, 1999.

<sup>18</sup> *ibid.*

<sup>19</sup> Gerber Scientific Inc., “Mass Customization,” <http://www.mass-customization.com>

<sup>20</sup> Prospective Strategy Consultants, “One to One Marketing: The Changing Dynamics of Marketing,” *Prospective Newsletter*.



One-to-one marketing is not a new concept. It has been widespread at least since the 1970s in the form of airline frequency programmes and loyalty cards used to offer personalised promotions and discounts for customers. However, the Web enhances the application of one-to-one marketing by offering new ways to identify and communicate with customers. The customer preferences on the Web can be acquired by asking customers directly about their likes and dislikes or encouraging them to register with sites. Some sites also build customer profiles utilising cookies. The individualised information can be presented immediately after the acquisition of personal information from users. This can be as simple as displaying the user's name on the start page, or making product suggestions based on unique customer profiles.

Amazon<sup>21</sup>, a major bookstore on the Web, perhaps, is the most successful one-to-one marketing site on the Web (Figure 3.2). Amazon keeps a profile of customers and identifies the type of books that would appeal to them. It builds an on-going dialogue with individual customers. It also gives the ordinary readers the opportunity to post their reviews and opinions on the books they read. This, in turn, is supposed to help other book readers in their book selections.

Apart from Amazon, there are many other interactive product sites that offer individualised product information. Anything from CDs to cars can be tailored on-line. Here are some interesting examples:

One of the earliest interactive product sites on the Web belongs to Dell Computer<sup>22</sup> (Figure 3.3). The site allows buyers to configure their own computer systems by selecting a range of peripherals offered by the company. Dell's site is a very successful e-commerce site generating 50% of the business of Dell.<sup>23</sup> The success of Dell led its competitors to move on-line.

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<sup>21</sup> <http://www.amazon.com>

<sup>22</sup> <http://www.dell.com>

<sup>23</sup> [http://www.dell.com/us/en/gen/corporate/factpack\\_000.htm](http://www.dell.com/us/en/gen/corporate/factpack_000.htm)



The screenshot shows the Amazon.co.uk homepage. At the top is the Amazon logo and navigation links like 'Your Account', 'Help', and 'SELL ITEMS'. Below this is a horizontal menu with categories: WELCOME, BOOKS, MUSIC, DVD & VIDEO, SOFTWARE, PC & VIDEO GAMES, KIDS, GIFTS, AUCTIONS, and ZSHOPS. A secondary menu includes 'HOW TO ORDER', 'GIFT CERTIFICATES', 'TOP SELLERS', 'BEATLES STORE', and 'DREAMCAST'. A search bar is present with the text 'SEARCH OUR SHOPS' and a dropdown menu showing 'All Products'. The main content area features a personalized welcome message for user 'S OFLUOGLU', recommending books, music, and DVD & Video. There are two main promotional sections: one for 'Refer a Friend' with a £100 incentive, and another for Christmas music. Below these are two featured items: 'Melody Maker' in music and 'Fantastic Fun' in books. A left sidebar titled 'BROWSE' lists categories: Books, Music, DVD, Video, and Software.

amazon.co.uk.

WELCOME BOOKS MUSIC DVD & VIDEO SOFTWARE PC & VIDEO GAMES KIDS GIFTS AUCTIONS ZSHOPS

HOW TO ORDER GIFT CERTIFICATES TOP SELLERS BEATLES STORE DREAMCAST

SEARCH OUR SHOPS All Products Go

Welcome back **S OFLUOGLU**, we have recommendations for you in [Books](#), [Music](#) and [DVD & Video](#) (if you're not S OFLUOGLU, [click here](#)).

Find everything from [Handsprings](#) to more PDAs in our [Gadget Store](#).

**BROWSE**

- Books
- Music
- DVD
- Video
- Software

**Refer a Friend--spread the Amazon word and earn up to £100 in gift certificates**

Get ready for Christmas--tune in to our [Christmas Music Store](#) for festive soundtracks.

Booker winner--Margaret Atwood's *The Blind Assassin* has won the [Booker Prize 2000](#).

**in MUSIC**

**Melody Maker:** More soulful than his last album, *Eat Boy Slim's Halfway*

**in BOOKS**

**Fantastic Fun:** In the endlessly inventive Terry Pratchett's latest novel

Figure 3.2: The Amazon Web site (<http://www.amazon.com>)

The screenshot shows the Dell.com website's customization page for the Dell Dimension 4100. The top navigation bar includes links to Dell.com, Gigabuy.com, About Dell, Contact, Search, Support.Dell.com, Order Status, and Your Cart. The main header features the Dell logo, 'United States', and 'HOME & HOME OFFICE'. A sidebar on the left provides contact information: 'Buy Online or Call 1-888-799-3355'. The main content area is titled 'CUSTOMIZE YOUR DELL® SYSTEM' and features a 'Dimension 4100' section with a 'PRICE DROP ON SELECT DESKTOPS!' announcement. It includes an image of the desktop and a 'pentium!!!' logo. Below this, a 'Your Price' table shows the purchase price as \$1,129.00\* and a monthly purchase plan starting at \$31/month. Action buttons for 'Update Price', 'View Cart', and 'Add to Cart' are provided. At the bottom, there are view options (Standard View, All Option View, Print/Fax View), an E-VALUE CODE (6V005 - 500501c), and a section for selecting options and adding them to the shopping cart. A dropdown menu shows 'Dimension® 4100 Series, Pentium® III Processor at 800MHz'. There is also a 'Choose Your Promo!' section with a 'None' selection.

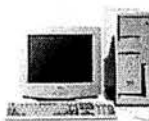

Dell.com Gigabuy.com About Dell Contact Search Support.Dell.com Order Status Your Cart

**DELL.COM** United States HOME & HOME OFFICE

Buy Online or Call 1-888-799-3355

**CUSTOMIZE YOUR DELL® SYSTEM**

**Dimension 4100**  
PRICE DROP ON SELECT DESKTOPS!

  More power. More Internet.

\$50 price drop on all 4100-series desktops with 128MB of SDRAM and above.

Your Price	
Purchase Price	<b>\$1,129.00*</b>
Monthly Purchase Plan	As low as \$31*/month <sup>18</sup> (48 mos.)
	<a href="#">Monthly Purchase Plan Details</a>

[Update Price](#) [View Cart](#) [Add to Cart](#)

Standard View All Option View Print/Fax View E-VALUE CODE: 6V005 - 500501c

Select options, update price and add to your shopping cart below.

**Dell Dimension 4100 Series** [Learn More](#)

The Dimension 4100 offers advanced technology at a great price. For Dell's fastest performing desktop, you can [customize a Dimension 9](#).

Dimension® 4100 Series, Pentium® III Processor at 800MHz

**Choose Your Promo!** [Learn More](#)

Please make a selection below

None

Figure 3.3: The Dell Web site (<http://www.dell.com>)

Nike offers a unique promotional novelty in its highly interactive site NIKEiD<sup>24</sup> (Figure 3.4). NIKEiD enables consumers to “design” their own sneakers within constraints. Visitors to NIKEiD can customise two of the Nike products the Air Turbulence running shoe and the Air Famished cross trainer. The customisation involves choosing the shoe's base and accent colours, and adding an eight-letter personal I.D. stitched into the heel of the shoe. The shoes, which are delivered within three weeks in the USA, cost \$10 more than their typical retail price.

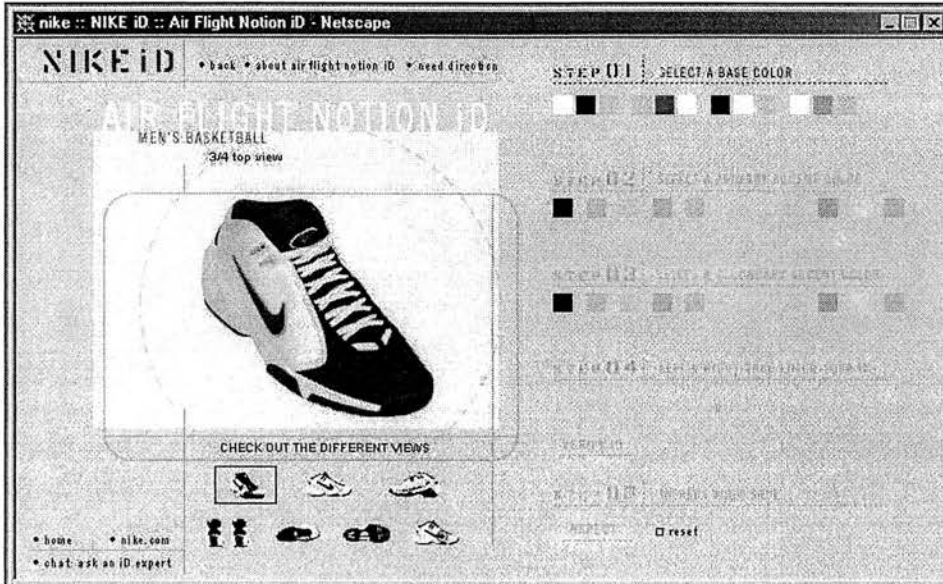


Figure 3.4: The NikeiD Web site (<http://www.nike.com>)

PresentPicker<sup>25</sup> is a site for purchasing gifts. It presents gifts in response to customer descriptions of the occasion, the interests and personality of the gift recipient (Figure 3.5).

Arabam.com<sup>26</sup> is a Turkish Web site for ordering cars on-line (Figure 3.6). The site provides an intuitive interface for potential customers to specify the model, accessories, colours and payment plan for the car of their choice. Customers can see the results of their decisions in real-time.

<sup>24</sup> <http://nikeid.nike.com>

<sup>25</sup> <http://presentpicker.com>

<sup>26</sup> <http://www.arabam.com>

**Perfect Present Picker** presentpicker.com

gift search top12 new home break

our database of gift ideas is fully editorial

**selectors**

- idea list
- hot gifts
- top sites
- gifts24.com
- giftmania.com
- gifts in a mug
- find gift ideas
- thanksgiving
- christmas
- all sites
- interactive
- directory
- keywords
- holidays
- celebrate
- gallery of love
- cybiko
- art soap
- categories
- interests
- occasions
- personalities
- lifestyles
- utilities

**sponsor's specials**

**most popular**

**Escape Gift Basket - \$36.95** **Shaving Set - \$22.00**

giftmania-Yahoo gifts24.com

**TOP 12: popular, choice, expensive, inexpensive, outrageous, and 12 sleepers**

**gift idea search** (use restrict checkboxes sparingly and select values in every box)

**interest**

- american
- angels
- animals
- antiques
- art related
- athletics
- beer or wine
- cars planes etc

☐ restrict

**occasion**

- anniversary
- any occasion
- april fools
- baby shower
- back to school
- barmitzvah
- birthday
- bon voyage

☐ restrict

**personality**

- always prepared
- analytical
- busy body
- cheerful
- childish
- competitive
- controlling
- creative

☐ restrict

More than one selection in any category is welcome. Multiple selections on some systems / browsers require control-C

go

Figure 3.5: The Present Picker Web site (http://presentpicker.com)

**arabam.com** Powered by Milpa

**Renk Seçiniz**

**Seçtiğiniz Otomobil** Siena 1.4 EL

**Standart Otomobil Fiyatı** 4,986

**Klima** 443

**Opsiyonlu Otomobil Fiyatı** 5,429

**KDV** 1,358

**Ek Taahhüt Alım Vergisi** 652

**Taahhüt Alım Vergisi** 864

**Diğer Vergiler ve Masraflar** 363

**Anahtar Teslim Fiyatı** 8,666

Fiyatlar milyon TL olup, üretici firma tarafından belirlenmiştir.

**Döşeme**

Renk ve desen örnekleri bilgilendirmek amacıyla sunulmuştur. Döşeme, kaporta rengine uygun olarak, üretici firma tarafından belirlenmektedir.

**Dış Renk**

	1.	2.
Beyaz	<input type="radio"/>	<input type="radio"/>
Barok Kırmızısı	<input type="radio"/>	<input type="radio"/>
Koyu Kiremit	<input type="radio"/>	<input type="radio"/>
Senfoni Mavisi	<input type="radio"/>	<input type="radio"/>
Pasifik Mavisi	<input type="radio"/>	<input type="radio"/>
Çelik Grisi	<input type="radio"/>	<input type="radio"/>
Füme	<input type="radio"/>	<input type="radio"/>
Fildişi	<input type="radio"/>	<input type="radio"/>
Buz Mavisi	<input type="radio"/>	<input type="radio"/>

**Jüpiter Mavisi** **Jüpiter Kırmızısı** **Gri Kadife** **Satürn Kırmızısı**

Renkler hakkında fikir edinmek için fareyi renk isimlerinin üzerinde gezdiriniz. 1.sütun ilk tercihiniz, 2.sütun ise ikinci tercihiniz içindir.

**Devam et**

Ana Sayfa | Görüş ve Önerileriniz | Bize Ulaşın | Arkadaşınıza Önerin | Sıkça Sorulan Sorular

Figure 3.6: The Arabam.com Web site (http://www.arabam.com)

In addition to the examples above, there are several other sites to exploit the idea of interactivity, some of which are CDIY<sup>27</sup> allowing consumers to create their own compilation CDs, idTOWN<sup>28</sup> giving the buyers the opportunity to design their watches, iPrint.com<sup>29</sup> selling customised stationery, mugs and T-shirts, and Alwaysinstyle<sup>30</sup> advising about various beauty products based on how visitors describe their appearance<sup>31</sup>.

There are also a few interactive sites that offer building products. One of the most notable is the Web site of Graham & Brown Ltd., a wallpaper manufacturer. The site<sup>32</sup> contains a Java applet that has two-dimensional modelling tools for potential customers to design their own wallpaper patterns (Figure 3.7). The customers can choose different geometric shapes, colour and line types in creating the patterns. The applet also has a button to submit the finished design to the supplier for production.

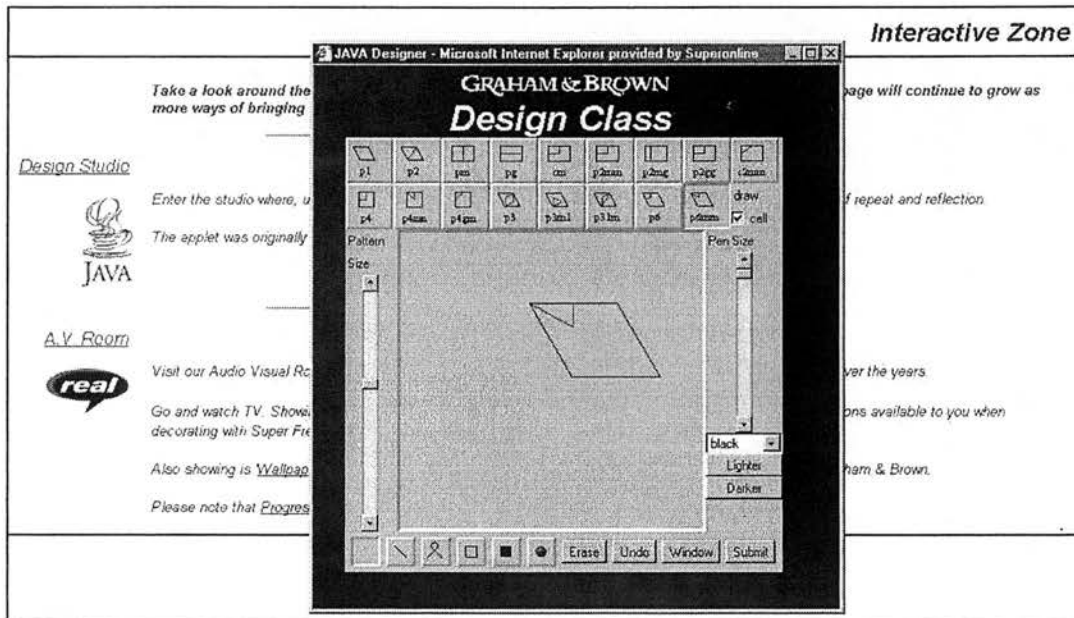


Figure 3.7: The Graham & Brown Ltd. Web site (<http://www.grahambrown.com>)

<sup>27</sup> <http://www.cdiy.com>

<sup>28</sup> <http://www.idtown.com>

<sup>29</sup> <http://www.iprint.com>

<sup>30</sup> <http://www.alwaysinstyle.com>

<sup>31</sup> McManus, "As You Like It," <http://www.sean.co.uk/customisation.htm>

<sup>32</sup> <http://www.grahambrown.com/interactive>

Another interactive building product site<sup>33</sup> belongs to Dulux, a worldwide paint manufacturer (Figure 3.8). This site offers a chance for visitors to choose from several room styles and then apply different colour schemes by clicking on the adjacent colour swatches. The colour of the room changes according to the selection. The product and colour names are listed underneath each picture.

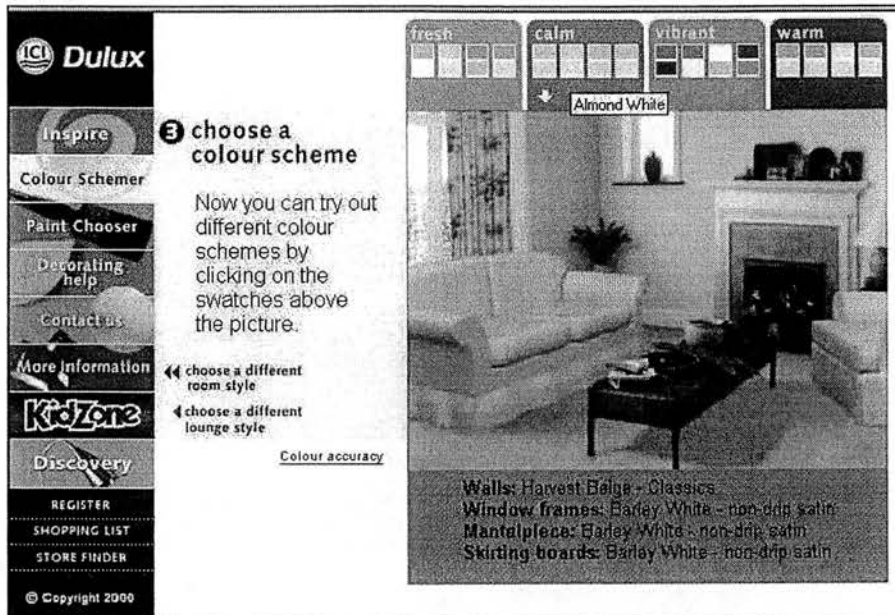


Figure 3.8: The Dulux Web site (<http://www.dulux.com>)

One architectural firm<sup>34</sup> on the Web also deploys interactive presentation methods. The firm allows its prospective clients to experiment with different finishes and colours for several elements in a mock-up space (Figure 3.9).

Whether these sites offer genuine opportunities for customers to explore options and enjoy greater access to personalised shopping or are simply lures to attract interest in the Web site and the brand, they at least demonstrate the strong potential of customised retail on the Web.

The interactive sites incorporate various different marking up and modelling languages, programming and scripting languages and plug-in software. Some of the

<sup>33</sup> <http://www.dulux.co.uk/UKRETAIL::DFinity.1QJiP4jmp5DM>

<sup>34</sup> <http://www.il-architects.com>

most popular interactive technologies deployed on the Web are HTML, CGI (Common Gateway Interface)/Perl Scripting, JavaScript, VBScript (Visual Basic Script), Java, Shockwave, Flash, VRML (Virtual Reality Modelling Language), ActiveX and Push technologies. These technologies offer varying degrees of interactivity from more interactive to less. The detailed description of CGI/Perl Scripting, JavaScript, Java and VRML will be provided in Chapter 5.

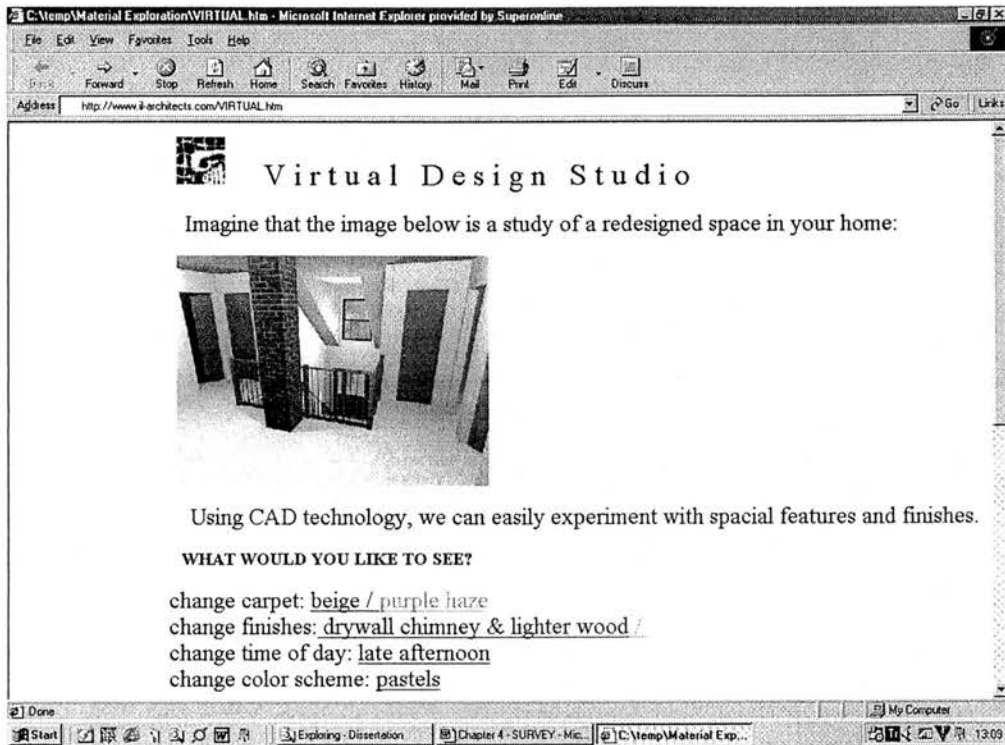


Figure 3.9 Changing the properties of a room as presented in the Ignarri-Lummi Architects Web site



## Drawbacks of the World Wide Web

The Web has some technical drawbacks too. The major ones are those related to security, bandwidth and information overload.

**1- Security:** This is a potential concern for all networked computer systems. However, it is even more critical when it comes to a large open system like the Web. Since the introduction of the Web, it has evolved to become a research, commercial, recreational and communicational platform. Every day millions of users transmit sensitive and confidential information as passwords, credit card numbers and identification information. This information is potentially susceptible to external and internal abuse.

Security concerns concentrate around the following areas<sup>35</sup>:

- 1- The client security, that is, the safety of a user's computer, applications and data,
- 2- The server security that has to do with the host computer, server software and all data on the host computer,
- 3- The connection security that refers to impregnability of the lines that connect one's machine to the server s/he is communicating with,
- 4- The transaction security that deals with protective protocols for data while being transferred to its destination.

Web servers offer various security procedures against unauthorised access and attacks:

- 1- Using a firewall, which is a set of related programs that protects the resources of a network from users in other networks,
- 2- Limiting access to the server,
- 3- Applying user authentication, which is the process of determining whether someone or something is, in fact, who or what it is declared to be<sup>36</sup>,

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<sup>35</sup> Honeycutt, *Using HTML 3.2*.

<sup>36</sup> [http://whatis.techtarget.com/WhatIs\\_Definition\\_Page/0,4152,211621,00.html](http://whatis.techtarget.com/WhatIs_Definition_Page/0,4152,211621,00.html)



- 4- Deploying data encryption methods, which involve converting data into a form that cannot be easily intercepted by unauthorised people. Two popular encryption protocols are Secure Socket Layers (SSL) and Secure HTTP (S-HTTP).

Web browsers also offer similar methods to ensure data security:

- 1- Digital signatures, that is, electronic signatures used by someone to authenticate the identity of the sender of a message or of the signer of a document,
- 2- Encryption,
- 3- Authentication.

In the majority of cases, the security techniques listed above prevent the unauthorised access and inappropriate use of sensitive data. However, not all sites implement these techniques, nor are users necessarily aware of their existence. The security of the Internet that relates to intellectual property rights, and the proliferation of obscene, defamatory and subversive material, are issues currently taxing legislators<sup>37</sup>.

**2- Bandwidth:** The Web generates a significant and rapidly growing percentage of Internet traffic. Web users' demand for higher bandwidth-consuming applications such as real-time audio and video, Internet telephony and animation increase everyday. This rapid increase and diversified use of the Web creates an additional burden on the already low-bandwidth of the Web that grows even slower each year<sup>38</sup>. The low-bandwidth hinders the timely transfer of information on the Web and has an important impact on the design of pages with richer information content that includes high-resolution images, audio and video clips and interactive technologies. For this reason, Web designers avoid including technologies demanding much bandwidth.

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<sup>37</sup> Davidson et al., "The Law of Cyberspace: Liability of Information Service Providers," *Journal of Internet Law*; Dekker, "Security of the Internet," *The Froehlich/Kent Encyclopaedia of Telecommunications*, pp. 231-255.

<sup>38</sup> Nielsen, "Nielsen's Law of Internet Bandwidth," Alertbox at useit.com. - This is ameliorated by the installation of higher bandwidth lines at local, national and international level, but this upgrading is at a cost and bottlenecks persist.

Fast transfer of data is critical for a Web page. However, as of mid-2001, many end-users only have analogue modems whose data transfer speeds are 56 Kbps, and the majority of Web sites aim at optimal usability over this speed. Still many companies do not even have an ISDN (Integrated Service Digital Network) access, which is a dedicated digital network allowing connection at 128 Kbps to the Internet<sup>39</sup>. It is expected that beginning from 2003, ISDN will be more readily available to the general public while technologies such as faster ISDN, T1 and ADSL, which will increase the current access speed up to 57 times and will be widely available for high-end users<sup>40</sup>.

**3- Information overload:** The Web is generally a useful source for information on many subjects. However, it can also overwhelm due to the immense amount of information available. As the amount of information on the Web continuously grows, it becomes even more difficult to find and extract relevant information. This situation can lead to information overload, which is an indiscriminate oversupply of data that varies in reliability, quality and relevance, and causes inability to extract particular knowledge from an immense quantity of information<sup>41</sup>.

One of the causes of information overload on the Web is its dual role of being both a private and a public medium<sup>42</sup>. Anyone anywhere can put any information on the Web. No editors or referees take responsibility for determining the quality of the material. There are Web pages devoted to hobbies and various passions of people. There are also pages that present scientific information for the research community or authoritative statutory information. It is often very difficult to sift useful content from personal “junk” information.

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<sup>39</sup> By mid-2001 in the UK, some cable companies offered to supply cable modem Internet access (512 Kbps) to domestic consumers for as low as £55 per month.

<sup>40</sup> Nielsen, “Nielsen’s Law of Internet Bandwidth,” Alertbox at useit.com.

<sup>41</sup> Nelson, “We Have the Information You Want, But Getting It Will Cost You: Being Held Hostage by Information Overload,” *The ACM's first electronic publication*.

<sup>42</sup> Berghel, “Cyberspace 2000: Dealing with Information Overload,” *Communications for the ACM*.

There are various ways to deal with information overload. One is to use search engines. However, although search engines are very useful research tools, they sort Web resources in a broad manner to present thousands of hits for a single query, many of them with no relevance to the intended search topic<sup>43</sup>. In addition, the search engines index only a small percentage of the Web<sup>44</sup>. Other common options of dealing with information overload include using personal information agents, which are computer programs that roam the Internet on behalf of users, looking for information<sup>45</sup> and services like InfoGate that provides personalised news content by using push technologies.

### **The Internet and the Web in Architectural Practice**

Computers have been a common place in architectural offices since the 1980s. They are used for a range of purposes, including Computer-Aided Design, Word processing, Specifications, Financial Management, Desktop Publishing, Scheduling/Personnel, Energy Analysis and Facility Management.

Since the early 1990s, the Internet has provided other applications of computers for architectural firms. Architects with on-line access grow at an exponential rate. Many believe that the Internet as a business tool will have a similar impact on businesses and their information systems as the spread of personal computers in the 1980s<sup>46</sup>.

One important use of the Internet in architecture is as a tool for communication and collaboration. Architectural design, a core of activity carried out by architects, is a social activity involving an array of participants that work<sup>47</sup>, in

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<sup>43</sup> Kennewick, "Internet Users Battle Information Overload," *Puget Sound Business Journal (Seattle)*.

<sup>44</sup> *ibid.*

<sup>45</sup> Berghel, "Cyberspace 2000: Dealing with Information Overload," *Communications for the ACM*.

<sup>46</sup> Pant and Hsu, "Business on the Web: Strategies and Economics," *The Fifth International World Wide Web Conference*.

<sup>47</sup> Kalay, "P3: An Integrated Environment to Support Design Collaboration," *Proc. ACADIA 97*, pp.192-193.

many cases, in disparate physical locations. Effective communication with all design participants is important in the successful and timely completion of design projects. The Internet promotes the concepts of collaboration and communication<sup>48</sup>. It reduces the barriers of setting up communication networks among design participants<sup>49</sup>. The Internet offers a graphical, timely and inexpensive way of exchanging information. The Internet fits into a matrix of communication technologies such as fax machines, portable telephones and pagers<sup>50</sup>.

The availability of fast and convenient communication over the Internet enables firms and project teams to work from disparate physical locations. This way of working constitutes a kind of distributed practice, which allows design participants to share human resources, databases and project information on-line. Having access to the same information has the potential to improve accuracy, relevancy and the speed of decision-making<sup>51</sup> in the design and in construction processes<sup>52</sup>.

Distributed practice is often motivated by the aim of establishing “virtual corporations<sup>53</sup>”, which are organisations containing clusters of small, ad hoc teams of people representing a variety of disciplines, and even companies that work on particular projects at remote locations<sup>54</sup>. Virtual corporations, in some ways, offer several advantages over conventional ones, such as lower overhead, greater flexibility and greater responsiveness to customer needs<sup>55</sup>, particularly for small firms<sup>56</sup>. Through virtual teams, firms can compete for projects outside their

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<sup>48</sup> Coyne, “CAD On-line,” *Proc. EuroPIA '97*, pp.63-75.

<sup>49</sup> Lowder and Antevy, “Project-Specific Web,” *Construction Specifier*.

<sup>50</sup> Coyne, “Who Needs the Internet? Computer-Mediated Communication in Design Firms,” *Environment and Planning B: Planning and Design*, pp.749-770.

<sup>51</sup> Coyne, “Who Needs the Internet? Computer-Mediated Communication in Design Firms,” *Environment and Planning B: Planning and Design*, pp.749-770.

<sup>52</sup> Lowder and Antevy, “Project-Specific Web,” *Construction Specifier*.

<sup>53</sup> Davidow, *The Virtual Corporation: Structuring and Revitalizing the Corporation for the 21<sup>st</sup> Century*.

<sup>54</sup> Fisher, “The Virtual Profession,” *Progressive Architecture*, p.9.

<sup>55</sup> Johnson and Clayton, “The Impact of Information Technology in Design and Construction: The Owner’s Perspective,” *Proc. ACADIA 97*, p.230.

<sup>56</sup> Coyne, 1996.

traditional markets and geographic boundaries<sup>57</sup>. Size does not matter either<sup>58</sup>. Virtual corporations also promote the internalisation of practice. Members of virtual organisations often include satellite offices and local practitioners. The virtual corporation offers a means of staying competitive<sup>59</sup> in a global marketplace. By relying on the communication infrastructure of the Internet, firms in different time zones can share their workloads in a way that allows continuous work around the clock

There are two forms of communication on the Internet: synchronous and asynchronous. Synchronous communication involves real time exchange of information through video/audio conferencing and shared whiteboards. On the other hand, information is exchanged sequentially in asynchronous communication. Common forms of Internet services using asynchronous communication are e-mail, bulletin board systems, File Transfer Protocol and World Wide Web sites.

Web sites, in a collaboration context, are typically used as integral information and communication hubs for design projects where members of design teams and clients can tap in to the latest project information, and exchange messages with each other<sup>60</sup>. They act as on-line locations or “virtual design studios.” Members of design teams visit project Web sites, as they would go to each other’s offices<sup>61</sup>. Many firms also have corporate Web sites in which they market their services and expertise to a larger audience. Many people judge firms by the information on their Web sites. The presence of a Web site can also serve to signal prospective customers

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<sup>57</sup> Sanders, *The Digital Architect: A Common-Sense Guide to Using Computer Technology in Design Practice*.

<sup>58</sup> *ibid.*

<sup>59</sup> Doherty, “Digital Management in the Internet Age,” *Evolv White Paper*.

<sup>60</sup> One interesting study that investigates electronic communication during the design process is conducted by the Martin Centre, Cambridge University. The project aims at finding ways of using the Internet to achieve better buildings, by improving the consultation process between architect and eventual user. See Richens and Trinder, 1999.

<sup>61</sup> Mitchell and McCullough, *Digital Design Media: A Handbook for Architects and Design Professionals*, 1997.

that the firm is on the cutting edge<sup>62</sup>. When this study first started, there were over a thousand architectural firms with Web pages. By mid-2001, having a corporate Web site has become as commonplace as a business card and as essential as being listed in the yellow pages<sup>63</sup>.

A small number of firms also use the Web to make direct sales to clients. However, the amount of sale and the range of services or products provided in this way are limited. The reason for that is that architecture is a service profession<sup>64</sup> and many clients prefer a face-to-face communication with their architects rather than on-line interaction. In addition, loyalty and previous experience are important in the relationship between architects and their clients. Most professional services offered by architects are also very costly. High-priced services do not sell as readily as consumer products<sup>65</sup> on the Web.

Another use of the World Wide Web in architecture is as an information source. The Web helps architects with information and knowledge that are not possessed in-house<sup>66</sup>. The Web constitutes an enormous electronic library containing a wealth of information in a range of different areas related to building codes, specifications, building products, CAD libraries and projects of other firms. There are also Web pages of various professional and reputable organisations offering rich professional information content. Information in most of these sites can be searched with search tools.

Intranets and Extranets are other Internet technologies utilised by architectural firms. Intranets use the same protocols and network technologies as Internet connections and offer browser-accessible information<sup>67</sup> inside a firm.

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<sup>62</sup> Hoffman et al., "Commercial Scenarios for the Web: Opportunities and Challenges," *Journal of Computer-Mediated Communication*.

<sup>63</sup> Tucker, "Project Extranets: Small Steps Reap Big Rewards," *AIA Architect*.

<sup>64</sup> Padjen, "Spinning Your Web Page," *Architecture*, p.168.

<sup>65</sup> Novitski, "Consumers are Buying Goods on the Internet in Growing Numbers: Will E-commerce Doom Retail Architecture," *Architectural Record*, p.234.

<sup>66</sup> Sanders, *The Digital Architect: A Common-Sense Guide to Using Computer Technology in Design Practice*, p.316.

<sup>67</sup> Laiserin, "Computer Intranets Move Firms Closer to the Seemingly Elusive Goal of a Well-Connected Practice," *Architectural Record*, March, p.39.



Intranets act like private Web sites presenting in-house information such as corporate data, project information, product data, office guidelines and CAD libraries. Access to an Intranet is generally restricted to the firm's members or project collaborators through password control or network discontinuity. Intranets significantly improve in-house communication by providing instantaneous access to the collective knowledge of the firm. A Web browser is used to search, view and edit records in various databases in an Intranet<sup>68</sup>. Extranets are project-specific Web sites<sup>69</sup> providing project-related data and links. Access to an Extranet is available only to the members of a project team such as client, consultants and contractors. For this reason, unlike public Web sites, Extranets offer secure transactions. Architectural firms generally use Extranets to co-ordinate the distribution of information to other project participants<sup>70</sup>.

### **Computer-Aided Design and the World Wide Web**

CAD constitutes the core software used by architects and other building professionals utilise in their practices. Recognising the growing effect of the Internet on the areas of business, communication and information retrieval, most CAD vendors make their products Internet-enabled<sup>71</sup>. Internet enabled-software is equipped with tools that can assist architects and other building professionals with various tasks that involve the Internet. Some of these tasks are opening, saving and sending files over a network; exporting files in Web-readable formats; viewing remotely located files; conducting searches on the Net; dragging and dropping information from the Web to local systems, and hyperlinking CAD data with on-line and local sources. All these tasks can be broadly grouped under three headings: 1- Collaborative, 2- Information search and retrieval, and 3- Information organisation and documentation tasks. The corresponding support offered by CAD software for these tasks will be reviewed below.

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<sup>68</sup> Sanders, "Firmwide Networks," *Architecture*, p.123.

<sup>69</sup> Laiserin, "Internet-based Project Collaboration Allow FarFlung Team Members to Design Buildings Without Flying Around to Meetings," *Architectural Record*, p.53.

<sup>70</sup> Clayton, "Distributed Design Knowledge Using Form, Function, and Behavior," *Proceedings of EurolA '98*, pp.87-93.

<sup>71</sup> Knoth, "Web-Enabled CAD," *Computer-Aided Engineering*, p.44.



### **Collaborative tasks**

Since the mid-1990s, CAD vendors have begun to integrate various features that take advantage of the Web to support the design collaboration. These features, at a fundamental level, concentrate on the ability to create Web-readable CAD data and offering resources to view this information.

Web-readable data is the type of data that can be interpreted by Web browsers. Having data in this format eliminates the need for complicated conversion procedures and the misinterpretation of data. Project information kept in a common format on the Web can be efficiently exchanged and shared by design teams distributed remotely. Often Web-readable CAD data is created by CAD operators or advanced users who need to access to working information for input, query and modification.

Typically, the Web supports GIF and JPEG raster images, HTML files and their variant formats. Recently various multimedia, presentation and vector formats, which are viewed by Web browsers through special plug-ins, have been also added to the list of these formats. As CAD files are vector-based, having the option of publishing their CAD data in a vector format on the Web has a special significance. In most cases, Web vector formats are preferred to native CAD vector formats such as DWG, DXF or DGN because CAD vector formats can be quite large in size, hence requiring longer downloading time. Native CAD formats do not support hyperlinking, which is establishing hypertext links between CAD data and other associated information. A significant advantage of Web vector formats is that they are considered more efficient in storing and displaying design information than raster images<sup>72</sup>. Now most CAD software has the capability of converting CAD data into a Web-readable vector format.

Common Web vector formats are DWF (Drawing Web Format), CGM (Computer Graphics Metafile), SVF (Simple Vector Format) and VRML (Virtual

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<sup>72</sup> Autodesk Inc., "Using DWF Files," *Autodesk White Paper*.

Reality Modelling Language). DWF developed by Autodesk is a highly compressed (up to six times smaller than DWG files) file format. It is much smaller than DWG or DXF, as it does not contain the non-visual components of a drawing such as blocks, layers, attributes and properties. For this reason it is a “view-only” file format used to showcase projects while maintaining the intellectual property contained within the DWG file<sup>73</sup>. CGM (Computer Graphics Metafile) developed by the InterCAP division of Intergraph is an international standard for two-dimensional vector and raster graphics. Being an open standard supported by many applications, CGM can be re-imported to applications that support CGM import and editing. However, CGM files can be very large<sup>74</sup>. SVF (Simple Vector Format) jointly developed by SoftSource and NCSA is a two-dimensional vector format. It is a Web display format only and cannot be imported to other applications for editing or output. It cannot be printed from a browser window either. Its two resolution options permit variable file sizes<sup>75</sup>. Finally, VRML (Virtual Reality Modelling Language) developed as a community effort is an international standard to publish three-dimensional data on the Web. It is also widely used for animations and interactive presentations. Because VRML is a text language based on ASCII characters, VRML files are generally much larger than binary CAD files, even if they are compressed. More information on VRML will be provided in Chapter 5. It should also be noted that, in addition to Web vector formats, much CAD software is capable of exporting data in other popular graphic Web formats such as QuickTime VR and Shockwave.

Most Web vector files can be created through “Save As” or “Export” options in the File menu of the CAD software. However, in AutoCAD r14, this is achieved through the “Internet” menu, and in MicroStation, the “HTML Author” option under the “Utilities” menu is used (Figure 3.10). There are also a number of utilities software that can translate drawing files from one format to another. When creating Web-readable CAD data, in addition to Web readable vector files, an accompanying HTML file is created in most cases. This file contains the codes for the embedded

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<sup>73</sup> Autodesk Inc, “AutoCAD Release 14 on the Internet,” *Autodesk White Paper*.

<sup>74</sup> Harley, “Getting Published,” *The Client Server*.

<sup>75</sup> Harley, “Getting Published,” *The Client Server*.

vector file, the layout parameters and in some cases textual information associated with the drawing.

Creating Web vector data is only the first step in sharing this information. The information needs to be viewed by others. As vector files are not standard file formats supported by Web browsers, plug-in software need to be installed in order to view the content of these files. These plug-ins are particularly useful for consultants and clients who are not CAD literate or do not have any CAD software to view CAD project data. Viewing only the visual aspects of a project would be sufficient for these people. They do not require access to non-graphic data such as layers, entities and attributes. They only need to look at the information created by others and do not need to modify working models. They are the consumers of the data<sup>76</sup>.

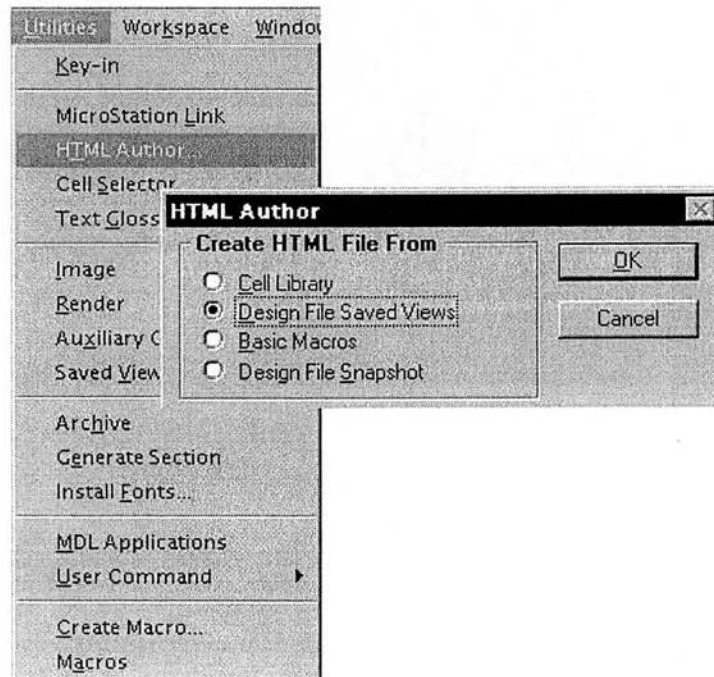


Figure 3.10: The dialog boxes for creating an HTML file from a drawing in MicroStation

Many CAD and third-party firms offer plug-in software to view Web vector CAD. This software is generally available free of charge or at a nominal cost. Some of the well-known plug-ins are WHIP! by Autodesk for DWF files, Vdraft Internet

<sup>76</sup> Sewall, "The Engineering Initiative," *The Client Server*.

Tools by SoftSource for DWG, DXF and SVF files, and Dr. DWG NetView, also for DWG files. In addition to the plug-ins, some CAD software, such as MicroStation, also supports its native DGN format through an integrated browser built into the system.

The features of plug-ins can be accessible through the right-mouse-button menu on a Windows PC. Generally, these plug-ins offer tools such as Zoom for zooming in and out of a portion of a drawing or a model, Pan for dynamically viewing different portions of a drawing that is not being displayed, Print for printing a drawing, Layers for controlling layers and Save As for saving files (Figure 3.11). In WHIP!, one can save either the DWF or the associated DWG version of the drawing through the Save As option provided that the DWG version of the file is also in the same directory. Most plug-ins also has the drag and drop capability. One can transfer data from the Internet directly to a drawing environment if the file format is re-importable.

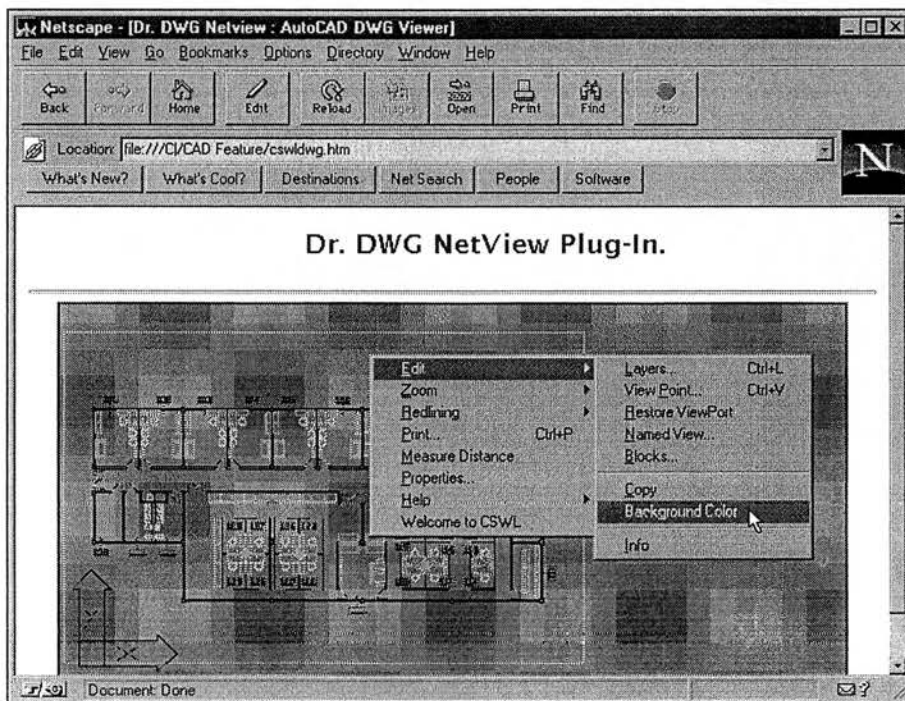


Figure 3.11: The menu of Dr. DWG NetView Plug-in<sup>77</sup>

<sup>77</sup> Image Source: Lurins, 1997.

Additional important features include redlining drawings, that is, making notes on areas that need revision, and authorisation for the manipulation of data. These are offered by Netserv by Dr. DWG and Modelserver by MicroStation, which run on a Web server. The applications are for creating and managing drawings, and offer such security features as automatically creating a copy of files and preventing unauthorised access to internal data by validating user identity<sup>78</sup>.

Other than publishing and viewing CAD data on the Web, another way of using the Internet-enabled CAD software is to support design communications and the exchange of documents. Until very recently this mode of interaction was not possible inside CAD software. However, the version of AutoCAD called AutoCAD 2000i<sup>79</sup> is capable of doing that. By taking advantage of the NetMeeting technology of Microsoft, AutoCAD 2000i enables designers to organise meetings over the Internet or an Intranet. The “Meet Now” feature enables designers to communicate with other team members and to share drawings and documents (Figure 3.12).



Figure 3.12: Sharing and exchanging documents in AutoCAD 2000i<sup>80</sup>

<sup>78</sup> <http://www.bentley.com/modelserver/tech>

<sup>79</sup> The “i” acronym represents the Internet.

<sup>80</sup> Image Source: Sayisal Grafik, 2000.



### **Information search and retrieval tasks:**

Collecting project information is an important aspect of designing. Having access to an adequate amount of information can help designers make more informed decisions. The Web is a good place to find all kinds of recent professional information. On-line product catalogues, specifications, local regulatory agencies for obtaining local code requirements and professional organisations are just a few of the useful information sources. Having access to these massive resources when designing can be a great design aid. The powerful searching mechanisms provided on the Web also help locate the information needed.

Various CAD vendors, among which are Autodesk, Bentley and CADkey, have enhanced their CAD software to provide direct Web access. They achieve this by offering a built-in Web browser integrated into their CAD systems (Figure 3.13). Using this tool, one can conduct searches on the Web as if using an ordinary Web browser. The only difference is that the Web browser is launched inside a CAD system, and the user does not need to leave a drawing session. Both tasks can be achieved concurrently. This improves productivity, saves time and provides the possibility of streamlining communications between the CAD systems and certain Web servers.

Information found on the Web can also be retrieved and inserted into a drawing or model through dragging and dropping provided that the data type transferred is compatible with the CAD system. For incompatible file types, it may be necessary to use add-on software. Increasingly CAD systems are being developed to recognise a wide range of other vector and raster formats.

In a practice context, for example, a practitioner can conduct through an on-line components catalogue and find a supplier whose components meet the expected project criteria. Then, s/he can directly insert the Web information into project drawings and documentation. Importantly, all these tasks are achieved without exiting a CAD system.

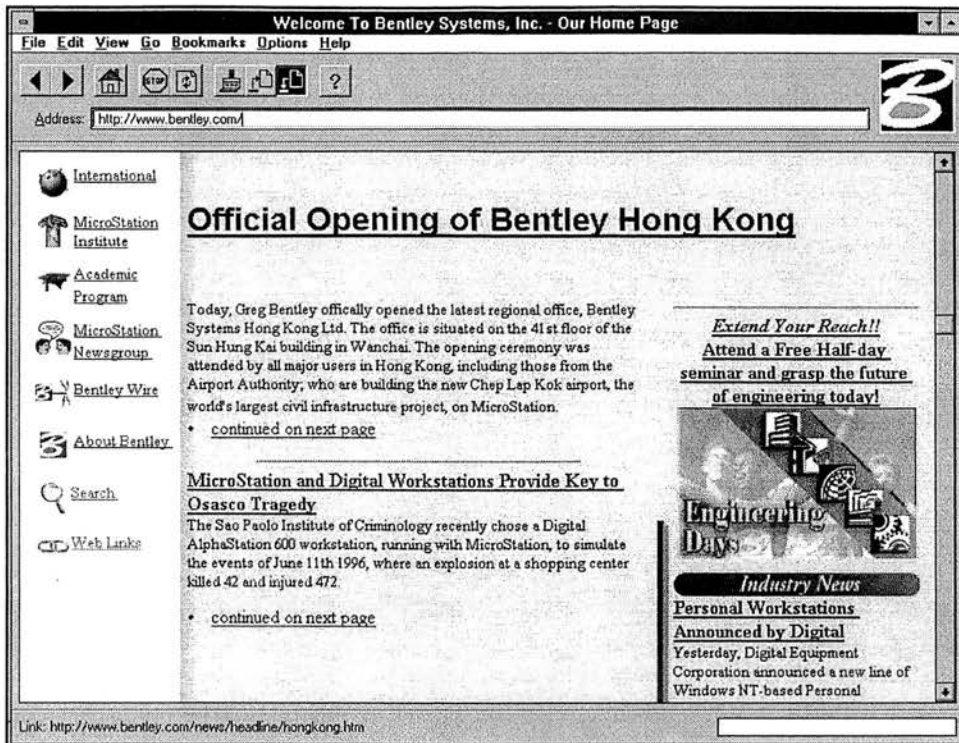


Figure 3.13: MicroStation's built-in browser

### **Information organisation and documentation tasks:**

The Internet has introduced new possibilities to organising and documenting projects. Typically, building projects consist of project and detail drawings and supportive documents such as bills of quantities and specifications. Generally, these documents are not well integrated. Tracking and maintaining files and their interrelationships can be problematic for even simple projects. This issue can be even more cumbersome when working collaboratively with large design teams. Any obstacle delaying access to information can create delays in other tasks too.

Another problem with current methods of design documentation is that documents can become quickly outdated following the completion of a project. This can be more apparent with documents dealing with volatile issues such as cost or discontinued products and materials.



Increasingly, CAD software supports linking between interrelated design documents, based on hyperlinks. Any local document or even URL can be attached to any entity or object inside a drawing and a model (Figure 3.14). For example, using the hyperlinking capability, one can link an object to bills of quantities and specifications in Microsoft Word documents or Excel spreadsheets. In order to embed a hyperlink in a drawing, the user first clicks on the link tool from the menu, select the object s/he would like to hyperlink and insert the link. In this way, the specified area saved in the drawing or model acts as a hotlink. The concept of embedding links to objects is the same as image maps in HTML. Like imagemaps, drawings that contain hyperlinks can be placed on the Web.

As mentioned earlier, through hyperlinking it is also possible to embed external Web sites in drawings. For example, doors and windows in a drawing can be linked to the Web site of the regulatory agency that specifies the code requirements and/or to the supplier's Web site for viewing more detailed and up-to-date product information<sup>81</sup>.

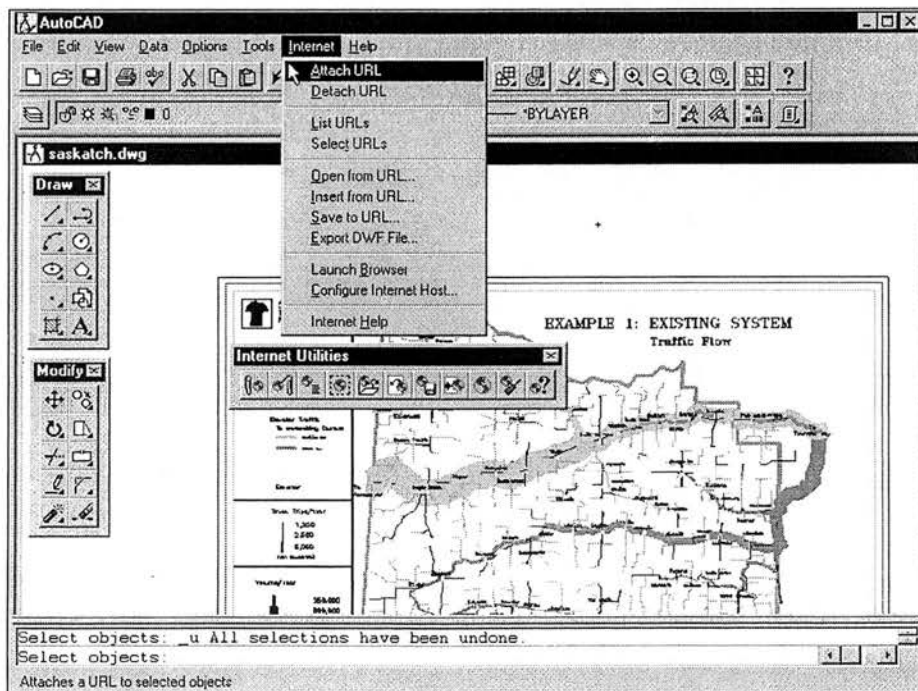


Figure 3.14: Embedding a hyperlink in a drawing in AutoCAD r14<sup>82</sup>

<sup>81</sup> Sewall, "The Engineering Initiative," *The Client Server*.

<sup>82</sup> Image Source: Lurins, 1997.

## **CHAPTER 4: BUILDING PRODUCT INFORMATION SURVEY**

### **Introduction**

The previous chapter examined the issues to do with the Web in commercial and business contexts, culminating in a consideration of its role in the design office. It set the context for a discussion of the survey that will be introduced in this chapter.

This chapter will present the results of a survey that examines how building professionals, mainly architects, are using on-line building product information, and explores the strengths and weaknesses of existing building product sites on the Web. The survey is the main method of data collection in this study. The findings of the survey fed into the development of the IPS (Interactive Product Selector), a prototypical environment for presenting building product information, which will be described in the next chapter.

It is important to acknowledge that the survey reflects the issues dealing with the practitioner side of on-line building product information. There are numerous other stakeholders in product information, including product suppliers, catalogue providers, building display centre owners and CAD developers. The input from these groups can be as important as that of practitioners in understanding the problems and opportunities of on-line product information. However, due to the time-constraint of this study, the scope of the survey had to be limited to practitioners.

### **Previous Surveys**

To date, there have been several surveys on building product information, most of which were conducted by trade journals. One such survey was by the

Aberdeen Group's Construction Marketing Research Services in 1997 intended to reveal which factors are important in selecting building products and which product information sources are most preferred by building professionals<sup>1</sup>. The survey, which was conducted among the 3000 subscribers of four trade magazines published by the Aberdeen Group, produced a response rate of 26%.

Building product catalogue service providers such as Sweet's and RIBA Information Services periodically conduct surveys to find out the share of their products in the market. In spite of being somewhat biased towards the products of service providers, these surveys provide some important information regarding the current trends in the building product information sector. One of the latest surveys of this kind is "The 2000 Survey on Information Services in the UK Construction Industry<sup>2</sup>." The survey of subscribers to the RIBA Product Selector 2000, which was conducted by the RIBA Information Services, contains several questions about on-line product information. 7770 professionals participated in this survey, yielding a response rate of 36%. The results show that the Internet still lags behind other product media such as in-house libraries, hard copy catalogues and CD-ROM sources.

The Sweet's, a leading American company that offers hardcopy, CD-ROM and on-line catalogue services, also conducted a survey in 1999<sup>3</sup>. The survey produced some significant results as to who are the decision makers in selecting, specifying and purchasing building products, which are the most popular product media and how many building professionals have on-line access. Unfortunately, no information is available on the sample and response rate of this survey.

Another product related survey was designed by the Construction Research Center at Georgia Tech University in 1998 to find out how building professionals use

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<sup>1</sup> Kolodziejczyk, "What Do Customers Want," *Construction Marketing Today*.

<sup>2</sup> RIBA Information Services, *The 2000 Survey on Information Services in the UK Construction Industry*.

<sup>3</sup> Hase-Shannon, "Use of Product Information and the Role of the Internet Among AEC Professionals," *Rose Research Report*.

the Internet and other product information media<sup>4</sup>. The survey that was conducted on the Web did not produce much valuable data for the reasons that it lacked a target audience and was open to all Internet users.

Although the surveys above have produced some valuable data on the use of building product information, none of them, with the exception of the Georgia Tech survey, was actually designed specifically towards on-line building product information. For this reason, the present survey fills an important research gap.

### **The Questionnaire**

Many other surveys and research articles were used in developing the survey questionnaire. These sources provided some preliminary indicators as to what factors might be important in formulating the survey questions.

The survey questionnaire<sup>5</sup> consists of single response, multiple-choice and open-ended questions, and has five sections:

The first section is called "The Firm." In this section, the respondents provide information about their firms' geographical origin, designation (being an architectural, multidisciplinary firm or some other type), size, branches (being a one place or dispersed practice) and scope of practice (involving a local/regional/national/international practice). This section helps establish the general characteristics of participant firms and the type of practices in which they are involved.

The second section, which is called "Utilisation of Network and Web Technologies," has questions related to the type of network and Web technologies used by the respondent firms. In this section, the respondents answer questions

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<sup>4</sup> No record is available on this survey, which was previously available on-line.

<sup>5</sup> The questionnaire can be found in Appendix A.

dealing with the types of network connections utilised in their firms (being Intranet, Internet, Extranet, etc.), primary and secondary objectives in establishing Internet access, how many hours they spend on the Web on a weekly basis, whether they purchased any products on the Web, if so, why they used the Web to purchase products, and how their corporate Web sites are utilised. This section is particularly useful in understanding how much the participant firms are familiar with network and Web technologies and in which ways they utilise these technologies. The section reflects the awareness of the firms about cutting edge technology.

The third section, which is "Utilisation of Building Product Information," contains questions related to the use of different product media. This section addresses the types of product media firms use, important factors to be considered in selecting building products, how the Web is used to locate product information, which product sites the respondents often visit and what are the advantages and shortcomings of on-line building product information. The section is especially important for the development of the IPS, as it identifies weaknesses and strengths of existing on-line product sites and illustrates important factors in selecting building products. It also gives clues on the features that a good product information system should possess.

The fourth section called "Utilisation of VRML Software" examines the use of VRML software by design practitioners. Three-dimensional technologies can contribute to a better assessment of building products. At the time of the survey, VRML was the primary technology to achieve that. This section explores how the respondents use VRML in their daily practice, which features of VRML they find particularly useful, whether they have visited any Web site with three-dimensional technologies, what the respondents liked or disliked about visiting a three-dimensional Web site and whether they think that the use of three-dimensional interactive technologies such as VRML and Java (particularly, three-dimensional Java applets) can contribute to on-line product information. This section is also geared towards the development of the IPS. It attempts to obtain useful feedback as

to which factors need to be considered when designing Web sites and systems that utilise VRML data.

The final section is "Other Comments and Feedback." In this section, the respondents state their opinions about the methodology of the survey. The outcome of this section helps in measuring the success of this way of collecting data based on interactivity.

### **Internet Surveys and Methodological Issues**

The survey was conducted on the World Wide Web (Figure 4.1). Internet surveys offer numerous advantages: They are substantially cheaper<sup>6</sup> than traditional surveys conducted through mail, telephone or fax<sup>7</sup>. Survey and feedback publishing costs, updating costs, survey distribution and collection costs are very low in Internet surveys. Data entry cost is also extremely low, as Internet surveys, being computerised surveys, eliminate the need for translating survey responses from paper to the computer for analysis<sup>8</sup>. Survey data, already in digital format, is almost immediately ready for statistical analysis and presentation<sup>9</sup>. The elimination of data entry also reduces the chance of introducing human errors into the database.

One of the most important advantages of Internet surveys is that one can gain access to a large population of individuals<sup>10</sup>, as the variable cost per respondent is

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<sup>6</sup> Tse, "Comparing the Response Rate, Response Speed and Response Quality of Two Methods of Sending Questionnaires: E-mail vs. Mail," *Journal of the Market Research Society*, p. 353; Deans and Adams, "Internet Survey Data Collection The Case Of Webqual," *ANZMAC99 Conference Marketing in the Third Millennium*; Farmer, "Using the Internet for Primary Research Data Collection," *Market Research Library*.

<sup>7</sup> Comley, "The Use of Internet as a Data Collection Method," *Paper presented at ESOMAR*.

<sup>8</sup> Rosenfeld et al., "Computer-Administered Surveys in Organizational Settings," *American Behavioral Scientist*, p. 487.

<sup>9</sup> Medlin et al., "World Wide Web Versus Mail Surveys: A Comparison And Report," *Paper presented at ANZMAC99 Conference*.

<sup>10</sup> Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behavior Research Methods, Instruments & Computers*, p. 274.



very low, almost zero<sup>11</sup>. In other words, an increase in the number of respondents in a sample has little impact on the cost of the survey. Correspondingly, Internet surveys have a wide geographic coverage<sup>12</sup>. Anyone with Internet access is a potential survey respondent regardless of geographical location. As a result, Internet surveys encourage working with geographically diverse large samples.

**Building Product Information Survey**  
UNIVERSITY OF EDINBURGH, DEPARTMENT OF ARCHITECTURE

**Section 1 - The Firm**

**Q-1.1. Please provide the following information about your firm.**  
(This information will remain confidential)

Firm Name:   
 City:  State:  Country:   
 Web Address:   
 Contact Person & E-mail Address:

**Q-1.2. Number of staff, including principals**

☐ 1 ☐ 2-4 ☐ 5-9 ☐ 10-19 ☐ more than 20

**Q-1.3. Please check the designation that best describes your firm.**

☐ Architecture  
☐ Architecture/Engineering  
☐ Architecture/Interior Design  
☐ Interior Design/Space Planning  
☐ Architecture/Planning  
☐ Planning  
☐ Architecture/Landscape Architecture  
☐ Landscape Architecture  
☐ Architecture/Illustration - Graphic Design  
☐ Other

previous responses

Figure 4.1: Building Product Information Survey

Another advantage of Internet surveys is that they offer a higher response speed<sup>13</sup>, which is the time lag between the return date and the mailing or e-mailing date of a questionnaire, than other survey methods. Information transfer and access are instantaneous in Internet surveys as opposed to snail mail or fax that are considerably less timely and insecure. The quick turn around time with Internet

<sup>11</sup> Schillewartz et al., "Non-Probability Sampling for WWW Surveys: A Comparison of Methods," *Journal of the Market Research Society*, p.309.

<sup>12</sup> *ibid.*, p.309.

<sup>13</sup> Brennan, "Survey-Based Experimental Research via the Web Some Observations," *Marketing Bulletin*, p.83; Farmer, "Using the Internet for Primary Research Data Collection," *Market Research Library*.



surveys is believed to be due to the fact that respondents feel urgency about electronic communication methods and have a tendency to reply to more quickly<sup>14</sup>.

Internet surveys also encourage co-operation and honesty<sup>15</sup>. Respondents are reported to give more distanced, truthful and independent answers<sup>16</sup> than other surveys. This is due to the fact that the contact between the researcher and the respondent is minimised in Internet surveys, and respondents feel that their anonymity is better guaranteed<sup>17</sup>. Respondents are also more willing to become engaged in on-line research<sup>18</sup>. That Internet surveys are relatively a new method of data collection seems to arouse the interest and curiosity of respondents<sup>19</sup>.

Among Internet surveys, those on the World Wide Web offer new presentation and data collection methods that were previously impossible to achieve. Web surveys are typically designed using HTML and CGI programs such as PERL and C. They are sometimes designed and/or supplemented with Java applets or Javascripts. The user interface of Web surveys is better than that of e-mail or newsgroup surveys: The Web offers multimedia stimulus incorporating graphics, three-dimensional and audio-visual data. This visual stimulus can provide the opportunity to instruct participants in ways that are not possible with other media<sup>20</sup>, and a better interface contributes to obtaining faster response times<sup>21</sup>.

Some of the other important advantages of Web surveys are that they can prevent unauthorised access through password protection schemes; potential respondents can be required to meet certain criteria through a screening questionnaire

<sup>14</sup> Tse et al., "Comparing the Response Rate, Response Speed and Response Quality of Two Methods of Sending Questionnaires: E-mail vs. Mail," *Journal of the Market Research Society*, p.353.

<sup>15</sup> Insights Online, "E-mail Surveys," <http://www.insightsonline.com/emailsurveys.htm>

<sup>16</sup> Strauss, "Early Survey Research on the Internet: Review, Illustration and Evaluation," *American Marketing Association Winter Educator's Conference Proceedings*.

<sup>17</sup> Hewson et al., "Proper Methodologies for Psychological and Sociological Studies Conducted via the Internet," *Behavior Research Methods, Instruments and Computers*, p.187.

<sup>18</sup> Deans and Adams, "Internet Survey Data Collection The Case Of Webqual," Paper presented at ANZMAC99 Conference Marketing in the Third Millennium.

<sup>19</sup> Tse, "Comparing the Response Rate, Response Speed and Response Quality of Two Methods of Sending Questionnaires: E-mail vs. Mail," *Journal of the Market Research Society*, p.355.

<sup>20</sup> Farmer, "Using the Internet for Primary Research Data Collection," *Market Research Library*.

<sup>21</sup> Comley, "The Use of Internet as a Data Collection Method," *ESOMAR Conference*.

before accessing the main questionnaire; data entry errors on the survey form can be recognised automatically at the time of sending the form, and immediately corrected; the survey content can be tailored to the respondent; the respondent can be provided with customised feedback as well as summary statistics about the results of all entries to date<sup>22</sup>.

Internet surveys pose several disadvantages too. Sampling problems are the main ones. Internet users are not representative of the general population.<sup>23</sup> Still, only relatively small portions of the population have access to the Internet. The characteristics of Internet users are generally different from the rest of the population. Thus, obtaining a projectable sample presents a great challenge in conducting an Internet survey<sup>24</sup>. Another sampling problem that has to do with Internet surveys is the use of unrestricted sampling, in which anyone may access and complete the survey<sup>25</sup>. Unrestricted sampling likely results in sampling errors<sup>26</sup> and affects the validity of the research<sup>27</sup>. Constantly changing electronic e-mail addresses and service providers also constitute a serious problem for Internet surveys. In e-mail surveys or Web surveys where e-mail recruiting is used, e-mail transmission errors have an impact on the representativeness of on-line samples<sup>28</sup>. The growing unsolicited mails in the form of spamming and junk mail also jeopardise on-line research. Potential respondents increasingly become more suspicious and feel uneasy about participating in Internet surveys. Human factors such as difficulty in reading information from a computer screen, techno-phobia, the fear of computers<sup>29</sup> and Internet and inexperience with on-line surveys<sup>30</sup> are other disadvantages of Internet surveys.

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<sup>22</sup> Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behavior Research Methods, Instruments & Computers*, p.276.

<sup>23</sup> Schmidt, *World-Wide Web survey research made easy with WWW survey assistant*, p.303.

<sup>24</sup> Business Research Lab, "A Discussion of Web Surveys," <http://busreslab.com/tips/tip38.htm>

<sup>25</sup> Medlin, "World Wide Web Versus Mail Surveys: A Comparison And Report," *Paper presented at ANZMAC99 Conference: Marketing in the Third Millennium*

<sup>26</sup> *ibid.*

<sup>27</sup> Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behaviour Research Methods, Instruments & Computers*, p.274.

<sup>28</sup> Deans and Adam, "Internet Survey Data Collection The Case Of Webqual," *ANZMAC99 Conference Marketing in the Third Millennium*.

<sup>29</sup> Shuldt and Totten, "Electronic Mail vs. Mail Survey Response Rates," *Marketing Research*, p.39.

<sup>30</sup> Dillman et al., "Principles for Constructing Web Surveys," *SESRC Technical Report 98-50*, 1998.

There were various reasons why this survey was conducted on the Web. One apparent reason was that the Web seemed to be a natural medium for a survey on the use of Web-based building product information. Another and more important reason was that it was the only viable option, as survey respondents were scattered around the world. 73% of survey respondents were US firms, and the remaining respondents were from remote locations such as Australia, Indonesia, Mexico and Chile. Communication cost with overseas practitioners through traditional methods would have been prohibitive and extended the duration of the project.

### **The Interactive Aspect of the Survey**

Another reason for conducting the survey on the Web was that the Web gave an opportunity to design an interactive/dynamic survey. The interactive nature of the survey offered an incentive for the invited firms to participate. Interactive surveys increase the motivation of respondents. Respondents no longer merely give information<sup>31</sup>, but they also receive information in return for their time and effort<sup>32</sup>. Schmidt<sup>33</sup> states that "If respondents know that the feedback they receive is about themselves, and based on the data that they provide, then they are likely to supply accurate and thoughtful responses."

Interactive Internet surveys also offer compatible features to those of telephone and face-to-face interviews. They achieve some of the flexibility available in oral interviews with less expense, thus, offering potential for a larger supply of interviewees<sup>34</sup>. Interactive surveys can be configured to provide clarification and instant feedback to respondents for any misunderstandings. Interactive features can be used to tailor survey content based on the responses and/or to enable respondents to skip irrelevant questions. As a result, these surveys increase the involvement of

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<sup>31</sup> Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behavior Research Methods, Instruments & Computers*, p.275.

<sup>32</sup> Schmidt, "World-Wide Web survey research made easy with WWW survey assistant," *Behavior Research Methods, Instruments, & Computers*, p.303.

<sup>33</sup> Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behaviour Research Methods, Instruments & Computers*, p.276.

<sup>34</sup> Hewson, "Proper Methodologies for Psychological and Sociological Studies Conducted via the Internet," *Behavior Research Methods, Instruments and Computers*, p.188.

users beyond that evoked by a paper questionnaire<sup>35</sup>. Interactive surveys also offer various advantages over oral interviews. One is that face-to-face and telephone interviews are susceptible to subject-experimenter effects<sup>36</sup>. There can be no interviewer bias in interactive Internet surveys<sup>37</sup>, as no one stands between respondents and the computer. As a result, respondents do not have the desire to please the interviewer or worry about social acceptability, and they talk straight to the point rather than talking to another person<sup>38</sup>. Finally, the asynchronous nature of interactive Internet surveys enable respondents to complete the survey at their convenience as opposed to that of the interviewer<sup>39</sup>.

In this survey, interactivity takes place in two ways: viewing the comments of previous participants and displaying the aggregated survey results. In order to view the text comments of previous participants, while completing the questionnaire, a survey respondent can click the “previous responses” icon next to the question to be answered (Figure 4.2). The comments will appear in the left frame. After sending the survey form, comments of the current respondent are added to the existing comments for others to view. It should be noted that this mode of interaction was only provided for open-ended questions and multiple-choice questions that had the “other” option for the respondents, to suggest additional choices. The mode of experimentation that encourages subjects to interact with each other is reported to have a great potential for future research in the short and medium term<sup>40</sup>.

The survey also included questions about the survey itself. 62 (48.8%) of respondents said that they viewed the comments of other respondents; 58 (45.7%) said that they did not; and 7 (5.5%) of respondents chose not to answer this question. The reason for allowing respondents to view others’ responses was to enable them to

<sup>35</sup> Kiesler and Sproull, “Response Effects in the Electronic Survey,” *Public Opinion Quarterly*, p.405.

<sup>36</sup> Hewson et al., “Proper Methodologies for Psychological and Sociological Studies Conducted via the Internet,” *Behavior Research Methods, Instruments and Computers*, p.187.

<sup>37</sup> Schillewaert et al., “Non-Probability Sampling for WWW Surveys: A Comparison of Methods,” *Journal of the Market Research Society*, p. 309.

<sup>38</sup> Insights Online, “E-mail Surveys,” <http://www.insightsonline.com/emailsurveys.htm>

<sup>39</sup> Insights Online, “Web Surveys,” <http://www.insightsonline.com/websurveys.htm>

<sup>40</sup> Hewson et al., “Proper Methodologies for Psychological and Sociological Studies Conducted via the Internet,” *Behavior Research Methods, Instruments and Computers*, p.190.

stimulate ideas, to express themselves better, and to suggest some other issues that may have been omitted in the questionnaire. Many of the respondents said that it was quite interesting, and they were curious to find out what others had said. A few pointed out that it was good to see other respondents who also had similar opinions and experiences. Several respondents said that having the ability to view others' responses clarified what the question was asking: "(It) made me sure that I was on track with the questions being asked." Similarly, another respondent said: "(It) helped me make sure I understood the question." This response was particularly significant, as normally only interviews provide the means of clarifying questions to respondents.

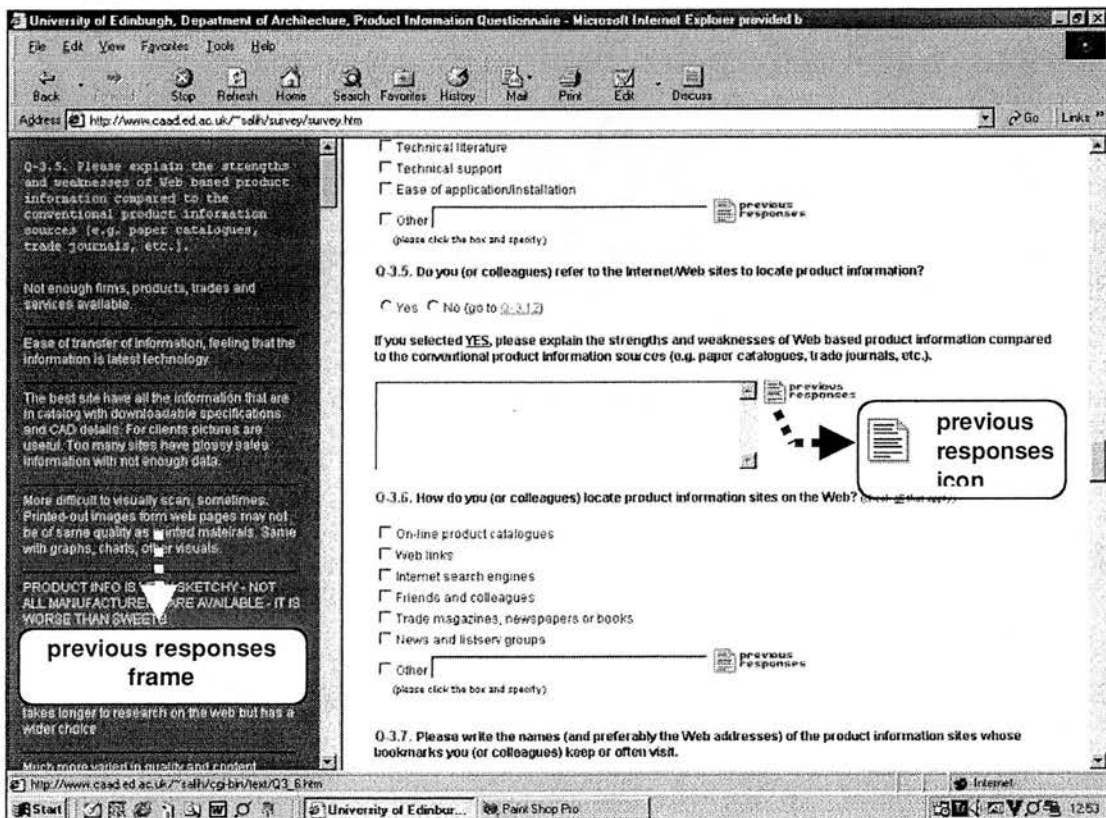


Figure 4.2: The feature that allows respondents to view the comments of other respondents

Many respondents used the words "innovative," "informative," and "helpful" in describing these features. One respondent said: "It is a great use of the technology, and it is only possible on the Web." Another said: "(It) reminded me of other uses of the Web that I hadn't thought of at first response." One also said: "You are to be



congratulated for introducing the idea (it's the first I've seen it) and for the way it's implemented." Some respondents even requested a copy of the survey script.

This method, in some ways, resembles Group Feedback Analysis (GFA) that allows the collection of the data in a dialogue with respondents<sup>41</sup>. In GFA, the experimenter asks members of a group to respond to a survey, and then provides the results as feedback to the group<sup>42</sup>. It uses the feedback information as a trigger to obtain in-depth information about the subject matter and/or judge its validation<sup>43</sup>.

One concern with the approach of being able to see others' responses is whether this causes a "band wagon" effect, the condition in which one's opinion might be unduly influenced by others when responding, producing a bias in the responses. With the exception of a few participants, this concern seemed unfounded. As the actual comments sheet shows, most of the respondents who said that they looked at the other participants' comments claimed that they used this feature for stimulating ideas, making sure they interpreted the question correctly, or to satisfy their curiosity about other responses.

As for the second interactive feature of the survey, after sending the survey form, the respondents were given the opportunity to view the aggregated graphical and textual results-to-date. Providing survey results to the respondents is an incentive often used in traditional research<sup>44</sup>. In this case, the respondents were allowed to see the results immediately after the completion of the survey. The respondents had a chance to learn about current trends in the utilisation of Internet and product information technologies (Figure 4.3). A large majority of survey respondents (76.4%) said that they would view the aggregated results of the survey; 18.9% said they would not, and the remaining 4.7% did not answer the question.

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<sup>41</sup> Dick, "Group Feedback Analysis," <http://www.scu.edu.au/schools/sawd/arr/gfa.html>

<sup>42</sup> Williams, *Research Methods and New Media*.

<sup>43</sup> Heller, "Group Feedback Analysis Applied to Longitudinal Monitoring of The Decision Making Process," *Human Relations*.

<sup>44</sup> Business Research Lab, "A Discussion of Web Surveys," <http://busreslab.com/tips/tip38.htm>

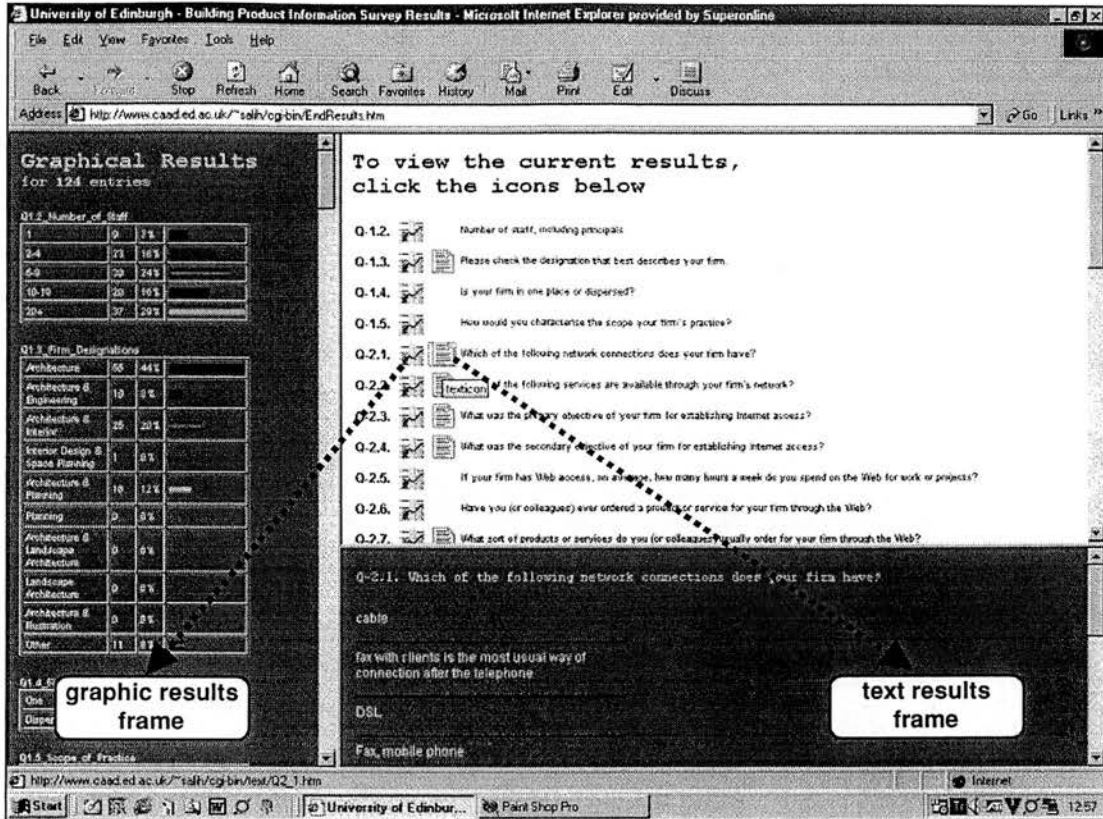


Figure 4.3: Viewing the aggregated results of the survey

In many Internet surveys, a frequently experienced problem is multiple submissions. In other words, from time to time, due to entry error, intent to foil the survey or just out of curiosity<sup>45</sup>, respondents make several entries by sending survey forms more than once. This clearly affects the outcome of the survey. In such circumstances, these entries have to be identified and discarded. Bearing this in mind, the present survey was designed in a way to detect and exclude multiple entries from the same IP. To a great extent, this feature worked successfully. Occasionally, in a few cases, it caused problems when respondents mistakenly sent the survey form midway through. These cases were detected on routine inspection of the database and deleted from the log file, and the respondent was e-mailed to complete the survey again. If the respondents dropped out mid-way through the survey, their responses were saved, and they were invited to complete the survey

<sup>45</sup> Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behavior Research Methods, Instruments & Computers*, p. 277.



from where they left off when they quit. Then, the earlier entries of these respondents were manually added to their last entries.

All of the features of the survey were made possible using a CGI/Perl script. The script was adapted from the BigNoseBird.Com's Survey Script.<sup>46</sup> The original script had limited capabilities intended for simple polls on the Web. It was extensively altered to accept multiple choice questions and long text-area answers, to allow survey participants to see others' responses and to present the aggregated survey results in a radically different format from the original.

At a fundamental level, this is how the survey works: The respondent fills out the survey form. The Web browser passes this input to the Web server upon clicking the submit button. Submission of the form to the CGI/Perl script is handled by the POST attribute of the FORM tag. Location of the script is also given on the HTML form. The server takes the input and passes it off to the CGI/Perl script, the program acting as a middleman between the Web browser and the Web server. The script contains all the instructions to process the data coming from the Web form. The CGI/Perl script processes the input. If the entry is unsuccessful, meaning that the form was sent more than once, an error message was displayed on the browser. If the entry is successful, the script 1- puts the "text area"<sup>47</sup> responses, which consist of written comments from respondents, into the folders allocated for each questions, 2- reads the entries for single response and multiple choice questions, and 3- creates an HTML file that contains the aggregated results. In addition, the respondent's entry is appended to the database file, which contains all of the entries the respondent made in the survey form (Figure 4.4), and to the log file, which, in addition to respondents' entries, has the IP address and the entry number assigned for the respondent firm. When the survey entry is successful the counter file, which shows the total number of entries, is also increased by one. The Web server returns a confirmation screen to the respondent via the browser. It takes, on average, less than thirty seconds to display

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<sup>46</sup> The script is freely available at <http://bignosebird.com>.

<sup>47</sup> An element in an HTML form

the confirmation screen. By following the link on this screen the respondent can view the aggregated graphical and text results of the survey.

The database file created from the respondents' entries consists of ASCII-delimited records. Most of the major spreadsheet, database and statistical analysis applications have import options for the ASCII text files. In this research, the database file was imported to Microsoft Excel, Microsoft Access, Minitab<sup>48</sup> and SPSS<sup>49</sup> for further investigations and statistical analysis.

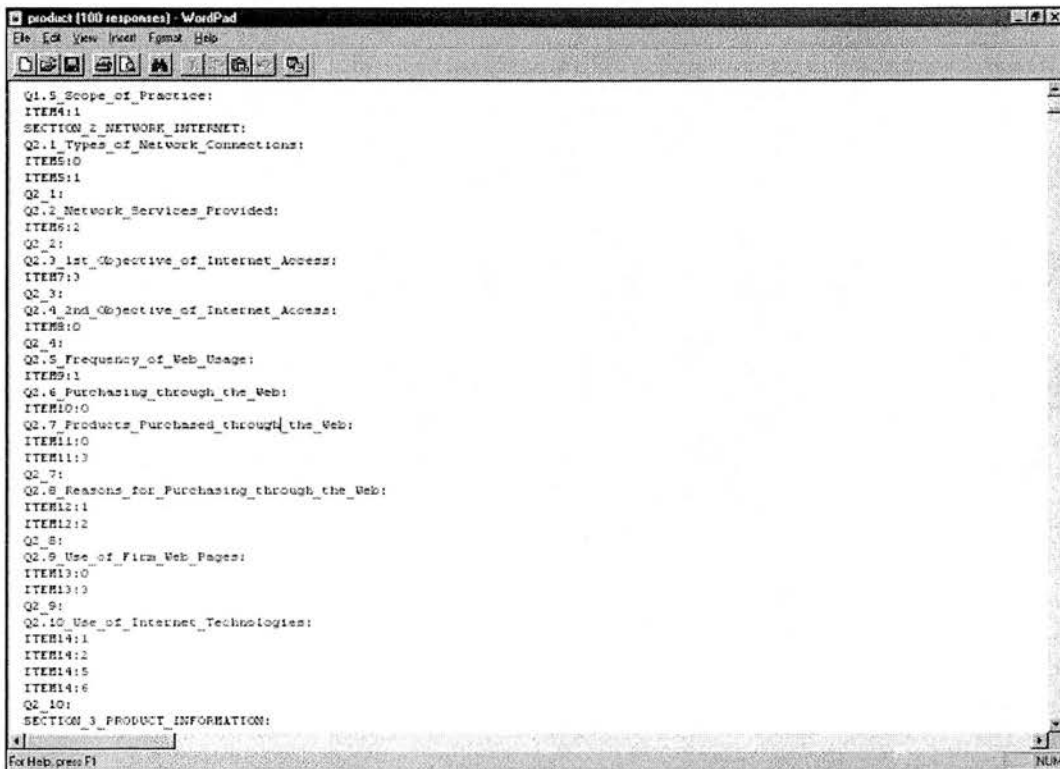


Figure 4.4: The database file containing the respondents' entries

## The Sample

The sample frame consists of 825 architecture and design firms that have a Web presence. The incentive behind the approach of selecting only the firms with Web pages was that these firms had already been using the Internet, and they had a

<sup>48</sup> A statistical analysis package by Minitab Inc. (<http://www.minitab.com>)

<sup>49</sup> A comprehensive statistical analysis package by SPSS Inc. (<http://www.spss.com>)

general understanding about the weaknesses and strengths of this new medium. Several of the selected firms stated on their Web sites that they use the Web to locate professional information: "We use the infinite resources offered by the Web to do research into the latest building products and materials, and are thereby connected to the largest information resource in the world."<sup>50</sup> It was also found that a number of firms kept product information site links on their Web pages in order to refer to or share them with others (Figure 4.5). These firms appeared more knowledgeable on the current use of Web based product information than other practitioners, and it was assumed that they would be more willing to contribute to the development of future Web based product information sites and environments. By conducting the survey with these firms, it was likely that the most insightful results would be gained.

It should be noted that the survey sample does not constitute a cross-sectional representation of all architecture and design professions. Nor was that the intention of this survey. In fact, Internet surveys are not generally suitable for working with statistically representative samples<sup>51</sup>. They should be used instead for a targeted population that has narrowly defined interests, and recruiting should be geared directly towards such individuals, who are more likely to be representative of their limited class than of the population as a whole<sup>52</sup>. Some of the topics that are appropriate for Internet research are research on computer products, Web sites, business environments and the early adopters of a new technology<sup>53</sup>. The survey sample fits within this framework. Although the survey may not be applicable to the entire architectural community, its results can be expected to provide insights into important trends in Web use.

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<sup>50</sup> Bucholz McEvoy Architects - <http://aoife.indigo.ie/~mcevoy>

<sup>51</sup> Comley, "The Use of Internet as a Data Collection Method," *ESOMAR Conference*; Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behavior Research Methods, Instruments & Computers*, p.278.

<sup>52</sup> Schmidt, "World-Wide Web Survey Research: Benefits, Potential Problems and Solutions," *Behaviour Research Methods, Instruments & Computers*, p.275.

<sup>53</sup> Comley, 1996.

Initially the survey sample consisted of 1012 firms<sup>54</sup>, which represented the majority of Web-searchable architectural firms with Web pages worldwide in 1998. In selecting these firms, various architectural indexes and Web sites of professional organisations were used: ProFile: The Architects Sourcebook<sup>55</sup>, ArchitectsUSA<sup>56</sup>, Cyburbia<sup>57</sup>, University of Toronto Architecture Virtual Library<sup>58</sup>, University of Nevada Architecture Web Resources<sup>59</sup>, Archioz,<sup>60</sup> and Yahoo<sup>61</sup>.

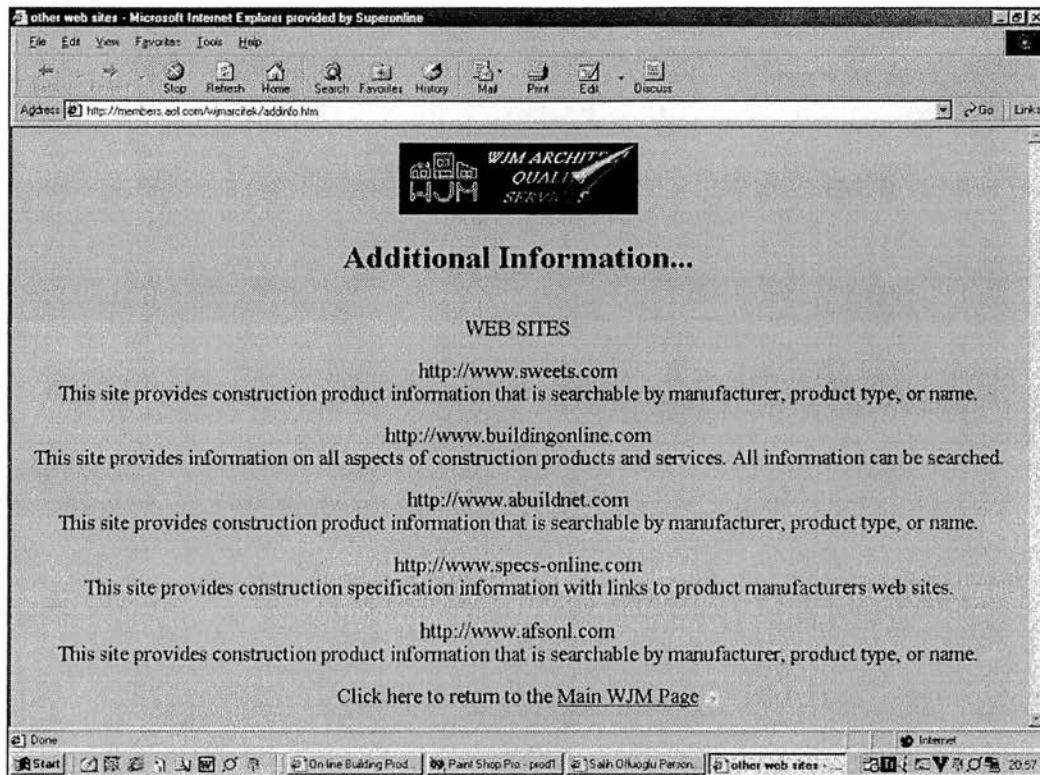


Figure 4.5: A Web page of an architectural firm that lists some of the leading building product sites<sup>62</sup>

<sup>54</sup> There is no concrete figure as to what percentage of architectural practices has Web pages. ProFile: The Architects Sourcebook (<http://www.cmdg.com/profile>), arguably the most comprehensive source in locating architectural practices in the USA, suggests that, as of 2000, there are approximately 7000 architectural firms with Web pages only in the USA. The most significant increase in architectural firms with Web pages had been between the years of 1998-2000 (DeGennaro, 2000).

<sup>55</sup> The Architects Sourcebook: <http://www.cmdg.com/profile>

<sup>56</sup> <http://www.architectsusa.com/home>

<sup>57</sup> [http://cyburbia.ap.buffalo.edu/cgi-bin/pairc/frm\\_arch](http://cyburbia.ap.buffalo.edu/cgi-bin/pairc/frm_arch)

<sup>58</sup> <http://www.clr.toronto.edu:1080/VIRTUALLIB/ARCH/firms.html>

<sup>59</sup> <http://www.nscee.edu/unlv/Libraries/arch/rsrce/websrce/main0002.html#Architects and Designers4100>

<sup>60</sup> <http://www.archioz.com.au>

<sup>61</sup> [http://www.yahoo.co.uk/Business\\_and\\_Economy/Companies/Architecture/](http://www.yahoo.co.uk/Business_and_Economy/Companies/Architecture/)

<sup>62</sup> WJM Architects - <http://members.aol.com/wjmarcitek/addinfo.htm>

Interestingly, these sites listed only a small portion of the firms' e-mail addresses. In order to contact the firms in the sample, it was important to acquire their e-mail addresses. One way of obtaining this information was from the Web sites of the firms. However, instead of visiting the Web sites of all the firms in the sample, which could have taken a long time on-line, their Web pages were downloaded for off-line viewing using the Teleport Pro<sup>63</sup> software. Firms' e-mail addresses were manually extracted off-line from the information downloaded. This process revealed that Web addresses for numerous firms were inaccurate; some sites did not have e-mail addresses; and various firms introduced as architecture or design/building firms were in fact misclassified. In the light of this information, the final sample was reduced to 825 containing 648 American (78.5%), 74 UK (8.9%), 27 Australian (3.3%), 27 Canadian (3.3%) firms as well as 49 (6.0%) firms from the rest of the world.

### **Pre-Testing**

A pre-test survey was conducted between 1 February 1999 and 1 March 1999 with 82 firms, which constitutes 10% of the total firms. In selecting the pre-test sample, stratified proportional random sampling was used taking into account the firms' country of origin and the relative frequency of the represented countries in the total sample using the Minitab statistical analysis software. Stratified proportional random sampling is a sampling method that takes into account the segments and their relative frequency in the total population. By doing so, it assures the representation of each segment in the pre-test sample at the approximate rate at which they appear in the overall population. A good stratified random proportional sample can be very accurate in representing the population<sup>64</sup>.

Respondents were recruited by e-mail and asked to fill out the survey form on the Web. This recruitment method prevents unrestricted access to the Web survey site. E-mail is considered the most direct and successful recruitment method in Web

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<sup>63</sup> A mirroring software, developed by TenMax Inc. (<http://www.tenmax.com>) for downloading a Web site in its entirety for off-line viewing.

<sup>64</sup> Roberts, *Data Analysis for the Social Sciences*, p.149.

surveys<sup>65</sup>. The e-mail recruitment method also produces a high response speed, as the transmission of information by e-mail is very fast, and respondents decide quickly whether or not to participate in the survey<sup>66</sup>.

An indirect method was used in contacting firms. In the indirect method, subjects are asked to participate in the survey before sending any material (i.e. the survey or the Web address for the survey). By doing so, subjects are given the opportunity to opt out if they wish. One advantage of the indirect method is that as participants volunteer to participate, the experimenter can have greater confidence that interest will be maintained through to the end of the experiment<sup>67</sup>. The indirect method is also reported to help obtain higher response rates and a better quality of response<sup>68</sup>.

The invitation e-mail included such details as introductory information about the researcher, the objective and interactive nature of the survey and the contribution that the respondents will make to the research area. The respondents were also specifically informed that their anonymity would be preserved. They were also told that the experimenter might acknowledge their contribution in various publications, but not in a way that would identify the name of the firm with the responses they give.

Following the invitation letter, another e-mail containing the Web address of the survey questionnaire was forwarded to the firms who showed an interest to participate in the survey. Two weeks after the initial e-mail letter, two separate follow-up letters were sent to the firms that were interested, but had not yet participated in the survey, and also to other firms who had not sent any response to the invitation letter.

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<sup>65</sup> Virtual Surveys Ltd, "Guide to Web Site Research," <http://www.virtualsurveys.com/papers/guide.htm>

<sup>66</sup> Shillewaert, "Non-Probability Sampling for WWW Surveys: A Comparison of Methods," *Journal of the Market Research Society*, p.317.

<sup>67</sup> Hewson et al., "Proper Methodologies for Psychological and Sociological Studies Conducted via the Internet," *Behavior Research Methods, Instruments and Computers*, p.189.

<sup>68</sup> Mehta and Sivadas, "Comparing Response Rates and Response Content in Mail vs. Electronic Mail Surveys," *Journal of the Market Research Society*, p.432.



In the end, 11 firms participated in the pre-test survey. 28 messages bounced. In other words, they were returned due to undeliverable and incorrect e-mail addresses. The pre-test response rate was 20.3% after excluding the unreachable firms.

One of the interactive features of the survey that enables respondents to view previous responses was disabled in the pre-test survey form, as there were not any comments to view. Nevertheless, the respondents' comments in the pre-test were included in the actual survey for new survey participants to view.

The respondents were specifically asked to make comments on problem areas, incomplete sections, and areas that needed additional clarifications on the questionnaire form. One of the common complaints was the fact that the instruction page was too long to read. The instructions were shortened and reworded in the actual survey. See Figure 4.6 for the final version of the instruction screen. Two respondents said that question 2.1 asking about the specific types of LAN, WAN and Internet connections they used was too technical to answer. The question was revised only to include the main categories of network connections, namely "Intranet/LAN," Internet, Extranet/WAN," and "ISDN." In addition, based on the feedback from the respondents, the "Product Literature" and "Sales Representatives" choices were added respectively to Question 2.7 and Question 3.1. The pre-test also gave an overall idea about the expected response rate, possible e-mail errors and turnaround speed for the actual survey.

### **Building Product Information Survey**

The main survey was conducted in between 1 April 1999 and 15 May 1999 using the same indirect recruitment e-mail method as the pre-test survey. Having deducted the 82 pre-test firms, the remaining 743 firms were contacted by e-mail to participate in the survey. Following the invitation letter, two follow-up letters were sent respectively on 15 April 1999 and 1 May 1999. These letters were addressed to the firms who were interested, but had not yet participated in the survey, and to the



firms who had not sent any response to date. Copies of the invitation letter and follow-up letters are provided in Appendix B.

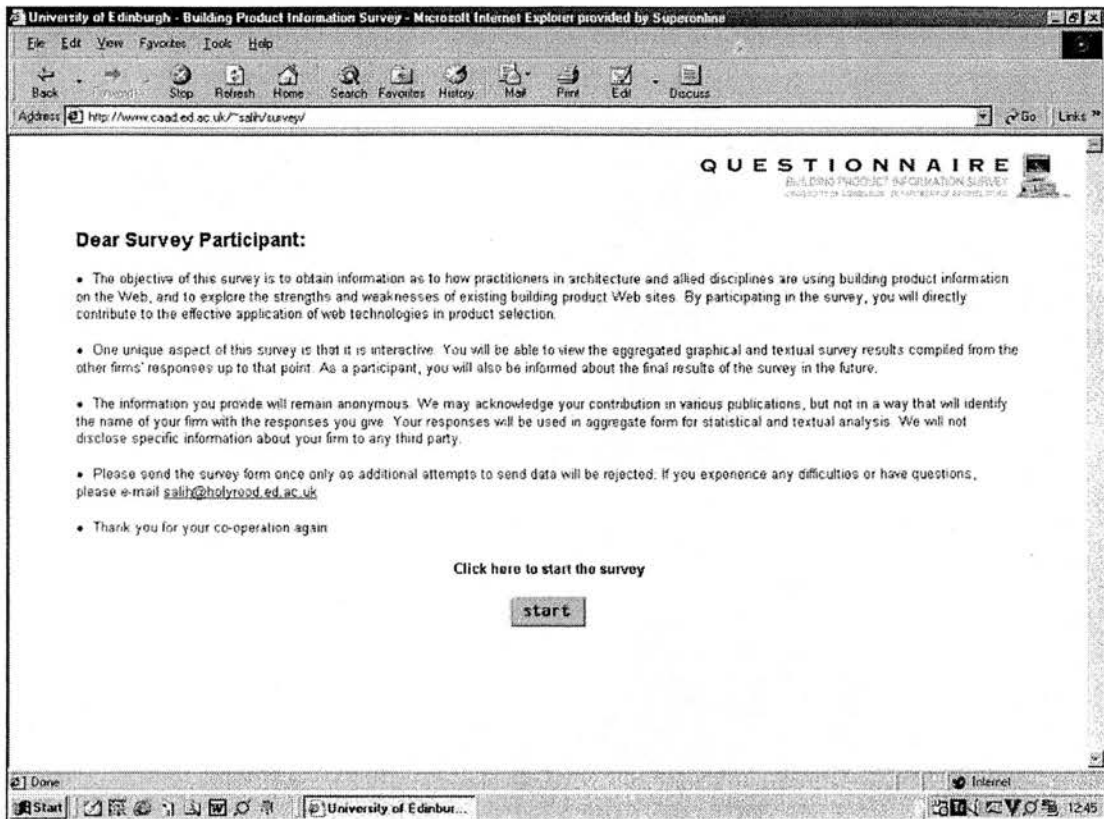


Figure 4.6: The survey instructions screen

## Survey Results

164 firms accepted to participate in the survey, and 33 firms stated that they did not want to participate in the survey. Of the 164 interested firms, 127 firms actually participated in the survey. 221 firms (29.7%) were not reached because of undeliverable and incorrect e-mail addresses. The response rate was calculated as 24.3% after deducting the unreachable firms.

The survey response rate is very close to that of the building product survey by the Aberdeen Group (26%), but lower than that of "The 2000 Survey on Information Services in the UK Construction Industry" by the RIBA Information Services (36%). It is important to take into account that both surveys were postal

surveys, which use postal services to distribute and collect survey materials. Postal surveys generally produce higher response rates than Internet surveys<sup>69</sup>. Typical response rates for Web surveys vary between 10%-15%<sup>70</sup>. However, it should be noted that, because Web surveys are a relatively new data collection method, there is no consensus as to what is the acceptable response rates for Web surveys. The rates differ from one research project to another<sup>71</sup>.

In the light of this, the response rate for the survey seems acceptable. Clearly, the *quality* of responses is also important for the success of a survey. This survey appears to be satisfactory in that respect too. Many respondents provided in-depth, well considered and truthful answers to survey questions. They were eager to expand on issues where they found it necessary to do so. The interactive nature of the survey has also been a contributing factor to this.

It is also noteworthy that 66% of participants sent their responses in four days within receiving the invitation letter. This supports the assertion that Web surveys generate quick turnarounds<sup>72</sup>.

Below, the survey results will be examined in detail according to the survey sections. SPSS software and Microsoft Access were used for statistical analysis of survey results. Charts were created in Microsoft Excel.

### **Section 1: The Firm**

This section consists of questions examining the general characteristics of the participant firms.

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<sup>69</sup> Shuldt and Totten, "Electronic Mail vs. Mail Survey Response Rates," p.38; Tse, "Comparing the Response Rate, Response Speed and Response Quality of Two Methods of Sending Questionnaires: E-mail vs. Mail," *Journal of the Market Research Society*, p.356; Medlin, "World Wide Web Versus Mail Surveys: A Comparison And Report," *ANZMAC99 Conference: Marketing in the Third Millennium*; Comley, "The Use of Internet as a Data Collection Method," *ESOMAR Conference*.

<sup>70</sup> Perseus Development Corp., "Seven Steps to a Successful Web Survey," [http://www.perseus.com/surveytips/thw\\_sevensteps.html](http://www.perseus.com/surveytips/thw_sevensteps.html).

<sup>71</sup> Brennan et al., "Survey-Based Experimental Research via the Web Some Observations," *Marketing Bulletin*, p.85.

<sup>72</sup> Virtual Surveys Ltd., "Guide to Web Site Research," <http://www.virtualsurveys.com/papers/guide.htm>

American firms had the largest participation in the survey (73.2%) due to their high representation in the sample frame; 93 American firms participated in the survey. British firms came second with the participation of 16 firms (12.5%). 4 Australian firms (3.1%), 3 Irish firms (2.3%), 3 Canadian firms (2.3%) and 2 Indonesian firms (1.5%) followed them. 6 other firms (4.7%) from France, Germany, the Netherlands, Spain, Mexico and Chile also participated in the survey.

Of the 127 total respondents, there were 43 Large firms (34%), 21 Mid-size firms (17%), 31 Small firms (24%), 23 Very Small firms (18%) and 9 One-Practitioner firms (7%) participated in the survey<sup>73</sup> (Figure 4.7). The fact that the majority of participants were from large firms might be an indication that most corporate Web sites belonged to large firms at the time of conducting this survey. However, it was surprising to see that there were more Small and Very Small participant firms than Mid-size firms.

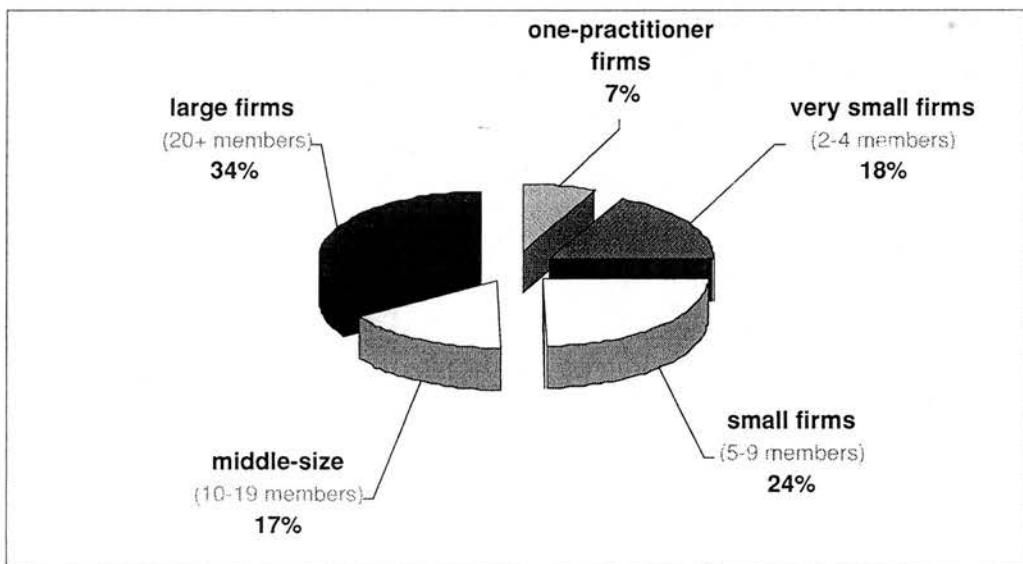


Figure 4.7: Participant firms by number of staff (Question 1.2)

<sup>73</sup> In identifying the firm sizes, the convention used in AIA Firm Surveys was taken as a base. According to that convention, firms with 2-4 staff are very small; 5-9 are small; 10-19 are mid-size, and 20 and more are large.

As expected, architectural firms were the primary participants in the survey (93%). Of the 118 architectural firms, 59 (46%) considered their designations solely as architecture, and the other 59 said that, in addition to architecture, they offer professional services such as Interior Design (28 firms; 22%), Planning (20 firms; 16%) and Engineering (11; 9%). Apart from architectural firms, one introduced itself as an Interior Design and Space Planning firm, and the remaining 8 firms (6%) described their designations in such diverse areas as “Human Perception Research,” “Laboratory Design,” “Architectural Software Development,” “Real Estate Development,” “Workplace Specialist,” “Management Consultants” and “On-line Building Industry Resource Centre”. See Figure 4.8.

99 participant firms (79%) reported that they conduct their professional services in one location as opposed to the 27 firms (21%) that choose multi-branch, dispersed practices. As anticipated, there was a correlation between the firm size and the possibility of conducting a dispersed practice. The dispersed practice was more common among the large and middle-sized firms than the smaller firms.

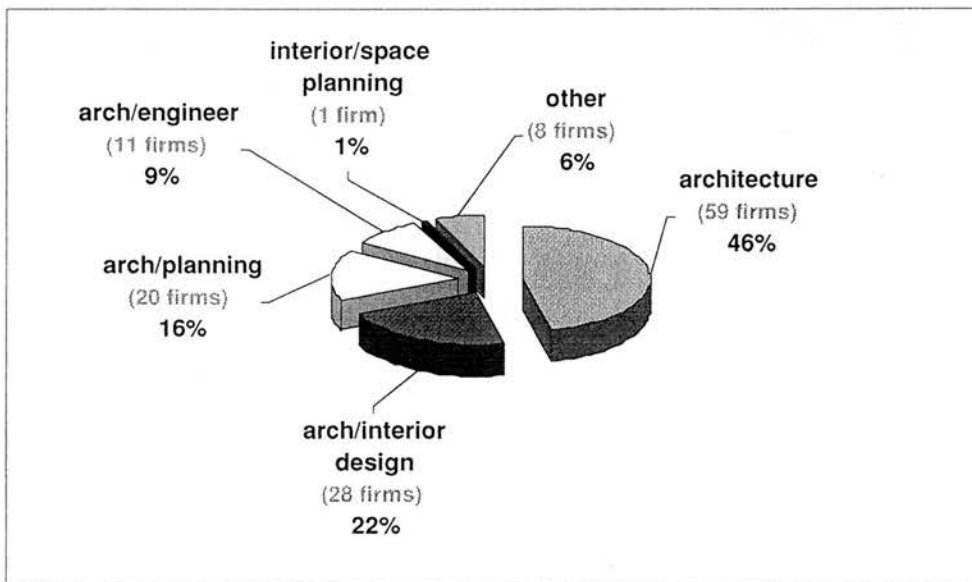


Figure 4.8: Participant firms by designation (Question 1.3)

Regional practice was a much preferred way of conducting businesses among the participant firms. 62 firms, accounting for 49%, stated that they characterise the

scope of practices of their firms as Regional; 30 firms, accounting for 24%, said that their practice is International; 25 firms, accounting for 20%, reported that they offer National services, and finally, 9 firms, accounting for 7%, said that they consider themselves Local practices (Figure 4.9). As expected, very small and one-practitioner firms mainly perform Local (89%) and Regional (56%) practices; whereas, large and middle-size firms conduct National (52%) and International (77%) practices. Although this finding was not very significant, it illustrates the overall quality, accuracy and hence the validity of the survey.

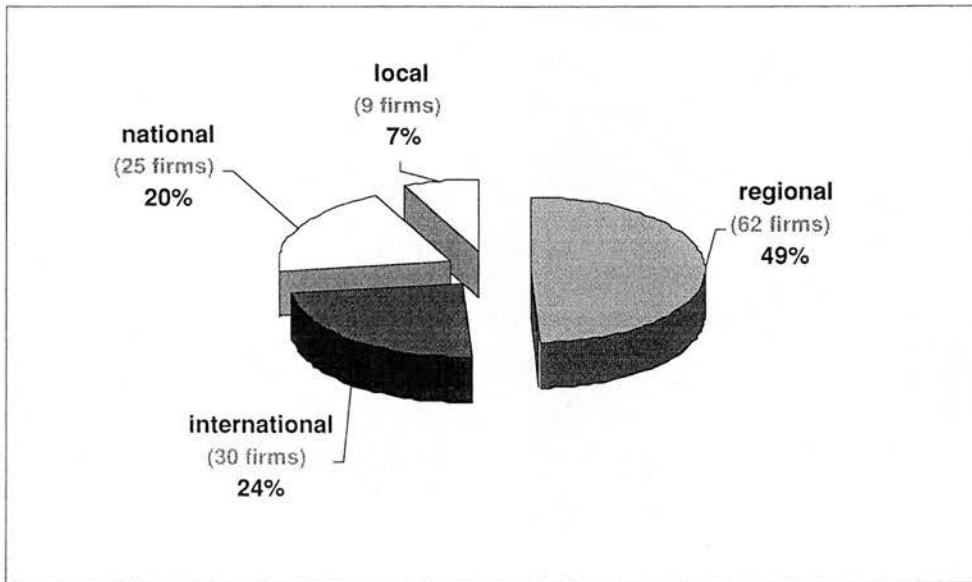


Figure 4.9: Participant firms by scope of practice (Question 1.5)

## **Section 2: Utilisation of Network and Web Technologies**

This section investigates the utilisation of network and Web technologies by the participant firms.

In answering the question asking about the type of network connections firms have, 113 respondents said that they have Internet access in their firm, 30 respondents stated that they have ISDN, 16 firms reported that they have an Intranet and 14 said that they have an Extranet connection (Figure 4.10). Cable modem, DSL, Lotus Communication System, Frame Relay, ADSL and Office Peer to Peer Network

were among other connection types mentioned by several participant firms. Among the firms answering this question, only 6 of them said that they have all of the connection types listed. Of the six firms, one also said it has a Frame Relay connection. Not surprisingly, these six firms were involved in national and international practices. Similarly, 11 of the 14 firms (78.5%) who said that they have an Extranet carried out national and international services. It was interesting that only a small number of firms had Intranets.

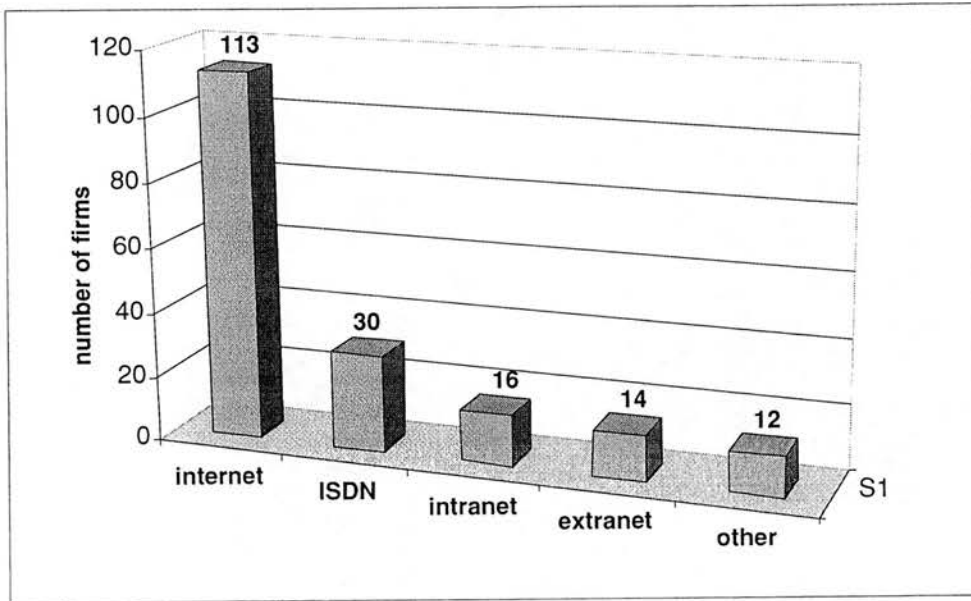


Figure 4.10: The types of network connections provided by the participant firms (Question 2.1)

As for the services available through the networks of the participant firms, E-mail (119 firms) and Web Access (116 firms) were the most common network services. They were followed by Shared Storage (88 firms), Central Database Access (66 firms) and Internal FTP sites (49 firms).

Similar to the above, E-mail was also the primary reason why participant firms establish Internet access. See Figure 4.11. 41 participant firms (32%) chose this option. This finding is also compatible with other sources. E-mail is clearly the most preferred Internet service among architecture and construction firms. 65% of the

firms listed in “ProFile: The Architects Sourcebook” have e-mail addresses<sup>74</sup>. In addition, the 2000 Survey on Information Services in the UK Construction Industry reveals that e-mail is the most used Internet service in the construction community. In the present survey, FTP comes slightly behind e-mail (40 firms; 31%). FTP is a popular and economic way of exchanging project information. Other reasons for establishing Internet access are Marketing the Firm’s Services (16 firms; 13%) and Locating Professional Information (8 firms; 6%), Appearing to Use Leading Edge Technology (7 firms; 6%), Collaboration (7 firms; 6%) and other purposes (8 firms; 6%) such as “Establishing a Web Presence,” “Providing Additional Business Avenue,” “Delivering Corporate Information” and “Maintaining Access to the Office Network when in the Field.”

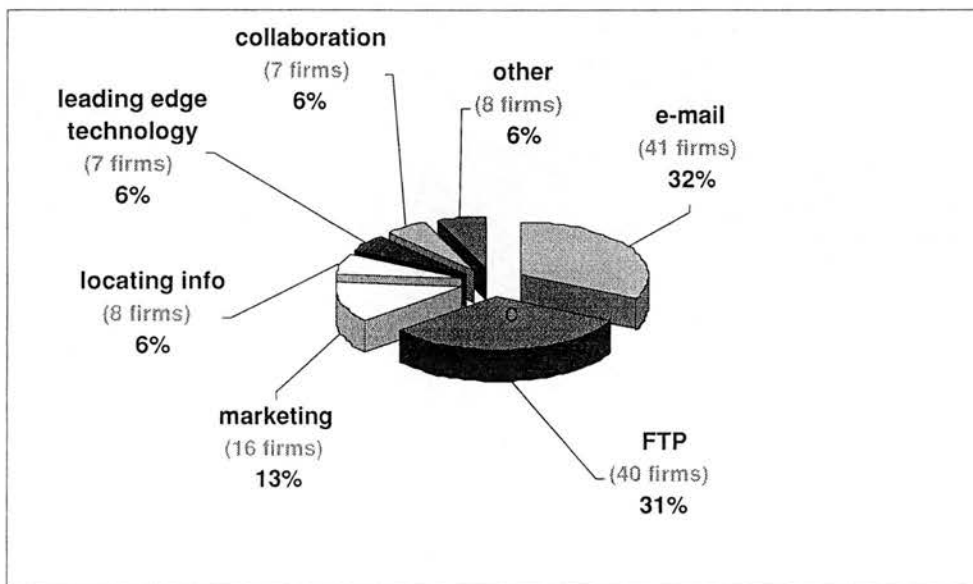


Figure 4.11: The primary objective for establishing Internet access (Question 2.3)

The secondary objective for establishing Internet access follows a similar trend to the primary objective above. E-mail is the secondary reason for establishing Internet access (37 firms; 29.1%). FTP (32 firms; 25.2%), Locating Professional Information (23 firms; 18.1%); Marketing the Firm’s Services (16 firms; 12.6%), Appearing to Use Leading Edge Technology (4 firms; 3.1%) and Collaboration (4 firms; 3.1%) follow it. As can be seen, one difference is that many more firms chose

<sup>74</sup> DeGennaro, “Re: Architects With Web Pages.”



Locating Professional Information as the secondary objective for establishing Internet access. This shows that respondents value the Internet as an information source as well as a communication tool.

While the Web is becoming an increasingly popular way of locating professional information, it was interesting to find out how much time architects spend on the Web per week for work-related activities. According to the responses, 67 firms, accounting for 52.8%, said that they only spend 1-4 hours a week on the Web; 35 firms (27.6%) indicated that they spend 5-7 hours weekly on the Web, 13 firms (10.2%) stated that they spend 8-10 hours of their time on the Web and 11 firms (8.7%) said that they spend more than 10 hours a week on the Web for work-related activities. 7 of the 11 firms who are heavy users of the Web take advantage of the Web in a range of unconventional areas such as marketing, collaboration, sales and showing awareness of state-of-the-art technology, along with communication purposes.

Of the 127 participants, the vast majority (111 firms; 87.4%) stated that they purchased products or services for their firms through the Web. Only 16 firms (12.6%) said that they have not done so. Among the products and services purchased through the Web are General-Purpose Software (73 firms), Architectural/CAD Software (56 firms), Computer Hardware (55 firms), Books/Magazines/Newspapers (55 firms), On-line Newspapers and Magazines (39 firms), Subscriptions to Professional or Research Information Services (35 firms) and Product Literature (16 firms). See Figure 4.12. "Travel," "Photography Supplies," "Fonts," "CDs," "Electronic Equipment," and even "Automobiles" were other goods and services purchased by the firms over the Web. Electronic/computer equipment, software and information, particularly professional and product information were also popular commodities bought on the Web. Product literature seems to lag behind other choices. One explanation of that would be that most product literature on the Web is still available free of charge, and there are only a few businesses and product suppliers that exploit the commercial potential of product literature.

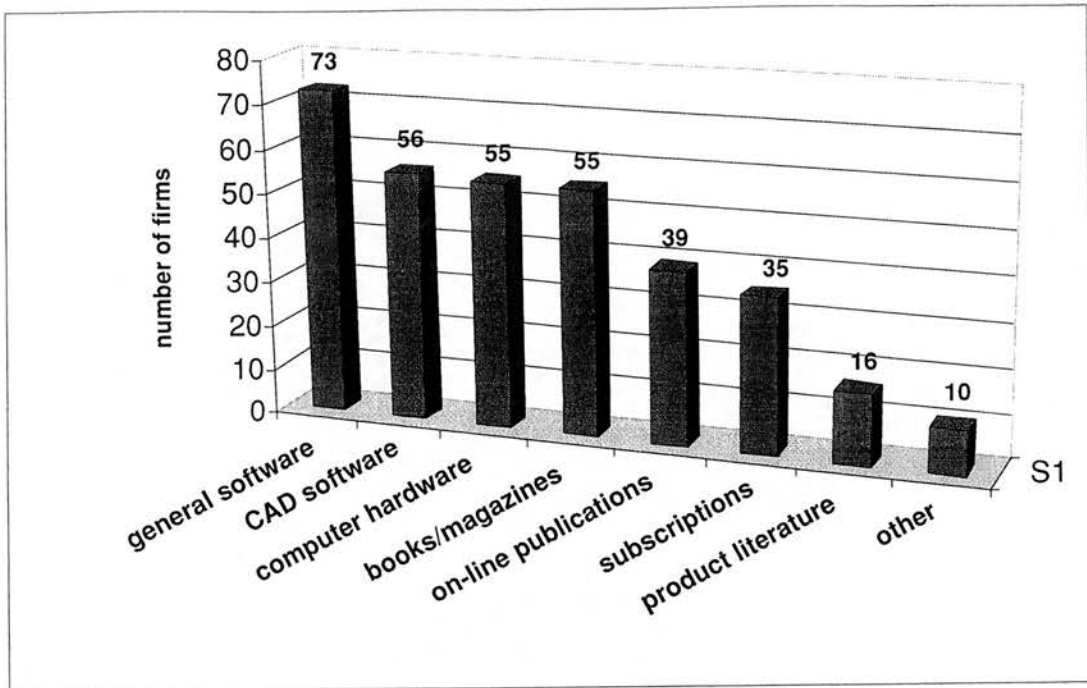


Figure 4.12: Type of items purchased over the Web (Question 2.7)

Why do these firms make purchases on the Web? Of the 127 participant firms, 84 firms believe that the Web is a convenient way of buying products and services. See Figure 4.13. The Web is like a 24-hour virtual store that can be accessed by any computer that has Internet access. In this way, shoppers can make purchases over the Web anytime from home, work or any other place. 73 firms said that purchasing on the Web saves time. Architects are very busy professionals. One advantage of the Web is that it saves travel time. 56 firms think that product comparison/selection is easy on the Web. Customers are more informed than before. One can view the products of different suppliers, become aware of existing options and compare them with each other before deciding which one to buy. 37 firms reported that they do not feel sales pressure, as there is no intermediary between products and consumers. The other 37 firms state that the Web offers a variety of choices. One can reach goods and services in local, regional, national and even global markets. One of the stated reasons for purchasing on the Web for 32 of the firms is that the Web presents interactive and personalised content. This is significant as most shopping environments are one-to-many, i.e. one product and many customers. On the Web, customers are able to specify their needs, and products can

be tailored to the specific needs of customers. Low product price or finding cheaper deals is an important factor for 27 of the firms. Various firms offer promotions and discounts only for purchases made on the Web. 7 firms think that the quality of graphic presentation is one of the reasons why they make purchases on the Web. Clearly, the fact that the Web is a multimedia environment contributes to making products more appealing. 4 firms also believe that cancelling orders is easy on the Web. Most of the time, cancelling is done entirely electronically. As no human interaction is involved in this process, consumers generally feel free to change their minds without embarrassment.

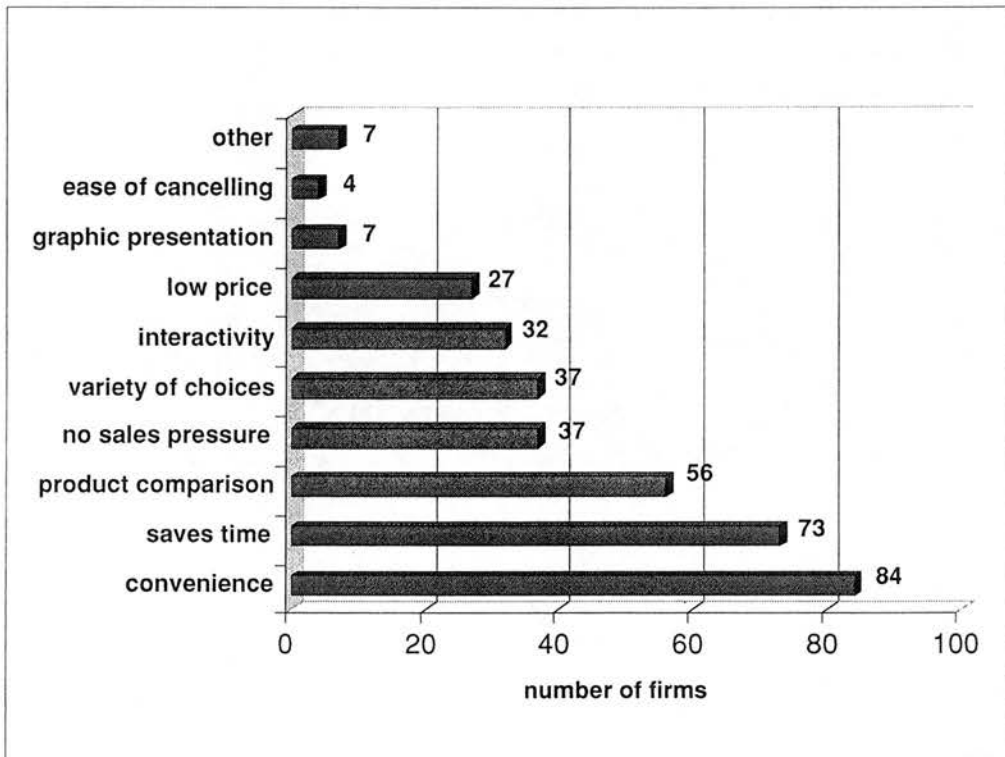


Figure 4.13: Reasons for purchasing through the Web (Question 2.8)

While the participant firms use the Web to purchase products and services, it was interesting to find out in what ways their Web presence helps them (Figure 4.14). An overwhelming 112 firms believe that the corporate Web sites of their firms are important to them for marketing purposes. Presumably, these pages act as windows opening to the rest of the world providing information on firms' services and resources. 30 firms think that their Web pages are important for collaboration

purposes. It is common practice to use Web sites as information repositories for projects. Project participants can access project Web sites to exchange views and documents. 11 firms pointed out that a corporate Web site is an alternative sales medium. One of the respondents said “We see the Web as an additional business avenue.” Similarly, another stated, “We use the Web to deliver all our business resource information.” 10 firms also use their Web sites for internal communications to share and exchange information between their departments and branches. Surprisingly, of these 10 firms, which find internal communication important, only 3 used an Intranet.

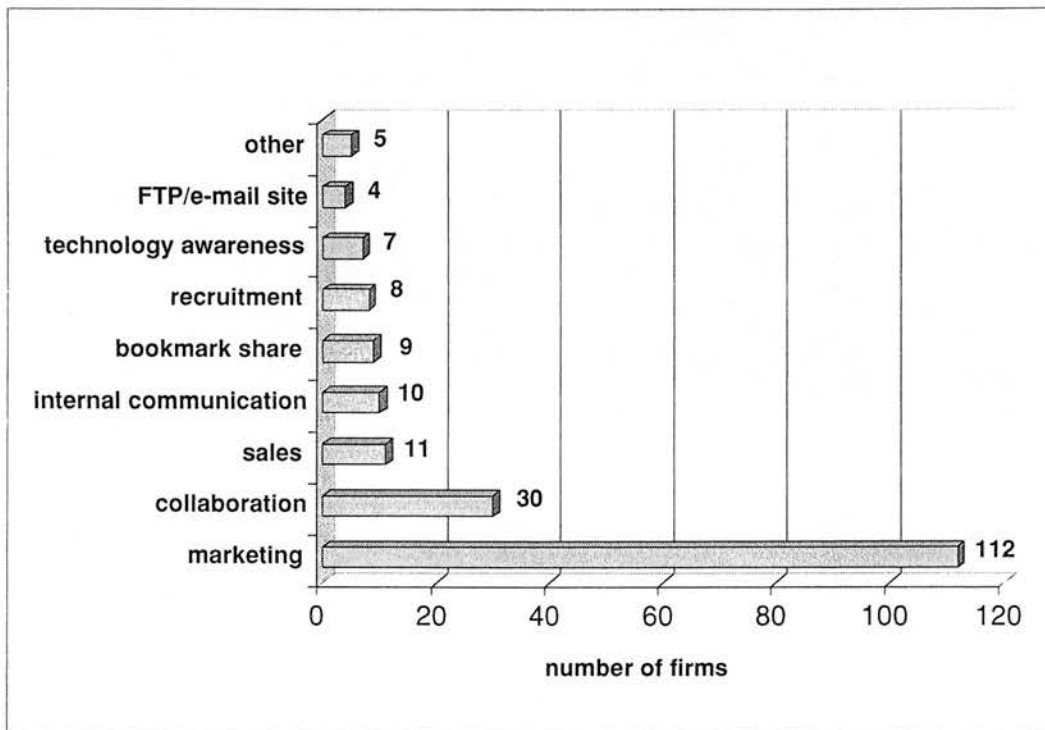


Figure 4.14: Objectives for owning a corporate Web site (Question 2.9)

Sharing bookmarks was another use of corporate Web sites: pages of important links for common use. A link page that compiles important Web sites for future use is very common. 9 firms chose this option. 8 firms indicated that their corporate sites are important for them to attract new employees. One firm said: "(Our Web site) informs potential employees of who we are." 7 firms think that a firm's Web page reflects the technological awareness of a firm. It is important for the image of the firm. According to one practitioner: "(Our Web pages exist) to show technological awareness and that we are a 'cutting edge' firm." One quite honestly said: "It (having a Web page) seemed like the thing to do to keep up." 4 firms said that their Web sites provide a gateway to FTP and e-mail services.

The participant firms seem to be pioneers at utilising the Web in their practices. It was worth finding out how familiar these firms were with some of the popular Internet technologies at the time. Knowing this information could have been helpful in identifying which technologies had found acceptance in the architectural community. It was also important in selecting the appropriate technologies for the design of future on-line environments or systems. As the responses illustrate (Figure 4.15.), 111 firms said that they downloaded software from the Web; 108 firms used FTP to transfer or receive files; 90 firms stated that they viewed a Web page containing a Java applet or JavaScript; 71 firms said that they viewed a Web page containing vector data or CAD drawing displayed in a Web readable format; 65 firms indicated that they viewed a three-dimensional site designed in VRML or QuickTime VR; 65 firms said that they streamed audio and/or video over the Internet. 33 respondents reported that they used a VRML plug-in. Finally, "ICQ," "Flash," ".asp," "Video Conferencing," "Push Technologies" and "Usenet groups" were other technologies mentioned by 8 firms.

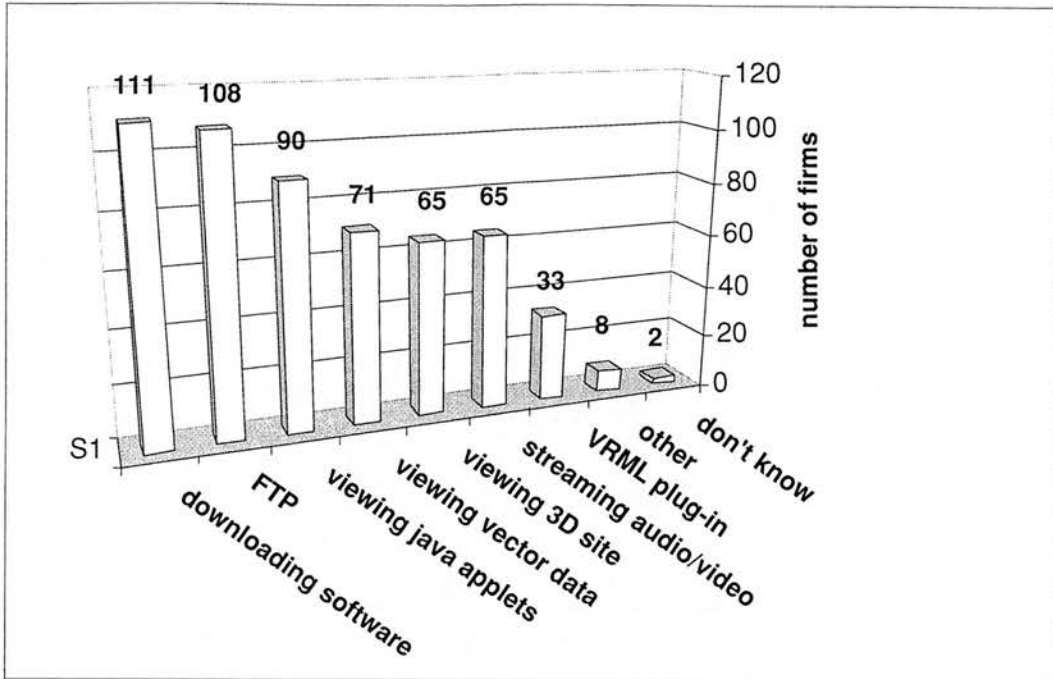


Figure 4.15: The usage of some of the Internet technologies (Question 2.10)

### **Section 3: Utilisation of Building Product Information**

This section consists of questions on the use of different product media, particularly on-line product information.

Printed catalogues are still the primary sources when it comes to obtaining product information (118 firms). See Figure 4.16. Amongst the survey respondents, the Internet is the second most used product information medium (104 firms). It should be noted that the figure obtained here regarding the use of the Internet as a product source is much higher than that of “the 2000 Survey on information services in the UK construction industry.”<sup>75</sup> The fact that the respondent firms were already Internet literate no doubt skews this result, but it was interesting to find out that within such a short time the Internet has become one of the major product information sources. In addition to Printed catalogues and the Internet, Trade journals (95 firms), CD-ROM (91 firms), Trade Shows and Building Display Centres

<sup>75</sup> RIBA Information Services, *The 2000 Survey on Information Services in the UK Construction Industry*.

(74 firms), Floppy diskettes (28 firms) and Sale Representatives (8 firms) were other product information sources.

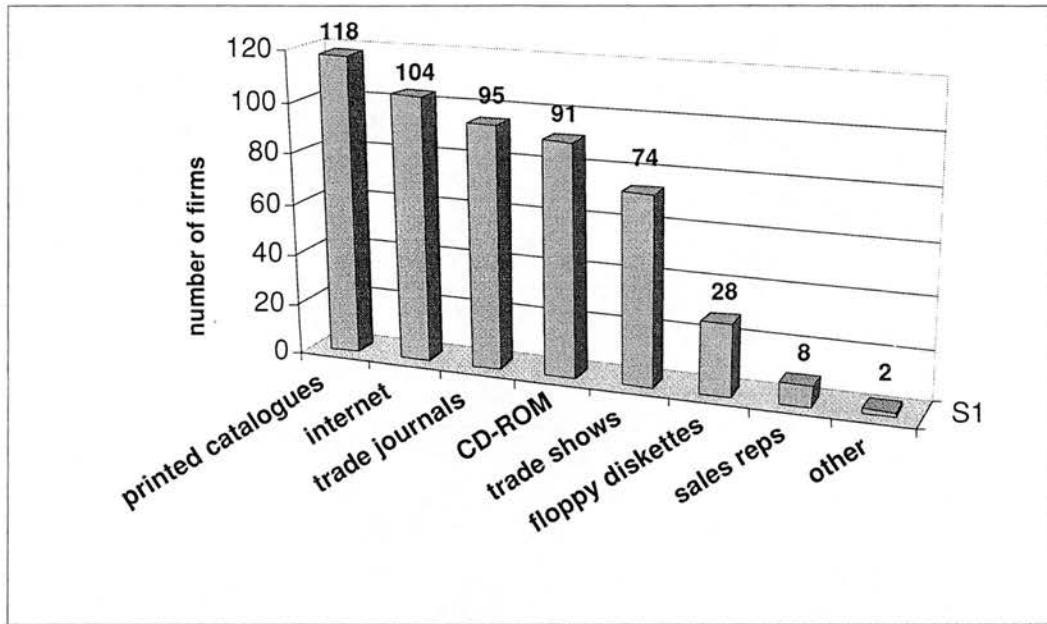


Figure 4.16: Building product information sources (Question 3.1)

Having listed the popular product information sources, it is important to examine the factors that influence architects in selecting building products. It seems that architects have the greatest interest in Product Appearance when selecting a product (105 firms). See Figure 4.17. This finding is also compatible with that of the survey of The Aberdeen Group's Construction Marketing Research Services in 1997<sup>76</sup>. Design Integration was also seen as an important factor affecting the selection of building products (92). Thirdly, Price (84 firms) and Experience with the Brand (84 firms). Various previous studies<sup>77</sup> also considered brand experience as an important element affecting the product selection process. Manufacturers Reputation (81 firms), Availability (81 firms), Technical Literature (70 firms), Technical Support (64 firms) and Ease of Application/Installation were other factors that have

<sup>76</sup> Kolodziejczyk, "What Do Customers Want," *Construction Marketing Today*.

<sup>77</sup> *ibid.*; Arioglu, "A Procedure for Selecting Building Products," *International Journal for Housing Science & Its Applications*, p.49; MacKinder, *The Selection and Specification of Building Materials and Components*, p.119; Coyne et al., "Applying Web-based Product Libraries," *Proc. of EuroPIA '98*, p.108.



an impact on selecting a building product. Several other respondents also mentioned “Product Performance,” “National Sourcing and/or Production,” and “Innovation.”

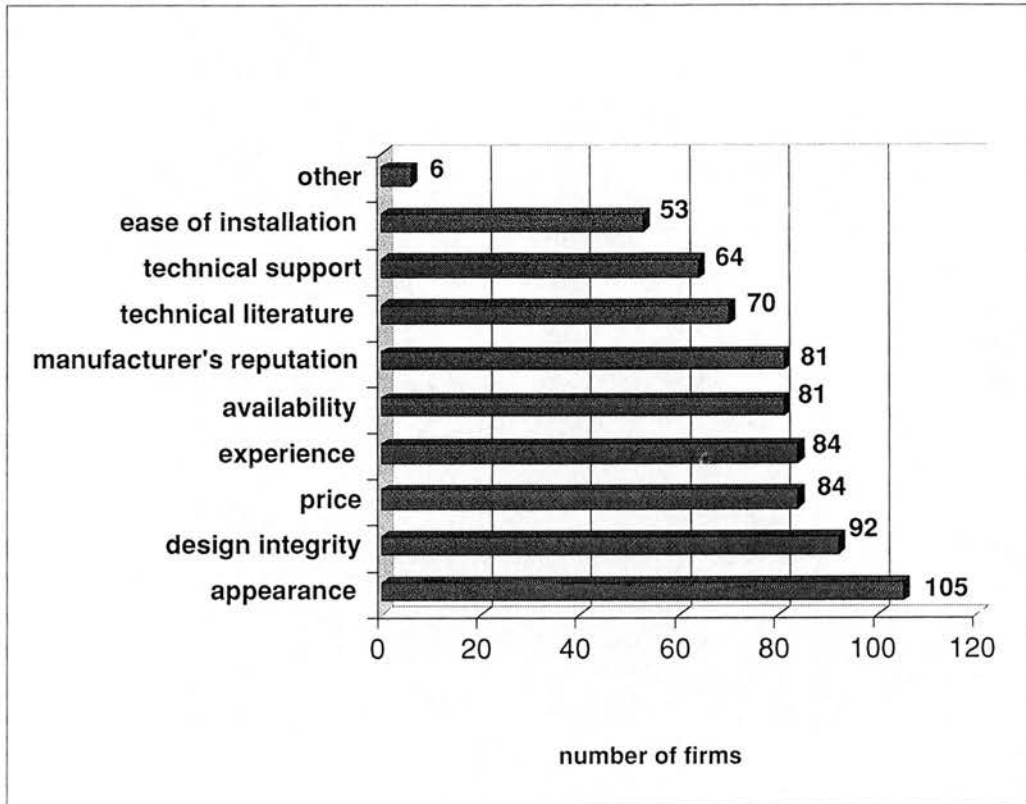


Figure 4.17: Factors affecting the selection of building products (Question 3.2)

As expected, the vast majority of the participant firms refer to Web sites to locate product information (81.8% vs. 16.6%). See Figure 4.18. In a leading question, respondents were asked to articulate on the reasons for using product sites on the Web and to identify the strengths and weaknesses associated with these sites.

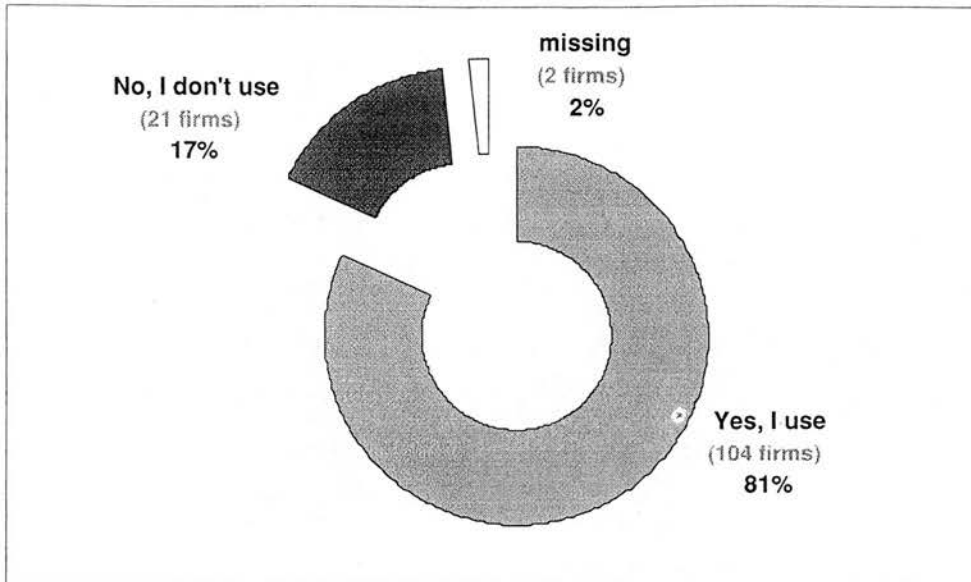


Figure 4.18: The usage of the Web as a product information source (Question 3.3)

One of the most common reasons given for using the Web to locate product information was that the building product information is up-to-date: “The major advantage is that Web sites maintained by companies are generally current. Paper catalogues may be out of date, containing discontinued or unavailable products. Checking the Web, if properly maintained, gives us a better idea of availability.” The large quantity of product related information available on the Web was also another reason: “Huge databases are available on the Web, and therefore, more information is available about the product(s).” Another respondent said: “Product data on the Web is often thorough. There is usually more information than is available in print.” One significant and related advantage of Web-based product information is that information is available on a wide variety of products and globally: “Using the Web one can see international products and obtain new product ideas. We can be an informed buyer.” In spite of the immensity of the product information available on the Web, on-line information does not take up any physical space: “Web product information takes up no office space.” Similarly, another respondent stated: “Because of the Web, we don’t have to maintain a massive library.” The powerful search capabilities of Web product sites are of a great help to architects too: “Web-based information is quicker to find if not in office files.” One also said: “We often initiate a successful search for something based upon

'descriptions of words' not found in Sweets or trade journals." Similarly, for another respondent: "The Web provides an opportunity to find what you are looking for when you don't know where to begin." Several also stated that the Web is especially good at locating information about hard-to-find items: "I have been able to locate materials/products on the Web that were not in the catalogues." "The Web is a good place to look for unusual or hard-to-find items." Using Web-based product information is convenient as well. Information is available from anywhere 24 hours a day: "(Product) Information is available at anytime even from remote sites." For another respondent: "The Web is available 24 hours a day. I work at odd hours." Several respondents pointed out that the nature of the Web in allowing two-way information exchange is also unique: "The Web allows interactive discussion of product characteristics." Communicating with the manufacturer of a product is also easy and immediate on the Web: "I can fill out a Web form with questions and order product samples and get fast responses. I don't have to call sales people." Availability of on-line specifications, CAD details and FAQ sections on product sites, and the ability to incorporate on-line data into documents are other strengths of building product sites on the Web cited by respondents.

When it comes to weaknesses with existing building products sites, interestingly, many respondents gave almost completely opposite comments to the strengths given above. For many, the major problem with product sites is searching and locating information: "A lot of sites are poorly organized for searching and browsing. I look on the Web if I can't find it in the Sweets Catalog(ue). The catalog(ue) is quicker than finding it on the Web." Several respondents also complained about the accuracy of findings provided by search engines: "Search engines are poor and irritating. They return too many sites that are not relevant to the exact purpose of the search." Another problem associated with on-line product information is that there are not enough manufacturers and products on the Web: "Finding the products is still hit and miss. Not all product data and manufacturers are available on the Net. You don't always know what you are missing." One also stated: "Product selection and information is thin compared with catalog(ue) sources. Over time, that should improve as more products go online and more info about them

becomes available. Many manufacturers are new to the Web and are in the experimentation stage when it comes to using it to their best advantage. As they learn what information to put out there and how to put it out, the Web will gradually become a fairly indispensable part of the construction industry from all sides, from owner through to user.” In the same way, several respondents claimed that existing product sites are not as complete or detailed as printed catalogues, and they lack technical information: “Most sites are underdeveloped at present with little technical information. Sites are nothing more than a contact page with a couple of paragraphs of descriptive text regarding the product(s).” Another respondent stated: “Many firms do not utilize the potential of the Web to present the depth of product line and comprehensive product information.” The problems associated with the Internet itself seem to affect the performance of product sites too: “The Internet is not 100% reliable, and access to some sites is not always available.” Another said: “You can get frustrated when trying to find what you want and with the speed of downloading.” One similarly added: “Slow connection times etc, make you feel like you are wasting time.” It is important to mention that a few respondents stated that the quality of Web sites varies from one site to another: “Quality of information varies, but so does paper data,” and another said: “There is no principle weaknesses with respect to building product sites. It depends how the Web pages are. The situation is always improving.”

Respondents mainly use search engines to locate product information on the Web (92 firms). See Figure 4.19. However, some respondents find search engines inadequate. For example, one respondent said: “Search Engines are hopeless, try searching for ‘lead sheet’ for example!” Trades journals follow search engines (65 firms). Nowadays, most ads and articles on building products include URL addresses. On-line product catalogues such as Sweets, Architects First sources and also Web links are used by equal numbers of respondents (59 firms) to locate product sites. Word of mouth, friends and colleagues are also other ways of locating product information on the Web (28 firms). In addition, some respondents said that they obtain product related information in news and listserv groups (14 firms). “AEC Search Engines” and, interestingly, “Spam” as reported by one respondent, are other

ways of finding product related information. Alternatively, one respondent said that one way he used to locate a product on the Web is to type “www.product name or company.com and then to search the site.”

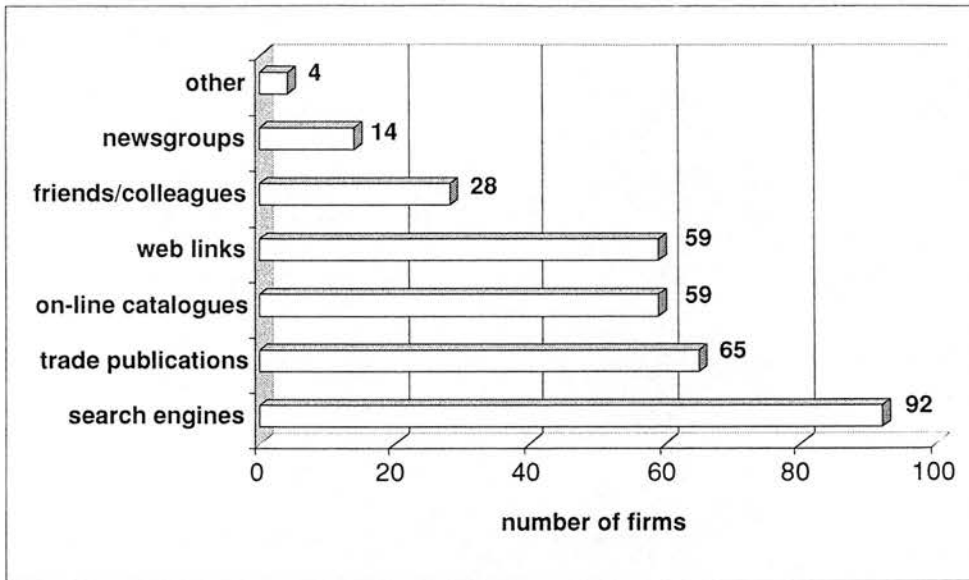


Figure 4.19: Methods of locating building product information on the Web (Question 3.4)

Some of the most visited building product sites were Sweets Catalog Online,<sup>78</sup> Architect’s First Source,<sup>79</sup> PierPoint,<sup>80</sup> Specs-Online.com,<sup>81</sup> Thomas Register<sup>82</sup>, Building Team,<sup>83</sup> CAISNET,<sup>84</sup> RIBA Product Selector,<sup>85</sup> Selector.com<sup>86</sup>, Builder Online,<sup>87</sup> AECinfo,<sup>88</sup> Material ConneXtion,<sup>89</sup> Interior Concepts<sup>90</sup> and numerous suppliers’ sites<sup>91</sup>. Some respondents stated that they do not bookmark information and generally do not visit the same sites again: “We don’t have a

<sup>78</sup> <http://www.sweets.com>

<sup>79</sup> <http://www.afsonl.com>

<sup>80</sup> <http://www.pierpoint.com>

<sup>81</sup> <http://www.specs-online.com>

<sup>82</sup> <http://www4.thomasregister.com>

<sup>83</sup> <http://www.buildingteam.com>

<sup>84</sup> <http://www.caisnet.com/products>

<sup>85</sup> <http://www.productselector.co.uk>

<sup>86</sup> <http://www.selector.com>

<sup>87</sup> <http://www.builderonline.com>

<sup>88</sup> <http://www.aecinfo.com/bpl>

<sup>89</sup> <http://www.materialconnexion.com>

<sup>90</sup> <http://www.interiorconcepts.com>

<sup>91</sup> A list of some of the on-line catalogue service providers on the Web can be found in Appendix D.

particular source that we revisit over and over. We usually know a product name, then go to the Web to find out where to get specs and pricing information.” One respondent also said: “We don’t have favourites. We just look for the information that we need, download it and file the hard copy.” Various other respondents stated that they have too many building product sites to list. One suggested: “check my site for the complete list.” Interestingly, one said that the interactive aspect of the survey allowed him to examine others’ product site links: “(I have) noted the Web sites mentioned and will look at them.”

The questions asking “what do respondents like and dislike about these particular sites?” supplemented the earlier open-ended question where strengths and weaknesses of Web product sites in general were discussed. Some important issues associated with product information sites, which might have been overlooked by the respondents, were introduced here too.

As expected, receiving up-to-date information was the most liked aspect of the product sites that respondents often visit (80 firms). See Figure 4.20. The second liked feature was easy information retrieval (66 firms). Accessibility, which is the ability to access on-line information from any location at any time, was also greatly appreciated (64 firms). The ability to contact product suppliers directly and instantly was a favoured capability of product sites too (50 firms). Self-navigation, which allows users to browse information according to their priorities and needs rather than content providers’, was the fifth most liked feature of the product sites (40 firms). Other favourable aspects of building product sites were no sales pressure (38 firms), direct usability of product data (35 firms), the well-organised nature of product information (29 firms), graphic product content (28 firms), availability of technical product information (28 firms), product comparison/selection (26 firms), compatibility of product file formats (25 firms), interactivity (19 firms) and easy purchasing (13 firms).

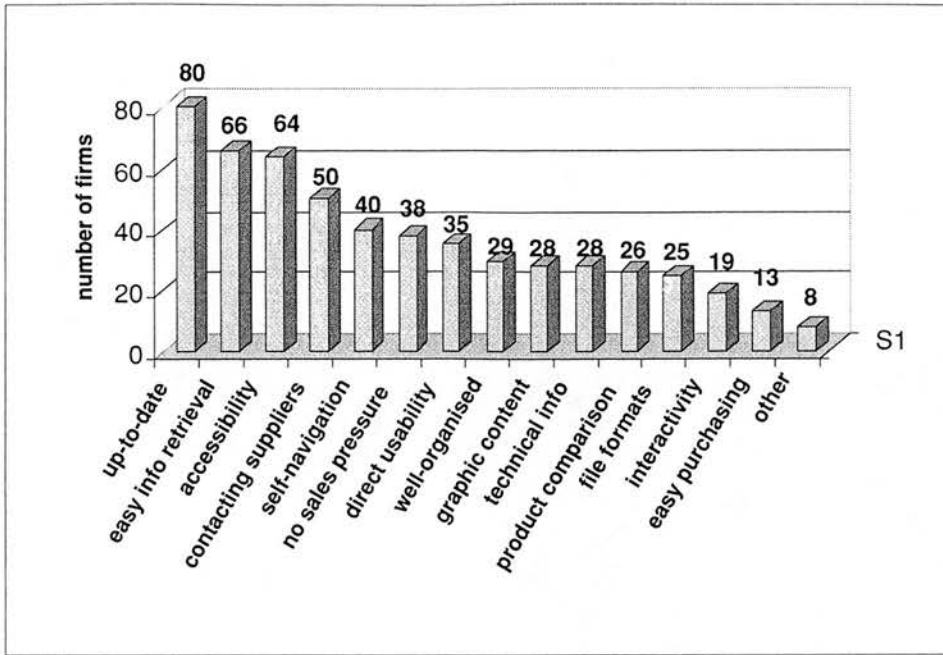


Figure 4.20: The favourable features of product sites on the Web (Question 3.6)

As for the weaknesses of the products sites visited by respondents, locating information is disliked most (66 firms): “It takes a lot of work to find what is needed.” Encountering a lot of junk and irrelevant information was another weakness of product sites (52 firms): “The search engines return too many sites. There is too much junk information. Paper catalogues are usually more handy and faster to use than the Web.” There is insufficient illustration of the visual attributes of products, such as colour and texture (43 firms). Only a few sites such as Dulux enable designers and potential customers to browse through the colour options of products visually and compare the suitability of products in different settings. See Figure 3.9 in Chapter 3. In this site, visitors point and click on products to change their attributes. Another complaint from 42 respondents was the lack of use of interactive, multimedia and three-dimensional technologies: “Product sites should be interactive. Video, animation samples, QTVR, VRML and live location shots should be provided in Web sites.” One said: “Interactive feedback in relation to products will extend the usefulness of Web-based product information.” Another respondent believes: “Three-dimensional product information helps making a more visually educated decision.” Insufficient technical information (41 firms), disorganised information (41 firms), outdated information (40 firms), incomplete supplier lists (33 firms),



problems in using downloaded information in documents (23 firms), incompatibility of data formats with that of in-house data (18 firms), and that there is no clear advantage of Web-based product information over the printed media (11 firms) were other weakness pointed out by the respondents. See 4.21. Several respondents also mentioned: “Little or no cost information,” “Lack of illustrations,” “Slow Internet access” and “Lack of local assistance and suppliers.”

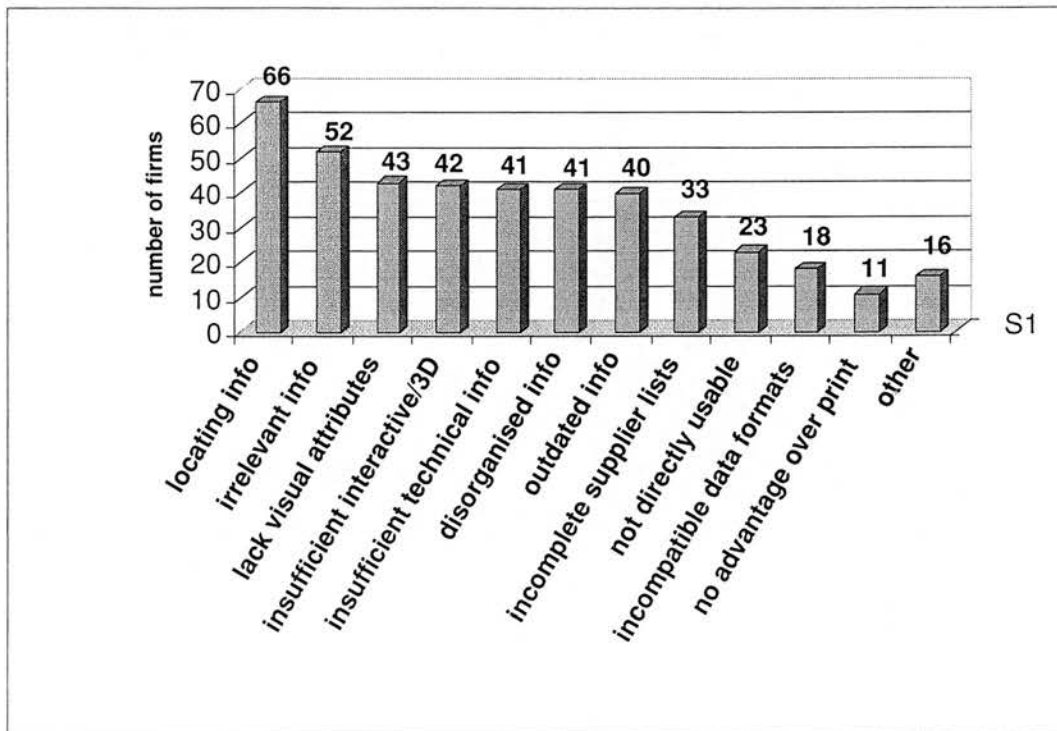


Figure 4.21: Drawbacks with building product sites on the Web (Question 3.7)

In spite of its various weaknesses, most respondents (62%) think that the Web will be the primary medium for product information in the future. See Figure 4.22. One said: “I have no doubts that the Web should be the sole medium for product information, as it already is for IT related information.” Another said: “I am sure that the future lies with on-line services. I would think that the way the Internet is developing, all this sort of CD stuff will disappear and we will eventually just use on-line services to reach all the manufacturers.” 27% of the respondents anticipated that there is the possibility of the Web becoming the primary medium for product information in the future. A small number of respondents (8 firms; 6%) do not

believe that this will happen. Two of these firms do not use the Web to locate information and the remaining six firms stated various reasons as to what they do not like about product sites on the Web. For one: "Product sites tend to be incomplete, it takes a lot of work to find what is needed, and sometimes the Web only serves as the medium to obtain the name of the person or company that must be called in person." For another respondent: "Product Information is very sketchy, not all manufacturers are available. Generally, if paper catalog(ue)s are handy, they are faster to use than the Web." One also added that his Internet service provider was not reliable.

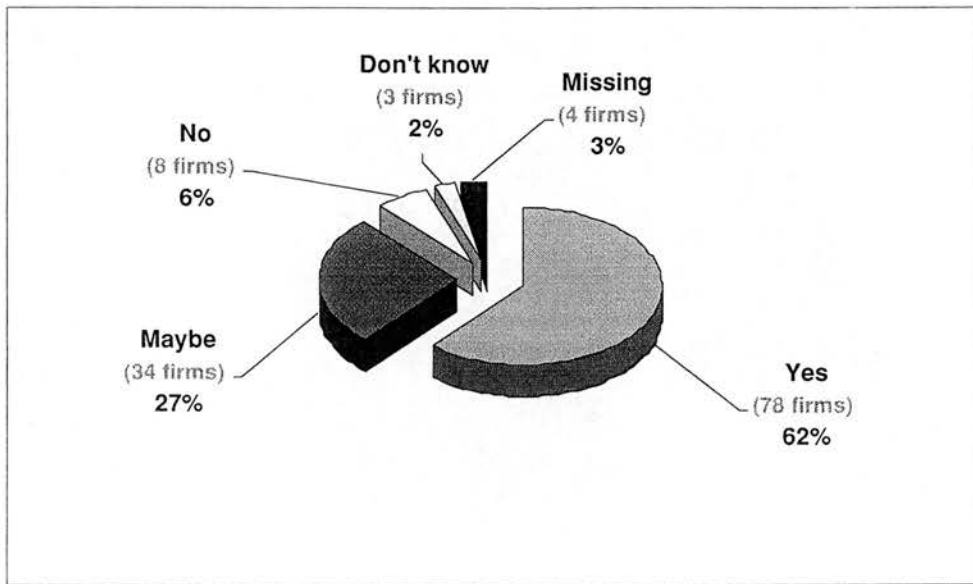


Figure 4.22: Will the Web become the Primary Product Information Medium? (Question 3.9)

#### **Section 4: Utilisation of VRML Software**

This section mainly examines the use of VRML software by the respondent firms.

The first question examines the use of some of the graphic software that has been used in desktop environments with similar functionality to VRML. It was interesting to find out how many of the respondents utilised these applications. Three-dimensional modelling applications such as Autodesk 3D Studio and Autodesk FormZ were the most popular (89 firms). Presentation software,

including applications such as PowerPoint and Corel Presentations, closely followed three-dimensional modelling applications (87 firms). Surprisingly, the use of CAD applications was behind both that of three-dimensional modelling and presentation software (72 firms). Animation software such as Autodesk 3D Studio and Strata Pro Studio were also among the most utilised graphics software (69 firms). Preceding them were Walkthrough software, e.g. Virtus Walkthrough, Autodesk Walkthrough (39 firms) and Multimedia software such as Macromedia Director and Asymetrix Toolbook (35 firms). See Figure 4.23.

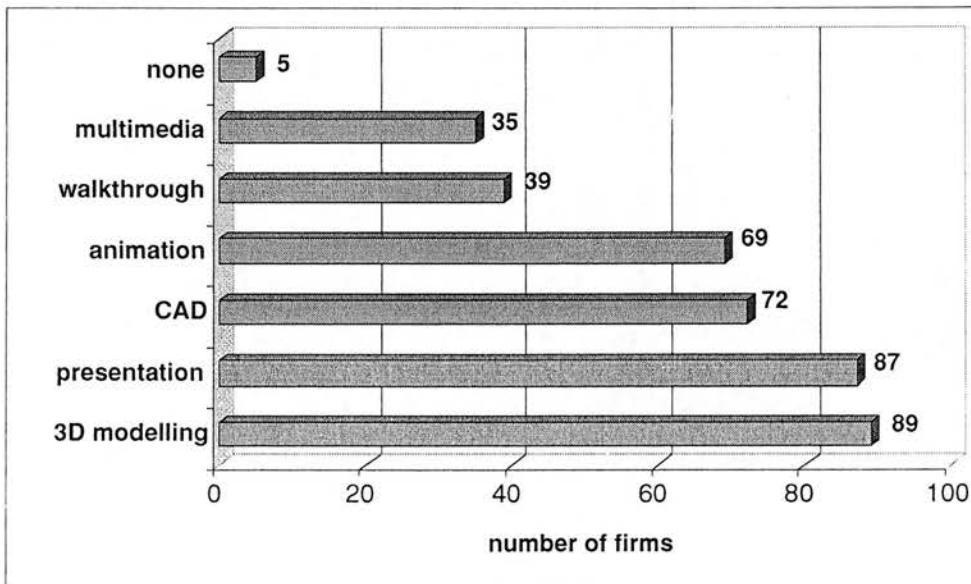


Figure 4.23: Some of the graphic software used by the respondents (Question 4.1)

In spite of the familiarity of most of the respondents with three-dimensional desktop software, it appears that most of them do not create VRML models for their projects (85 firms). Only a small number of firms (32 firms) said that they used VRML modelling. See Figure 4.24.

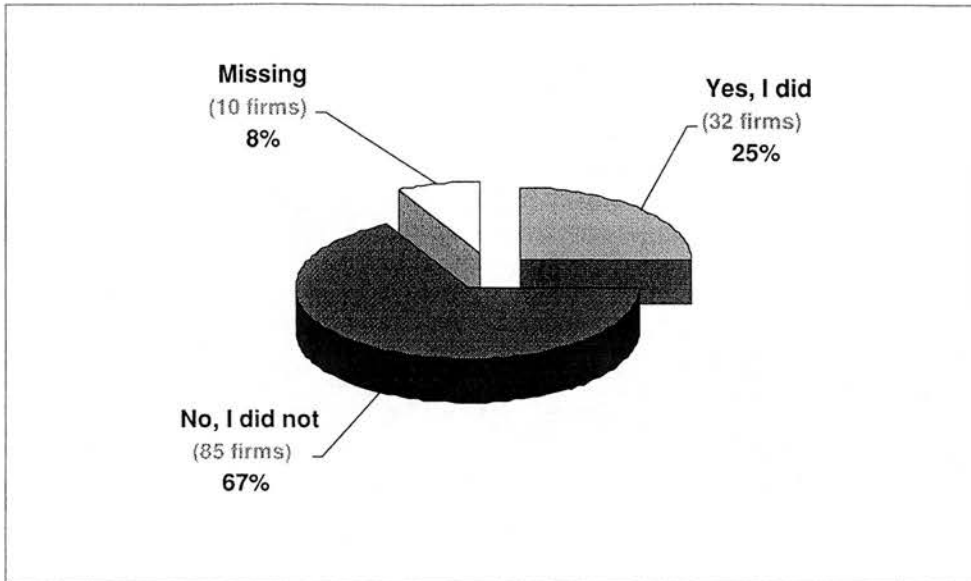


Figure 4.24: Creating VRML models (Question 4.2)

Those firms who said that they use VRML in their projects primarily utilise it as an aid to design (29 firms). Many respondents use it to increase client understanding and appreciation of their designs: “Sometimes our clients do not really know how to ‘read’ the plans. They do not imagine how it will look or how it will feel to stand inside them.” One added: “VRML models can provide clients with a good impression of your work. If it is prepared well, they will wait for the download.” VRML helps design presentations and communications between design participants: “It gives the presentation the ‘wow’ factor. Many people want to be ‘on the cutting edge of technology.’ It gives them something to brag about to their peers. The important thing is the communication of ideas. This is a good way to communicate the visual image to someone who may have a hard time creating a 3D visual image in their mind from looking at a group of 2D images.” One also stated: “VRML provides all design members with a clear picture of the design.” Visualising buildings before their actual construction is also a very important use of VRML (26 firms): “We create a visual world. It is nice to be able to see it before it’s built.” One pointed out: “VRML allows for changes before construction; therefore, it saves time and money.” Creating walkthroughs and other types of animations of firms’ projects was a popular way of using VRML too (26 firms): “I think moving pictures can communicate more than still images.” Making multimedia and interactive

presentations was one of the other uses of VRML that was found acceptance among the respondents (22 firms): “I liked the ability to interact, and user control in VRML.” Other uses of VRML were displaying projects on the Web (11 firms), as a 3D interchange format (4 firms) and collaborative uses (4 firms). See Figure 4.25. Several respondents also mentioned marketing potential.

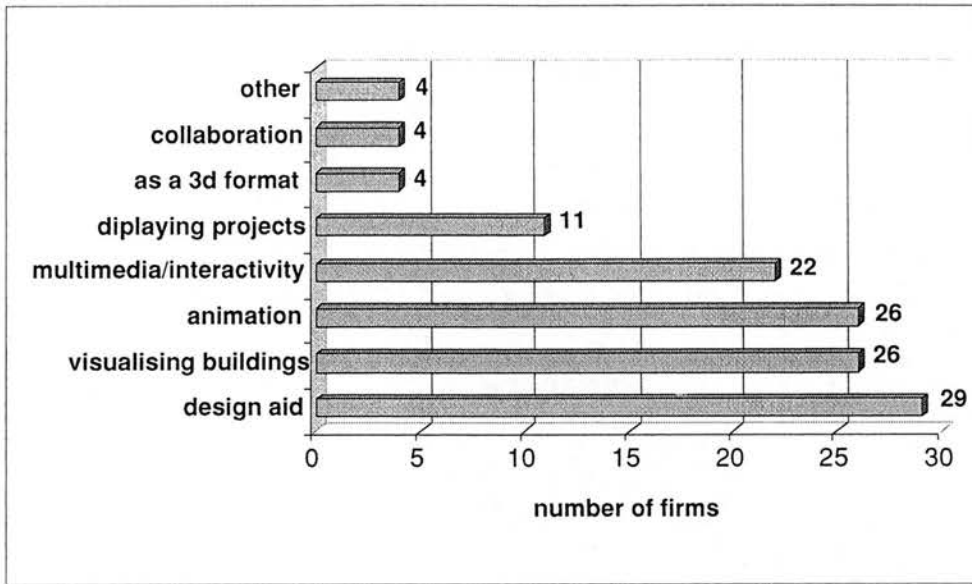


Figure 4.25: Utilisation of VRML data (Question 4.3)

Self-navigation is the most liked aspect of VRML (32 firms). VRML enables users to view and explore three-dimensional models in their own way in real time. The second liked feature is attribute explorations (22 firms). It is possible to create VRML environments in which users can examine VRML objects with different attributes (e.g. colour, texture variations) and under different lighting and climate conditions. Dynamic/interactive content provided by VRML is much appreciated too (21 firms). VRML changes the static nature of the Web. It allows walkthroughs and other types of animations on the Web. Powered with programming languages VRML allow users to communicate with models interactively. The ability to view VRML models is also an important advantage (19 firms). VRML models can be viewed with a VRML browser plug-in or stand-alone software, which is, in most cases, available free of charge. The VRML's capability of incorporating multimedia data is regarded highly as well (16 firms). Multi-platform compatibility (15 firms), usability as a

neutral three-dimensional interchange format (11 firms), incorporating programming support (8 firms), easy syntax (6 firms) and the editability (6 firms) of the VRML language are other features of VRML found useful by the respondents. See Figure 4.26.

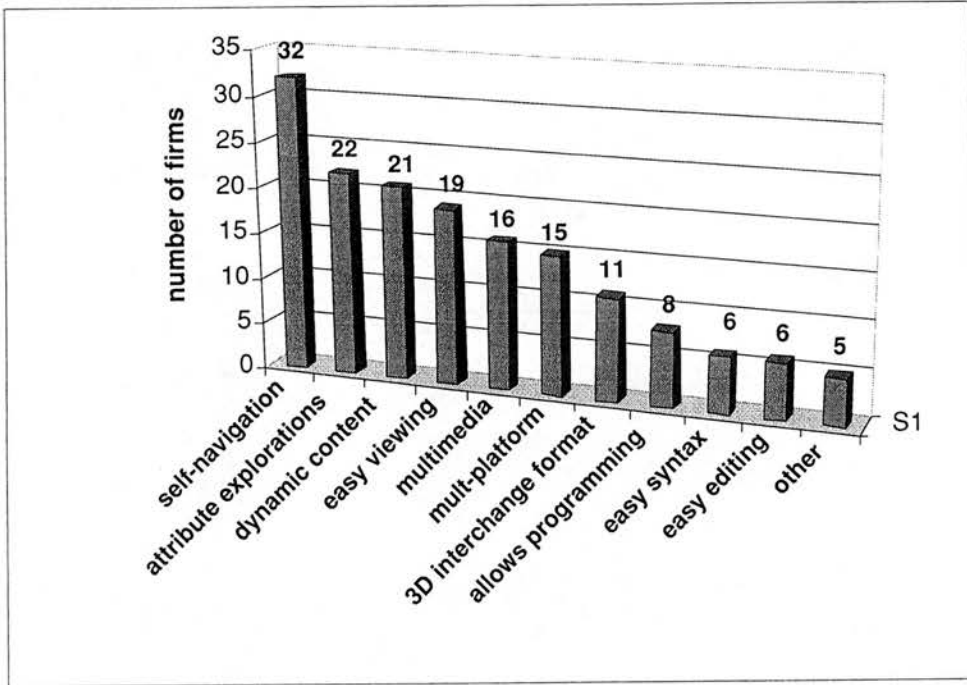


Figure 4.26: Some useful aspects of VRML (Question 4.4)

There are many sites on the Web designed with three-dimensional technologies such as VRML or QTVR. These three-dimensional spaces incorporate a range of different environments such as virtual museums, villages and shopping malls. 46% the respondents (59 firms) stated that they visited these environments; slightly less respondents (52 firms; 41%) said that they did not have a chance to do so and 7% of the respondents (9 firms) reported that they did not remember whether they had ever visited a three-dimensional Web environment. See Figure 4.27. Many used expressions like “fun” and “cool” for this experience. The most liked feature of these sites was the interactive presentation of information: “The thing that I liked most was the interactive exploration. It was nice to have control over where you go.” Several respondents talked about the uniqueness of the three-dimensional experience:

“3D gives a more realistic idea of the environment being modelled. It’s great to be able walk through the model.”

Three-dimensional Web sites present various obstacles and problems too. The major one is long downloading times: “Large VRML files suffer from bandwidth limitation during downloads.” Similarly, another respondent said: “ I dislike how long it takes to download the QTVR image.” Another problem has to do with the poor quality of graphics. In order to lower the file size for shortening the downloading times, many sacrifice the graphic quality: “Many of the images are distorted and of poor quality.” Another said: “They (three-dimensional sites) generally don’t offer any better representation than traditional 2D drawings.” The necessity of downloading a plug-in to view 3D data was especially disliked: “The only part of the experience I did not like was having to download a plug-in before viewing the images.” One also mentioned the navigational problem in three-dimensional Web environments: “One can easily disorient in such environments if not designed well. It can be too awkward to handle.”

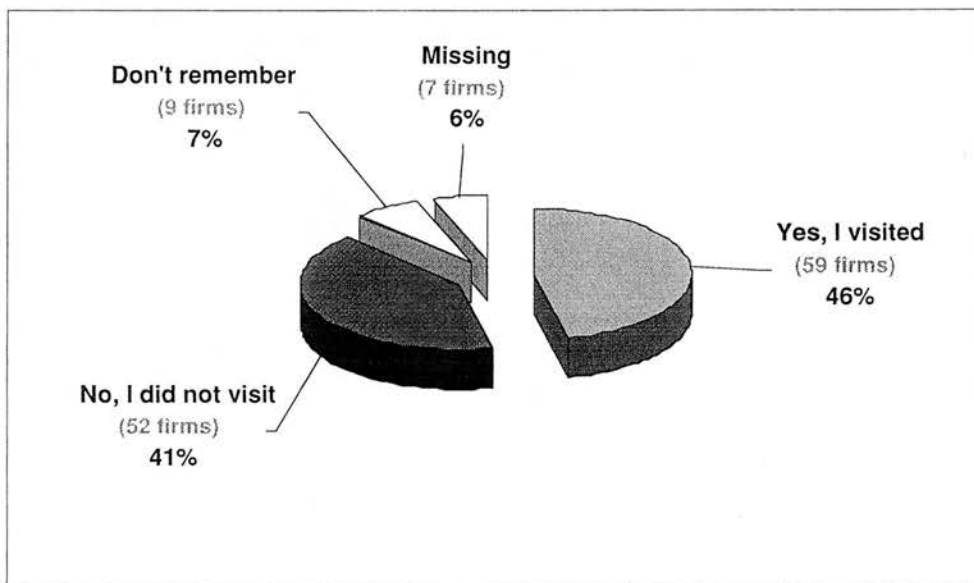


Figure 4.27: Visiting a three-dimensional Web site (Question 4.5)

In responding to a question asking whether interactive three-dimensional technologies (e.g. VRML, QTVR and Java) can contribute to product sites on the



Web, the majority (58 firms) of the firms said Yes they can; 28 firms (22%) stated that interactive technologies such as VRML might contribute to Web-based product information; 12 firms (9%) said that they do not know the answer of this question and 11 firms (9%) replied No. See Figure 4.28. Interestingly, it seems that most of the respondents saying No to this questions did not have much experience with VRML or other three-dimensional technologies. Most of them neither created VRML models nor had they visited a three-dimensional site.

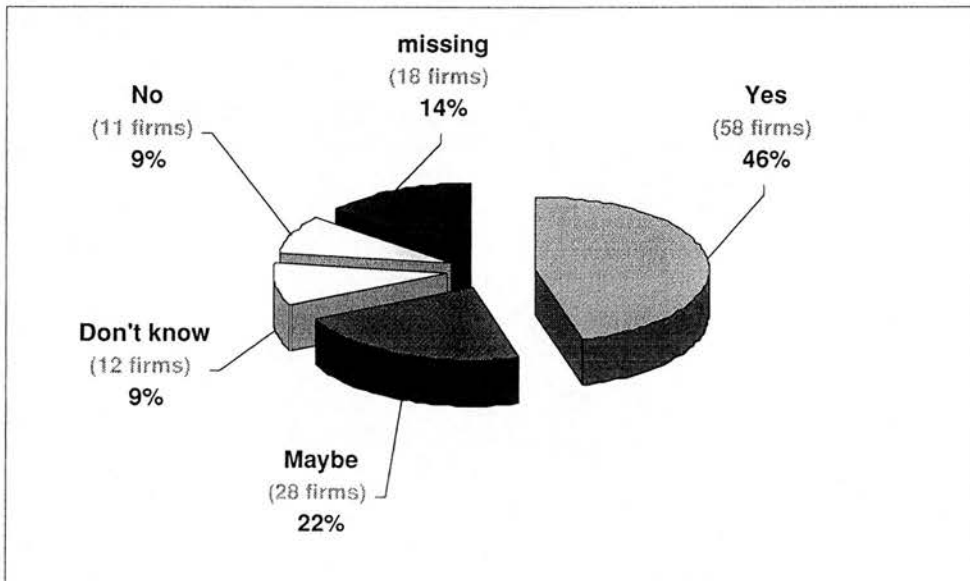


Figure 4.28: Can 3D and interactive technologies contribute to product sites on the Web?  
(Question 4.6)

Most of the respondents who believed that interactive three-dimensional technologies can contribute to product information on the Web think that these technologies can be particularly useful for better product assessment: “This method would help to facilitate a user’s understanding of the product and/or installation of the materials.” Another said: “Interactive technologies offer the opportunity to portray visual characteristics, details and installation techniques.” One also stated: “This provided an enhanced view of potential purchases. Better ability to evaluate a product.” Many respondents strongly believe that three-dimensional representations are particularly useful in product assessment: “Three-dimensions would allow a greater level of detail to be conveyed.” Another said: “It improved the ability to

visualise products.” One suggested: “VRML could act as 3D catalog(ue) of suppliers for objects and structures, i.e. point and click on a kitchen surface and bring a Web page of suppliers for that material.” Interactive presentation of products is found valuable by several respondents too: “Interactivity allows the viewer to have control of what he would like to see.” According to another respondent: “This should be the key advantage of the Web- to offer us a more advanced, comprehensive and interactive way to review product information, thereby facilitating product selection, specification, ordering and installation.”

It is also important to mention that interactive three-dimensional technologies have some downsides that can affect the quality of product presentations. Similar to the problems with three-dimensional environments, these are long downloading times, poor image or graphics quality, navigational problems and the necessity of downloading plug-ins.

### **Section 5: Comments on the Survey and Feedback**

This section has questions asking for opinions on the methodology of the survey.

One of the questions in this section was whether the respondents looked at the other respondents' comments. 62 (48.8%) respondents said that they did; 58 (45.7%) said that they did not, and 7 (5.5%) respondents chose not to answer this question. See Figure 4.29.

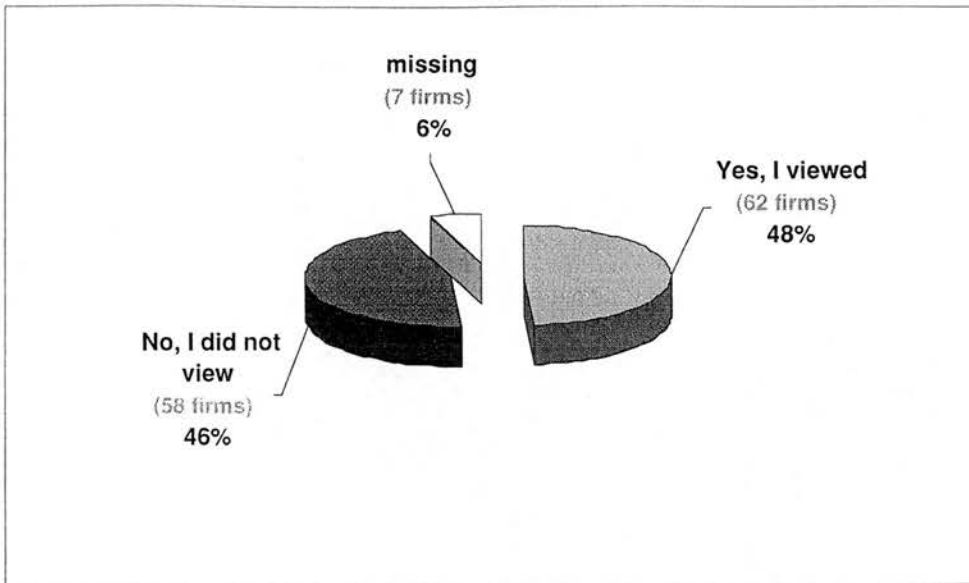


Figure 4.29: Viewing the comments of other respondents (Question 5.1)

Respondents were also asked whether they would view the graphic analysis of aggregated survey results. More respondents (76.4%) than in the previous question stated that they would view the aggregated results of the survey; 18.9% said they would not, and the remaining 4.7% did not answer the question. See Figure 4.30.

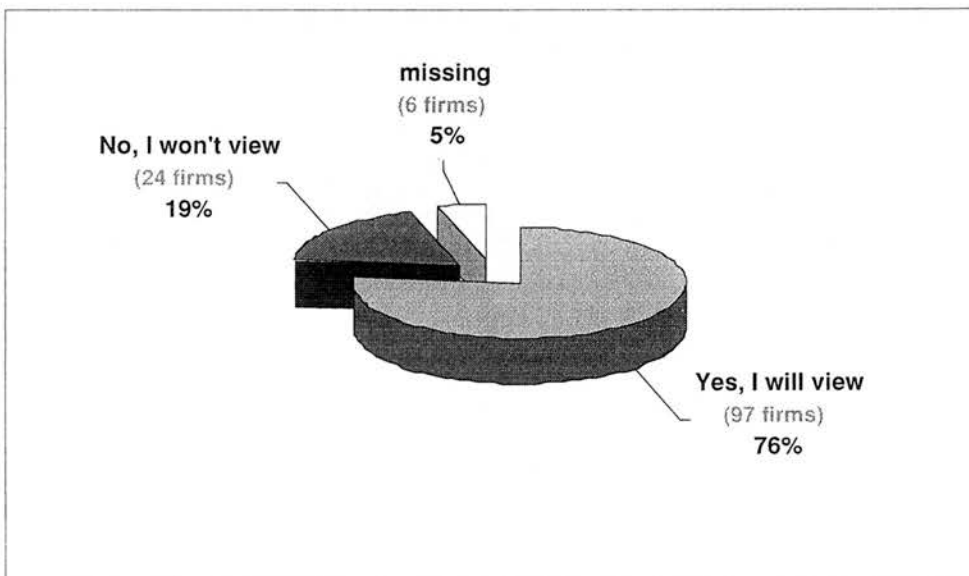


Figure 4.30: Viewing the aggregated graphic survey results (Question 5.2)

11 respondents stated that the survey was well laid out; its format and presentation were quite good. A more detailed discussion of this section of the survey and the further comments of the respondents are available under the heading “The Interactive Aspect of the Survey” in this chapter.

### **Important Survey Findings**

The survey shows that the use of web-based product information is common among the architectural and design firms having a Web presence. Of the 127 respondents, 104 said that they refer to the Web to locate product information. Most respondents also stated that they purchased products and/or services over the Web. Among the product media, the Internet was the second choice, only marginally behind hard-copy catalogues. However, the majority of the respondents expect that the Internet will become the primary product information medium in the future.

In reviewing the survey results, one should remember that the majority of the respondent firms already had Web access and, therefore, were more Internet literate than average architecture and design firms. Most of these respondents were already familiar with the existing Web technologies and deployed the Web for the purposes of marketing, collaboration, sales and/or simply as an information source. However, due to the expanding use of the Internet, one would expect these type of firms to become more common. As a consequence, the survey results, which appear not to be applicable to the entire architectural community in the present circumstances, provide insights into Web usage that we will see in the near future, particularly in relation to building product information.

Here are some highlights from the survey:

Most respondents believe that the major strength of the Web as a product medium lies in its ability to offer the most up-to-date information. They also think that it is easier to retrieve product information from the Web than from paper media. Easy information retrieval on the Web has to do with the direct and instantaneous

download of information without any intermediaries. Accessibility of information from anywhere is also much valued by the respondents. In addition, some respondents believe that the ability to contact product suppliers directly is a significant asset for building product sites.

On the other hand, many of the respondents feel that currently the Web is underused as a product medium. They stated that the number of suppliers and products is incomparably less than those of hard copy catalogues, and similarly, the content of product information is less comprehensive in Web sites than that of other product media. Another major problem with product sites is the difficulty of locating information. It seems that most respondents use search engines to locate product information. They stated that these tools are insufficient in returning concise search results. Many respondents think that they encounter a lot of irrelevant information.

The problems highlighted above regarding product web sites are extremely important and need to be tackled by future studies in the area of on-line product information. As stated earlier, the focus of this research is the methods deployed in Web sites for presenting building product information. Some of the interesting findings of the survey in this regard are as follows:

Many respondents have a high regard for the ability of the Web to enable self-navigation of product information. Unlike traditional product media, on the Web, users can browse through information using their own methods rather than following a hierarchical or linear order. One respondent also confirmed that: "One of the strengths of on-line product sites is that you have the control over where you go and what you look at." The capability of self-navigation is one of the most remarkable features of hypertext/hypermedia systems such as the Web.

Some respondents feel that product sites are not very strong in making product comparisons and selections, although, in an earlier question, this was the third most liked feature of the Web when purchasing a product. One respondent pointed out: "I have trouble comparing different products at the same time. With

catalogues, you can open several different manufacturers' literature and compare. With a Web site it is more difficult."

Similarly, many respondents think that building product sites are not as strong as other sites in presenting interactive and personalised information. Only 19 respondents believe that interactivity and personalisation is an important feature of product sites, which is significantly lower than the 32 respondents who, in an earlier question, responded that interactivity and personalisation were one of the main reasons why they make purchases on the Web. This outcome might have to do with the fact there are far less building product sites offering interactive and personalised content than sites offering consumer products. One respondent believes: "There should be more interactive product sites. This allows two-way communication and the ability to control over the information."

Another significant finding of the survey was that most respondents think that appearance is the most important factor in selecting a product. At the same time, a lot of respondents think that existing product sites offer insufficient illustration of the visual attributes of products (e.g. colour, texture, etc.). Various respondents stated that they wish to see different colour and finish choices of products visually and to point and click on products to change their attributes. A considerable number of respondents also feel that building product sites insufficiently utilise interactive, multimedia and three-dimensional technologies that allow users to self-navigate, interact and perceive products better: "Web sites should include more graphic product information such as CAD, AVI, audio and VRML. This helps visualising products."

Many respondents agree that Web-based three-dimensional and interactive technologies such as VRML and Java can contribute to the product information on the Web. One respondent said: "This will make the information more understandable and usable. It will also help visualising products before actually seeing them."

The next chapter will introduce the prototypical system called Interactive Product Selector (IPS) that was designed to address some of the shortcomings of existing building product sites. The system was developed using interactive and three-dimensional technologies such as CGI/Perl, JavaScript, Java and VRML. It:

- 1- encourages users to self-navigate information,
- 2- provides interactive tools to make selections and comparisons between different products,
- 3- offers personalised information content, and
- 4- incorporates three-dimensional and graphic data that help better product assessments.



## CHAPTER 5 – INTERACTIVE PRODUCT SELECTOR (IPS)

### Introduction

This chapter will introduce a prototypical web tool called Interactive Product Selector (IPS) for selecting building products. Prototypes are useful research tools for identifying problems associated with product requirements and designs<sup>1</sup>, assessing technical and economic feasibility of a concept<sup>2</sup> and communicating with people who are not familiar with a product or technology.

The IPS works in conjunction with the product information survey presented in the previous chapter. By utilising the survey information, the IPS demonstrates a way to deal with some of the problems associated with existing building product sites and also attempts to accommodate some of the desirable attributes of such sites as raised by the survey participants. Overall, the IPS constitutes a platform to test and improve our understanding of some of the concepts introduced in this study.

### Background

The IPS is a virtual showroom that presents office furniture from various manufacturers on the Web. It is also a decision support system that enables users to compare products with each other, to change some of the attributes of products and to verify whether the selected product fits in the intended context, i.e. a room or space. Although the IPS was developed to work with office furniture, with minor adjustments, it can function equally well with other building products.

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<sup>1</sup> Doyle, "Prototyping," <http://junix.ju.edu/UserWebPages/bdoyle/chap9/sld010.htm>

<sup>2</sup> Ng, "Why Prototype Development?," *Technology Entrepreneurship II*.

The IPS is not in any way intended to replace the physical showrooms of manufacturers, building display centres and trade shows where a range of different products can be viewed, experimented with and ordered in-person. In fact, the IPS is designed to complement these places: it could extend the working hours of the physical sites, as the IPS can be accessible around the clock on the Web; it may help narrow down the choice of products prior to the practitioners' visits to product display centres and allows them to concentrate on a few specific products during their visits. Overall, the IPS could assist building professionals in making more-informed product decisions and using their time most efficiently when visiting product display centres.

It is possible to draw similarities between some of the characteristics of the IPS and those of printed consumer catalogues such as Argos and Index, the leading retailers of household items in the United Kingdom. Catalogue sales constitute a multi-billion dollar business in which the buyer gets an idea about products, and, to a large extent, makes purchases based on seeing a small photograph and brief information about products. However, the IPS is intended to improve on paper-based catalogues by presenting information in a way that is much more informative, compelling and interactive.

The IPS was designed to present office furniture. Office furniture is classified as a building product under "Division 12-Interior Products" in MasterFormat, "7-Fittings/72-Furniture" in CI/SfB and "L8-Fixtures-Furnishings/L85-Work Environment Furniture" in Uniclass. Some of the advantages of using office furniture in the IPS are that: there are a number of office furniture manufacturers on the Web; it is relatively easy to incorporate interactive features into these products; office furniture can accommodate a number of different attributes (i.e. colour, finish) and variations in size and shapes; the modularity and portability of office furniture lend themselves to cataloguing, modelling and arrangement in three-dimensions.

In designing the IPS, the findings in the following areas of the product information survey have been particularly important:

**1- Self-navigation:** As explained previously, self-navigation is a method that allows users to browse information according to their priorities and needs rather than content providers'. The survey revealed that, for most respondents, self-navigation is an important feature of the Web making it distinct from other media.

The IPS supports self-navigation through hyperlinks. The IPS is a hypertext/hypermedia environment, which presents information in a non-linear, non-sequential fashion or "in a more human way," that is jumping from one thought to another, connecting ideas with appropriate links<sup>3</sup>. Users of the system can browse through information by clicking appropriate links and selecting menu options instead of following a hierarchical order. The IPS also presents an ability to self-navigate products in three-dimension. The three-dimensional VRML models of products can be viewed from various angles, and users can even walk through the environment in which products are displayed.

**2- Interactivity and Personalisation of information:** Interactivity and personalisation are interrelated with self-navigation. Generally, a good interactive and personalised system encourages self-navigation through information. The survey demonstrated that the respondents value interaction and personalisation in Web sites. However, they think that these features are underused in existing building product sites.

The IPS aims to be a highly interactive system that encourages user participation. Interactivity in the IPS begins when the user designates the basic dimensions of an office space. Then users can insert products into this space. They can drag or rotate the products in a VRML representation of the space to arrange them. Another type of interaction involves personalisation of information on the screen. Users can change properties of products (e.g. colour and finishes) to find the options that suit their requirements.

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<sup>3</sup> Conklin, "Hypertext: An Introduction and Survey," *Computer*, pp. 17-41.

The IPS intends to provide a kind of a guided interactivity, in which users are offered navigational and content related help<sup>4</sup>. Hopefully, this makes the interactive experience more effective and more relevant to the task. Complete interactivity, on the other hand, is not necessarily helpful for users. In extremely interactive three-dimensional environments, contents provided can stray from the original intent<sup>5</sup>, and users can find themselves wandering around or disoriented. Guided interactivity in the IPS is offered through pre-defined VRML viewpoints to which users can refer in case they became disoriented.

**3- Product comparison and selection:** Many survey respondents pointed out that existing product sites are not strong in comparing different products and selecting appropriate products.

In response to that, the IPS aims to offer a more complete visual environment that facilitates the comparison and selection of products. Products can be selected by clicking on their picture in the menu area and inserted into the three-dimensional VRML scene by pressing the "add" button. Multiple products can be selected and reviewed. The products in the VRML scene can be compared with each other visually. Using the text area assigned for each product, the technical details about products can also be contrasted. The system also enables users to test whether a product fits in its designated space. Products can be dragged around and rotated in the VRML scene. Before exiting the system, users also have the option to print out or save the information about the products they selected.

**4- Three-dimensional and visual product information:** We are used to interpreting information presented in three-dimensional formats<sup>6</sup>. The three-dimensional representation of data can have a great impact in areas such as product demonstrations and documentation, advertising, graphic and architectural design as well as simulated physical experience. The survey illustrated that many respondents feel that viewing products in three-dimensions is especially important in gaining an accurate assessment of them. The majority of respondents also stated that VRML and

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<sup>4</sup> Filipczak, "Engaged! The Nature of Computer Interactivity," *Training*, p.52.

<sup>5</sup> Frook, "Setting a Site Apart Through Interactivity," *Interactive Age*, p.20.

<sup>6</sup> Honeycutt et al., *Using HTML 3.2*.

Java technologies could be used in offering three-dimensional and more interactive product information.

The IPS uses VRML technology for presenting product information in three-dimensions. The furniture items in the system are generic products modelled in FormZ (by Autodesk) and then exported to the VRML format in the same package. The interactions were built manually using VrmIpad by ParallelGraphics<sup>7</sup>. Cortona VRML plug-in software by Parallel Graphics was used for viewing VRML files. Cortona supports EAI (the External Authoring Interface)<sup>8</sup>, which is a set of classes and methods that allows external programs to communicate with a VRML scene, and is quite a small application to download (only 1.35MB).

The concept of using VRML in presenting product information is not new. There are various shopping environments built in VRML. One such environment is 3DBOOM<sup>9</sup> that allows visitors to walk in, examine and purchase products in a three-dimensional environment (Figure 5.1). One study, conducted to determine the impact of different Web site development techniques on behaviours of on-line shoppers, concludes out that VRML worlds help increase the volume of sales and the length of time shoppers spend on-line<sup>10</sup>.

In addition to 3DBOOM, there are numerous other sites that use three-dimensional technologies to display products and let customers interact with them. Some of these are<sup>11</sup>: Aibo from Sony<sup>12</sup>, Nike Iconoclast<sup>13</sup>, Hewlett Packard<sup>14</sup>, Palm VII<sup>15</sup>, Volvo<sup>16</sup> and Manolo Blahnik Shoe Boutique<sup>17</sup>.

<sup>7</sup> Parallel Graphics is one of the few companies that offer new VRML products and dedicated support for them.

<sup>8</sup> <http://www.web3d.org/WorkingGroups/vrml-eai>

<sup>9</sup> <http://www.3dboom.com>

<sup>10</sup> Richmond, "Enticing On-line Shoppers to buy: A Human Behavior Study," *The Fifth International World Wide Web Conference*.

<sup>11</sup> Ressler, "Using VRML to Access Manufacturing Data," *Proc. VRML 98 Conference*.

<sup>12</sup> <http://www.sony.com/aibo>

<sup>13</sup> <http://www.viewpoint.com/demos/airmax/index.html>

<sup>14</sup> <http://www.hpbriefingroom.com/models/hp/index.html>

<sup>15</sup> <http://www.palm.com/products/palmvii/index.html>

<sup>16</sup> <http://volvos60.volvocars.se/uk/>

<sup>17</sup> <http://www.neimanmarcus.com/wg%5Fboutique.jhtml>

In architecture and urban design research projects, VRML is utilised particularly in urban simulation projects, such as the Bath Model by CASA (the Centre for Advanced Studies in Architecture) at Bath University and the Glasgow Model by ABACUS (Architecture and Building Aids Computer Unit Strathclyde) at University of Strathclyde. One on going project on the same subject is conducted in School of Architecture at University of Sheffield<sup>18</sup>. The project is involved in producing computer models of buildings at the city centre of Sheffield, which will illustrate the evolution of city's development across different periods of time, and generating an interactive searchable hypermedia databank, which will be dedicated to the research on historical buildings and places at Sheffield. VRML modelling is used not only for three-dimensional visualisation, but also for embedding contextual information, which consists of texts, drawings and still/animated images about the region, in three-dimensional models. These projects demonstrate that VRML is very suitable for generating complex visualisation projects consisting millions of polygons and sharing it on-line.

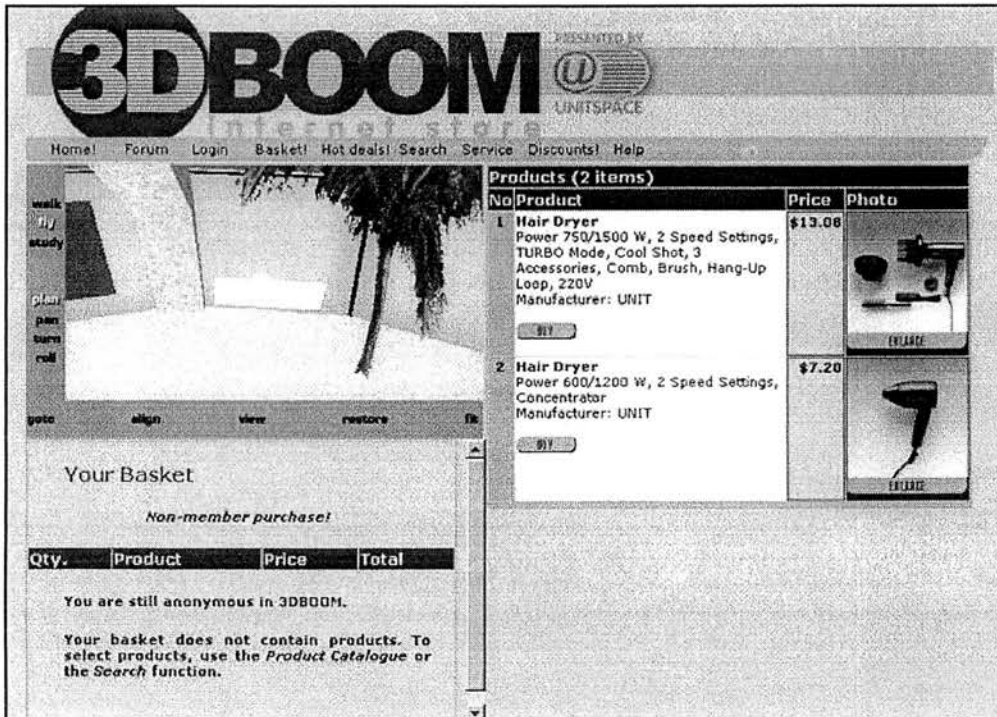


Figure 5.1: 3D BOOM shopping mall designed in VRML

<sup>18</sup> Peng and Blundell, "Hypermedia Authoring and Contextual Modelling in Architecture and Urban Design: Collaborative Reconstructing Historical Sheffield," *Proc. of the ACADIA'99*, pp. 116-127.



## The System

The initial screen of the IPS consists of a Web form into which the user types width, depth and height dimensions for the space where the office furniture will be placed (Figure 5.2). Upon completion of the form and sending it to the server, the system creates a three-dimensional space in VRML format (Figure 5.3). The VRML space on the right side and a tabbed menu containing the thumbnail pictures of a catalogue of office furniture on the left side of the screen are displayed.

**INTERACTIVE PRODUCT  
I.P.S. Selector**

**ENTER ROOM MEASUREMENTS**

COORDINATE X: width

COORDINATE Y: depth

COORDINATE Z: height

(all dimensions in meters)

3D diagram labels: COORDINATE X: WIDTH, COORDINATE Y: DEPTH, COORDINATE Z: HEIGHT

Browser window: INTERACTIVE PRODUCT SELECTOR (I.P.S.) - Microsoft Internet Explorer provided by Superonline  
Address: C:\WINDOWS\Desktop\may2001\IPS\ipform.html  
Taskbar: Start, INTERACTIVE PROD..., My Computer, 12:17 PM

Figure 5.2: Creating an office space in VRML



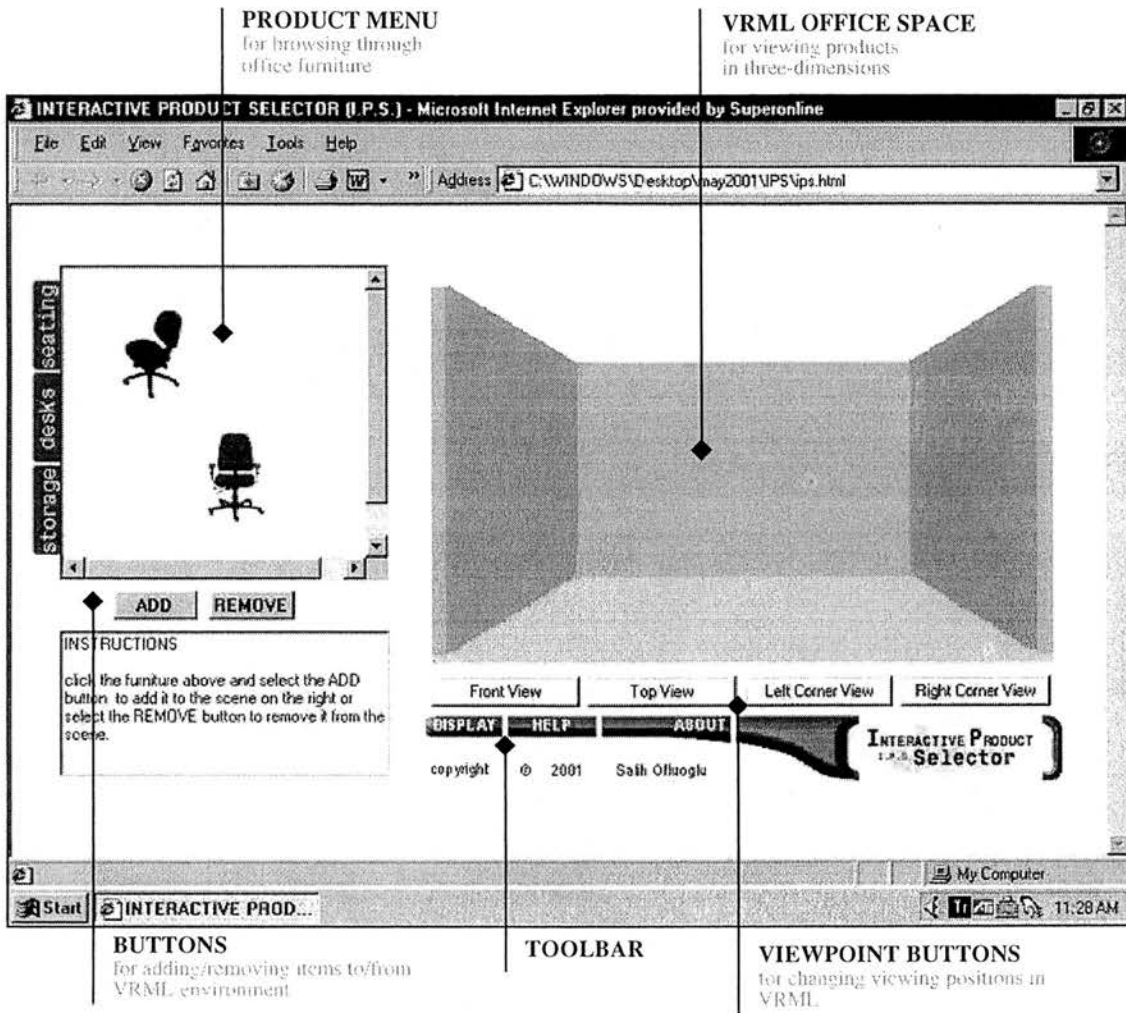


Figure 5.3: The interface of the IPS

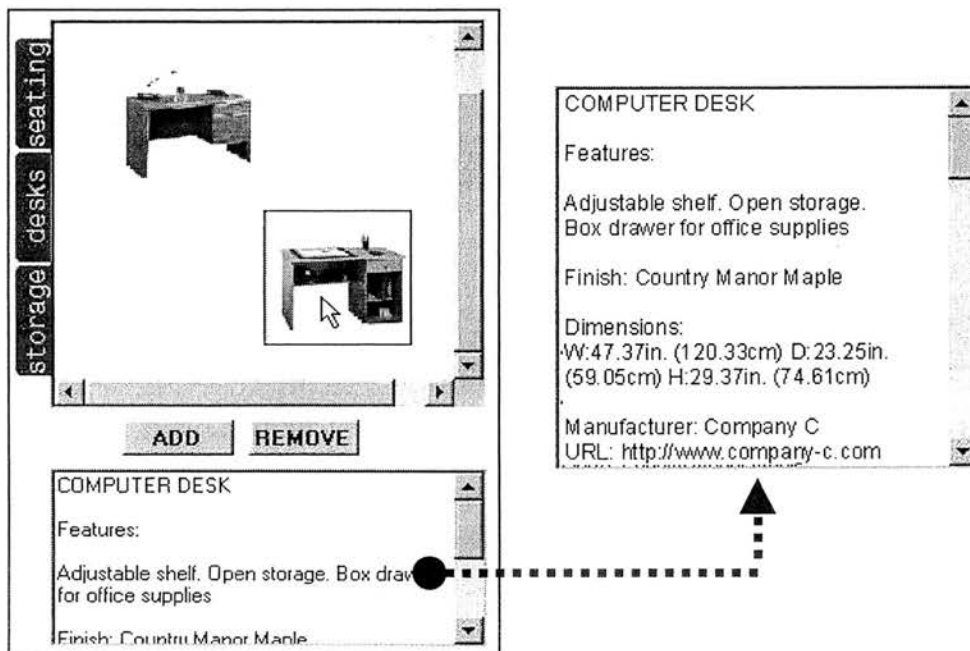


Figure 5.4: The product menu for browsing products in the IPS

The VRML space allows the user to examine the products in three-dimensions from different angles and to test how the products fit in the intended space. Products can be examined in two modes: self-navigated and pre-defined. In the self-navigated mode, the default mode, users explore the VRML environment freely based on their preferences. They decide their navigation speed and viewing angles. In order to that, they use the set of tools provided with the plug-in software (Figure 5.5). In contrast, the pre-defined mode involves the utilisation of viewpoint buttons to examine products in three-dimension. The buttons allow users to view products quickly in four different viewing positions: front, top, left corner and right corner (Figure 5.6 & 5.7). Both self-navigated and pre-defined modes can also be used together. For example, a self-navigating user can use the viewpoint buttons to go back to the position where s/he started the navigation if disoriented.

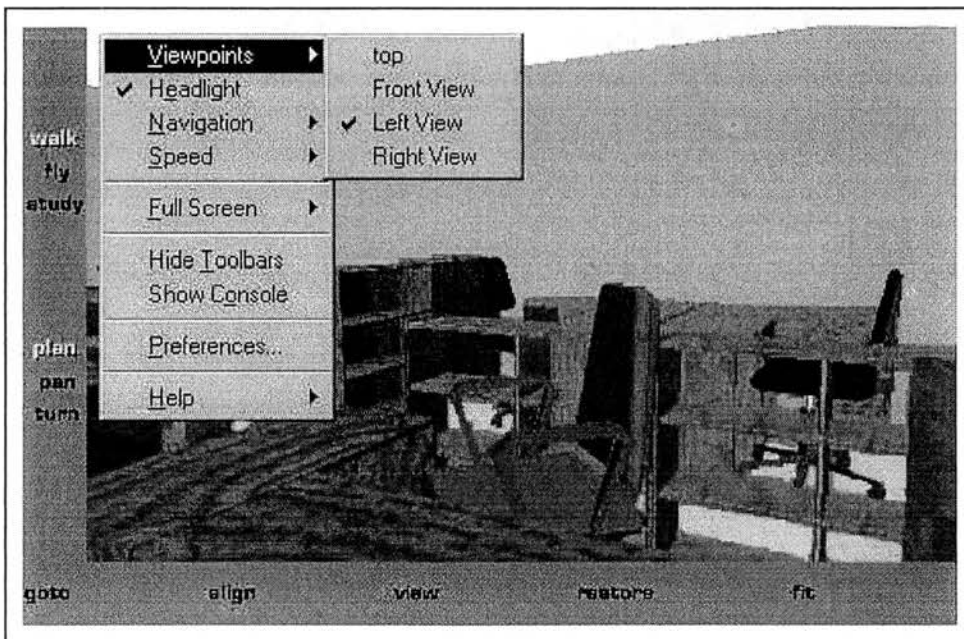


Figure 5.5: Built-in tools provided by the Cortona plug-in software

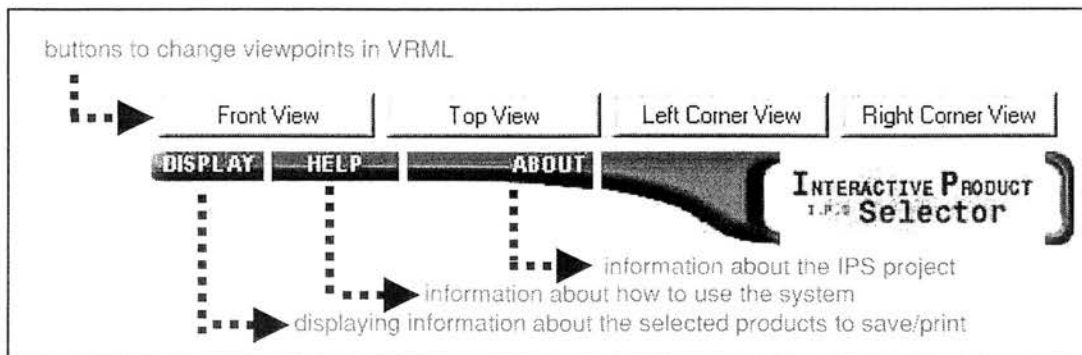


Figure 5.6: The viewpoint buttons and the toolbar

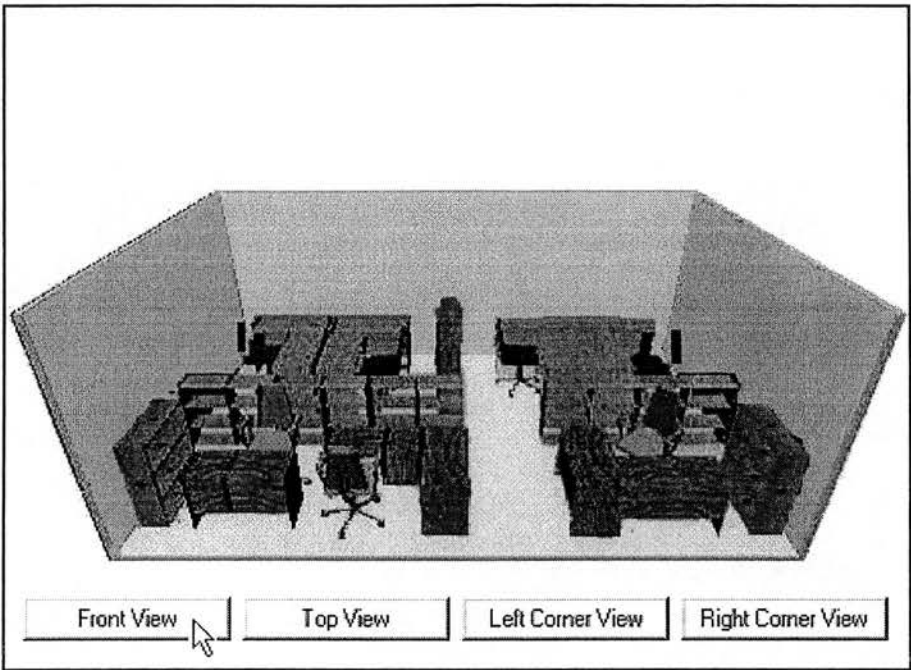


Figure 5.7a: Changing the viewing position in the pre-defined mode:  
Front View

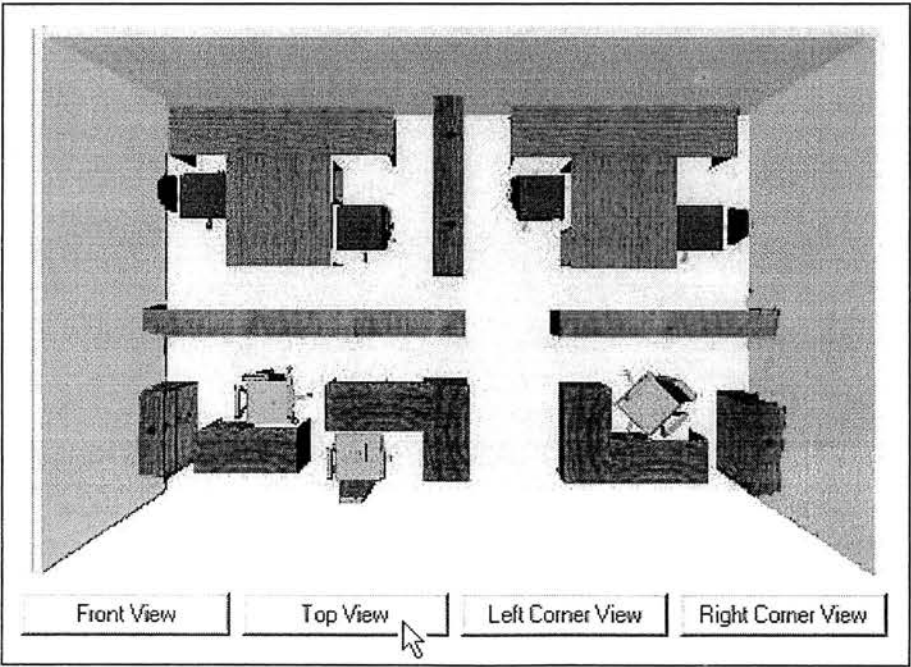


Figure 5.7b: Changing the viewing position in the pre-defined mode:  
Top View

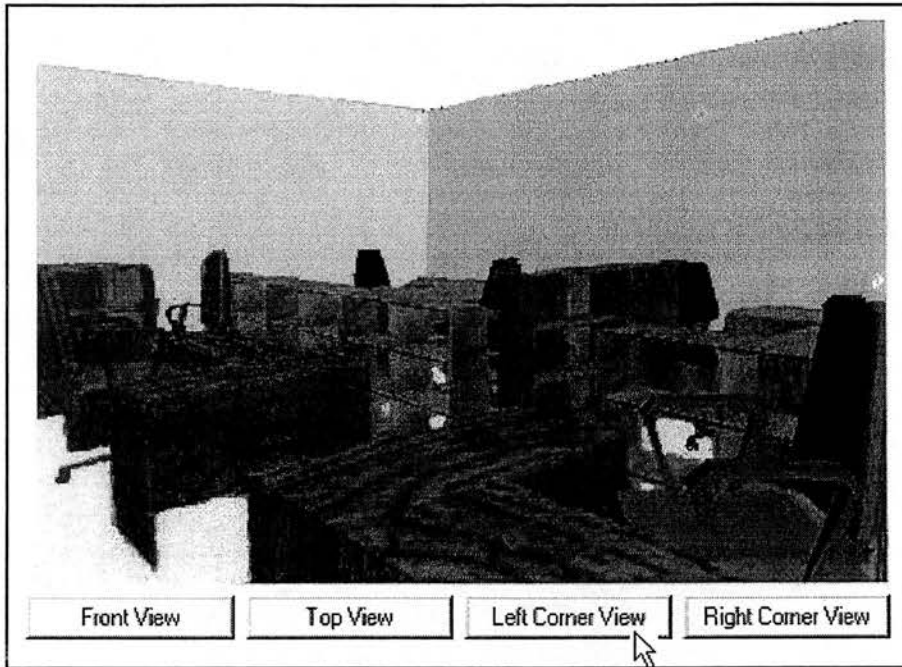


Figure 5.7c: Changing the viewing position in the pre-defined mode:  
Left Corner View

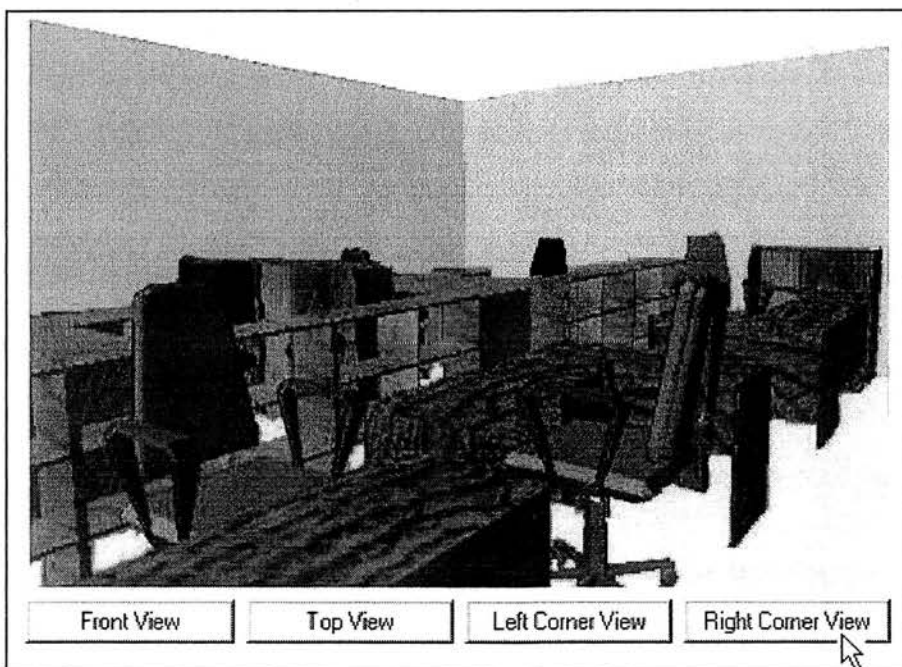


Figure 5.7d: Changing the viewing position in the pre-defined mode:  
Right Corner View

In order to add a product to the VRML area, it needs to be selected. As explained, a product can be selected by clicking its picture. A square border appears around the selected furniture item, and then the item can be added to the VRML space on the right by clicking the "add" button. The user can insert more than one product into the VRML space and compare them with each other. Inserted products can also be removed from the screen by following the same procedure, however, this time by clicking the "remove" button (Figure 5.8).

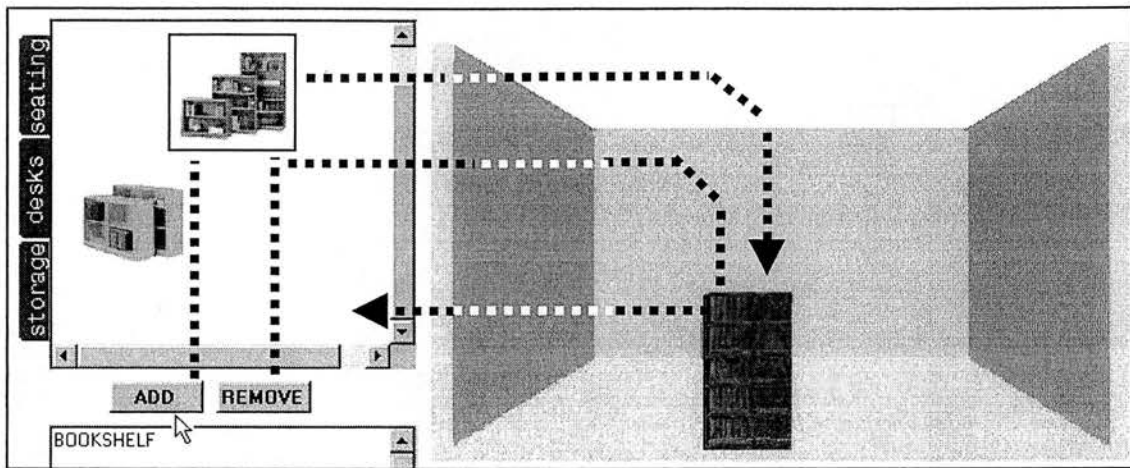


Figure 5.8: Adding/Removing a product to/from the VRML area

The IPS differs from other systems in offering a greater degree of interactivity. The presentation of office furniture products is designed to support a number of different interactions, such as moving objects. All products can be dragged<sup>19</sup> around the VRML office space and placed in various arrangements. Other types of interactions were also investigated. These interactions, which will be explained below, were particularly useful for depicting various features of products explicitly.

Chair models in the IPS support a range of different interactions (Figure 5.9). By clicking on the hot spots on a chair object, which are identified by the cursor changing shape on roll over, one can adjust the seat height, back height and back position of a chair (1). In the case of the chair with arm support, the chair can swivel when clicked on its arms (2). The default fabric colour for the chair can also be changed by clicking on the seating area. This opens a pop-up menu where the user can

<sup>19</sup> Dragging means clicking on an item and moving it around while holding down the mouse button.

select a different fabric colour by clicking a relevant button (3). The hot spots can be identified by the change of the cursor shape.

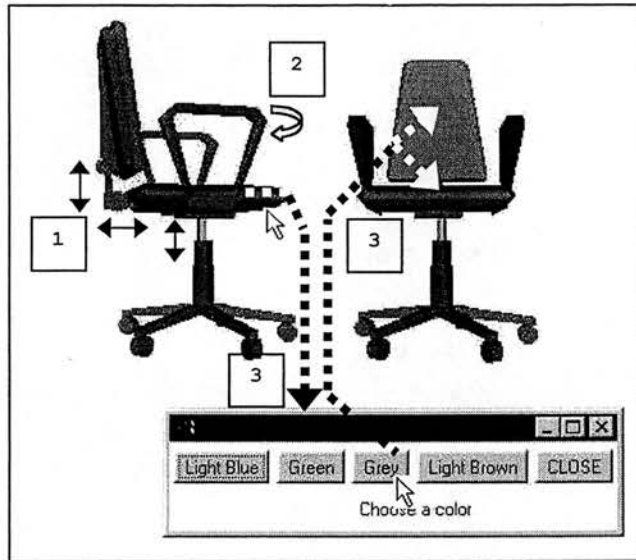


Figure 5.9: The interactions embedded in the chair object

Desks incorporate various interesting interactions too (Figure 5.10). Desk drawers can be opened and closed by clicking on the knob and dragging it forward or backward (1). Both desks can be rotated around themselves by clicking the areas illustrated below (2) and holding down the left mouse button. In one of the desks it is also possible to change the position of the adjustable shelf by dragging it upwards (3).

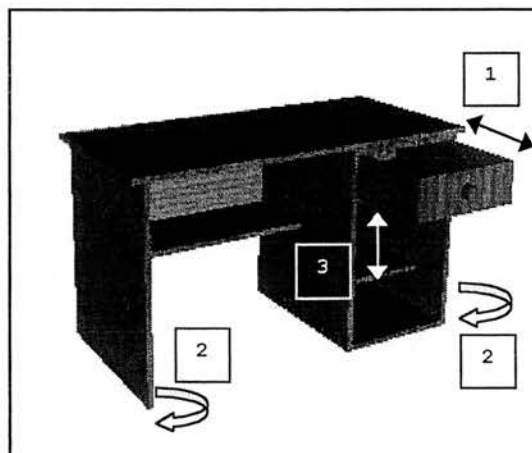


Figure 5.10: The interactions embedded in the desk object



Bookcases contain relatively less interactions than those described above (Figure 5.11). The idea examined here was to incorporate different product configurations in one object. For example, the VRML bookcase model illustrated below was created to include three different sizes within the one model: 2 shelves, 3 shelves and 5 shelves. By clicking the hot spots in the middle shelves (1) one can see different shelf options for the same product. This enables users to quickly view the configurations for the same line of products. Like desks, bookcases can also be rotated by clicking on the base of the unit (2) and holding down the mouse button.

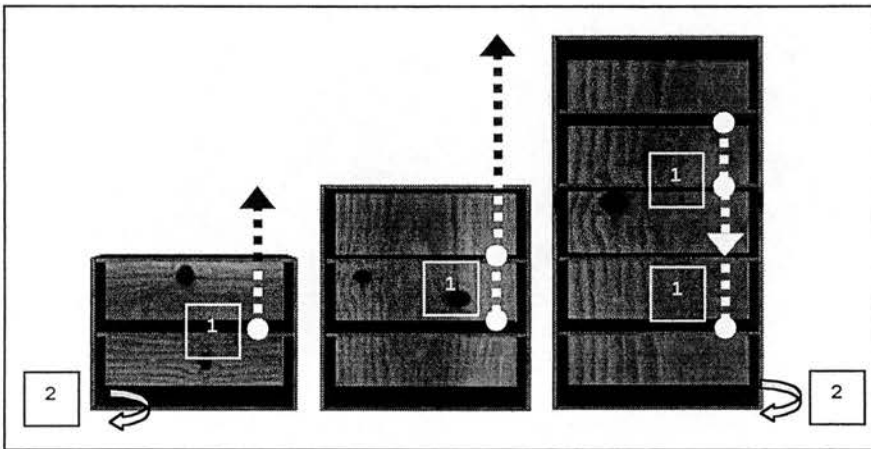


Figure 5.11: The interactions embedded in the bookcase object

Finally, if the user is satisfied with his/her selections, s/he can click the "display" button in the toolbar to display the description of the selected items on the screen. The pop-up window lists various items of information about the selected products, the URL of the manufacturers' web site along with the address of the supplier (Figure 5.12). This information can then be printed or saved.



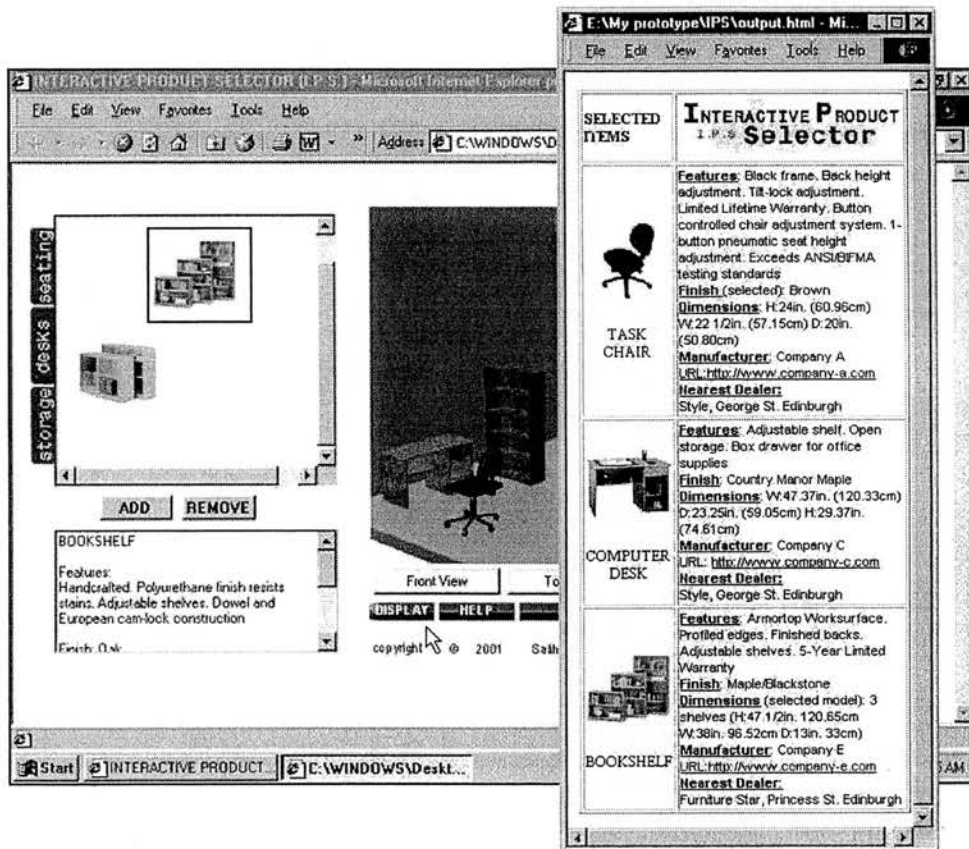


Figure 5.12: Displaying information about the selected products

## Implementation

The prototype was developed using a combination of different Web-based interactive technologies, namely, CGI/Perl, JavaScript, Java and VRML (Figure 5.13). Here is a brief discussion of these technologies and how they are applied in the prototype.

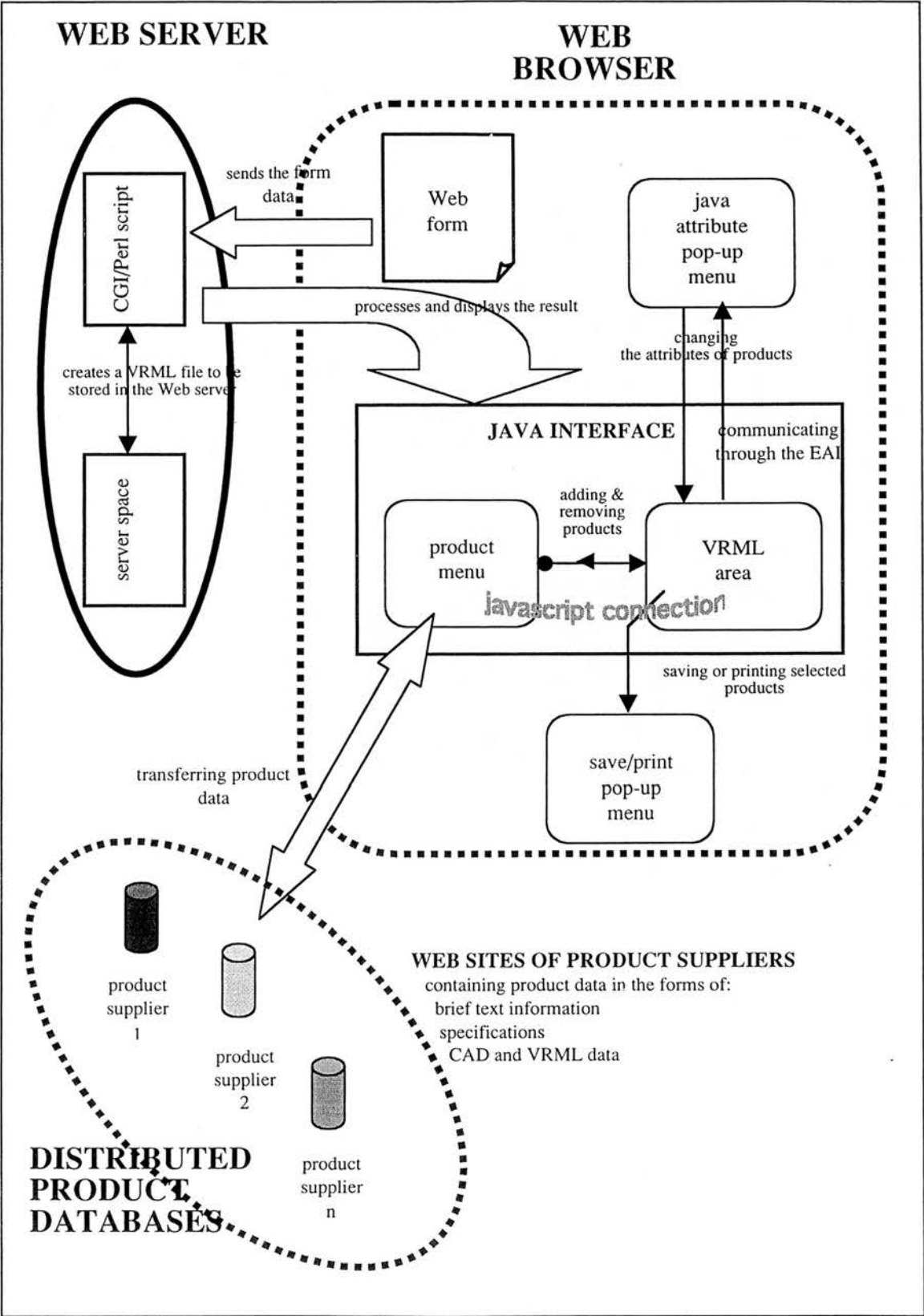


Figure 5.13: The working diagram of the system

CGI/Perl and JavaScript technologies were used in creating the web form in which the user types the dimensions of the furniture space. CGI, the Common Gateway Interface, is a set of standards that enable Web servers to communicate and execute external programs. CGI scripting is a way of writing scripts or small programs that adheres with the CGI standard. Many sites use CGI scripting to create dynamic and interactive content. Some of the common application areas for CGI scripting are Web forms, search engines, shopping carts, bulletin boards, guestbooks and chat rooms. The majority of CGI scripts are written in Perl (the Practical Extraction and Report Language), which is an interpreted language, due to its flexibility, ease of use and powerful text handling capabilities. The CGI/Perl script in the IPS accepts the form data that contains the dimensions of the space, creates a VRML file from this data and stores it in the server.

JavaScript, the other component of the Web form, is an object-oriented scripting language that is generally used to make Web pages interactive and to give the Web developer more control over Web page design with minimal programming effort. JavaScripts are often embedded in dynamic Web pages that respond to user events such as mouse clicks and data entry in forms<sup>20</sup>. Most Web browsers have built-in interpreters for JavaScripts. In contrast to CGI scripts that run on the server side, JavaScripts operate on the client's side, which is the browser. As a result, they provide faster responses. In the IPS, the JavaScript is used to validate the Web form data before the CGI/Perl script accepts the input and sends it to the server. The advantage of this approach is that, since, the process takes place on the client side, a possible typing errors on the form can be detected quickly without waiting for the response of the server. JavaScript in the IPS also allows the Java applet, the system interface file, to communicate with the other elements in the browser, which is the VRML file in this case.

Java, which is another technology used in the construction of the IPS, is an object-oriented programming language that can be used both for creating stand-alone applications and more commonly for creating applets, which are small programs incorporated into Web pages. One of the most significant aspects of Java is that it is a

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<sup>20</sup> Lemay, *Laura Lemay's Web Workshop: JavaScript*.

platform independent programming language. This means that a Java program written once can be used in different types of systems, hence saving time and programming effort. The platform independency in Java lies with the fact that Java is both a compiled and interpreted language. In Java, source code is compiled into a platform-independent intermediary format called bytecode, which is a platform independent code consisting of sets of instructions<sup>21</sup>. The downloaded applications on the Web are in bytecodes. The bytecodes, then, need to be interpreted for the specific machine language and processor instructions of the client's system<sup>22</sup>. The interpreter used for this purpose is called a Virtual Machine, which is available for different hardware and software platforms and is built into most browsers. In developing the IPS, Java is used in designing the product menu and viewpoint buttons. Java was also utilised as an external programming language to communicate with the VRML scene.

VRML is a modelling language for publishing and distributing three-dimensional data on the Web. VRML files are often created in a VRML "builder" or geometric modelling software and are viewed via VRML browser plug-ins, which are generally available as freeware. As its name suggests, VRML is closely connected to the concept of Virtual Reality (VR)<sup>23</sup>. It is a networked VR technology claimed to be the foundation technology for the growing number of on-line virtual communities<sup>24</sup> and spatially immersive communication environments (cyberspace). However, unlike other full-blown VR technologies that require special devices such as a head-mounted display and digital gloves, VRML only needs a computer screen and a mouse to operate. Hence, it is much more widely supported. In the case of the IPS, VRML is used to display office furniture and office spaces in three-dimensions on the Web. Perhaps, one of the most powerful features of VRML is that it puts the user in control. The user can self-navigate, explore and interact with three-dimensional models at his/her own pace rather than in a predefined manner. For more improved interactivity, VRML has the ability to communicate with external programming languages. This is achieved through the External Authoring Interface (EAI). Programming and scripting

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<sup>21</sup> Norton, *Peter Norton's Guide to Java Programming*.

<sup>22</sup> Breedlove et al., *Web Programming Unleashed*.

<sup>23</sup> Matsuba and Roehl, *Special Edition: Using VRML*.

<sup>24</sup> Carey and Bell, *The Annotated VRML 2.0 Reference Manual*.

languages work in the Script node of VRML. They can access fields, manipulate values of fields and return results to parameters that affect VRML models. They are used to assign some unique characteristics and behaviours to VRML objects. As mentioned previously, the IPS utilises Java as its external programming language.

The IPS is based on the distributed database approach, which means the most of the product data will reside in building product manufacturers' own sites and the system will access this information remotely. Although the user feels as if s/he obtains all the product information from the prototype, the actual information comes from the manufacturers' sites. This approach enables manufacturers to have control over their data and helps the IPS offer the most-up-to-date information with minimal data maintenance. It is proposed that manufacturers keep CAD and VRML models, specifications and other textual information about products at their own sites. The interactive features such as changing product attributes that require programming knowledge are specified by product manufacturers and may be designed by the IPS staff.

It should be noted that there are challenges to presenting such graphic-intensive content on the Web. VRML files generally make use of considerable network resources and require longer downloading times than average Web pages. Additionally, for smooth VRML experiences there is a need for computers with fast processor speeds and large memories. Lower-powered computers offer slower rendering speed, hence less convincing displays. To overcome this problem some sites use compression methods such as gzip. In addition, some work is being undertaken to offer a binary file format that will offer a higher compression ratio than existing methods in the future versions of VRML<sup>25</sup>. There are also evolving three-dimensional technologies such as Java3D and X3D that are supposed to make the presentation of three-dimensional content on the Web faster and more efficient than existing methods.

However, at the moment, when providing graphically intensive files, it is essential to establish a reasonable balance between high quality, a photo-realistic

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<sup>25</sup> Carey and Bell, *The Annotated VRML 2.0 Reference Manual*.

VRML environment that is slow to download and a less realistic, but faster downloadable VRML environment. In this research, the general tendency has been to choose the second option due to the bandwidth limitations of the Web.

### **Practice Simulation**

User testing in a simulated practice scenario was conducted to obtain feedback on the use of the IPS. This phase was particularly important for being an extension of the survey investigation addressing new issues beyond the ones raised in the survey. The testing allowed further examination the effectiveness of an interactive Web environment like the IPS, identifying possible problems with it and seeking ways to improve the system.

The testing was performed on 7 May 2001 in Istanbul, Turkey where the final stages of this research project took place. Experimenters were selected by posting a call for interest in the Computer-Aided Architectural Department at Yıldız Technical University, one of the leading architecture schools in Turkey. Only postgraduate students with work experience in architectural firms and basic knowledge of the Internet were invited to participate.

Three people applied to take part in the study. All of the applicants were Internet literate, spending approximately 13-20 hours a week on the Net. They generally use the Internet to search for information, to stay up-to-date and to communicate. All of the experimenters also mentioned that searching for building product information was one of the reasons why they used the Internet. Two also said that they previously visited various VRML sites on the Web.

An individual session was conducted with each practitioner to reduce any possible influences between them. Sessions took approximately 30-40 minutes to complete. The testing was conducted on a Pentium III 600 Mhz computer with 128 MB of RAM, 20GB of hard disk and a screen resolution of 800x600 dpi True Colour (32 bit), the standard resolution supported by the majority of sites on the Web. Internet connection was supplied through a 56K modem that provides a typical connection speed deployed in many small to middle-size firms as of mid-2001.



The IPS site was placed on the Web server of one of the Internet service providers in Turkey. In order to reflect a real world distributed Web environment scenario, VRML product models associated with the system were distributed at six different Web locations, each acting like a different product manufacturer's web site. For this purpose, mostly free or promotional Web sites like Geocities, Tripod and their Turkish equivalents were used.

The VRML files were intentionally kept small to allow for fast data transfer. The largest of the product VRML models was only 37.3KB. Consequently, the downloading time was quite satisfactory owing to the small file sizes. The file transfer speed varied from one file to another depending on the size of the file and location of the Web site. The fastest downloading file was a 20KB model from a Turkish web site taking 3 seconds to download. The slowest one was the 37.3 KB file from a Geocities site taking 10 seconds to download. Of course, the connection time of the day, which took place between 3:00pm-5:00pm, might have had an effect on the downloading times. None of the experimenters complained about the downloading time.

After a brief introduction to the IPS and an explanation of how it works, the practitioners were invited to try out the system for themselves in the context of having to select furniture for a simple office design. Then they were asked questions about the various aspects of the IPS<sup>26</sup> and requested to state any additional comments they might have.

First, practitioners were asked whether there was a difference between the IPS and other products sites. A common response was that the IPS is more interactive than other sites, and unlike many sites relying solely on bitmap product images, product information is provided in three-dimension in the IPS. One said: "It is a general tendency to provide visual information about products through bitmap images. In such sites, there isn't as much interactivity as it is provided in the IPS. You cannot open a drawer, increase the number of shelves and see products from various angles. You have to compare products based on static images. In contrast to the IPS, these sites

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<sup>26</sup> See Appendix C for the questions asked in the user testing.



force you to visualise the products in your mind.” Another said: “The system is a good example showing how a real world product selecting experience can be computerised. The system is a small replica of a physical product showroom. You can see and try out almost all the features associated with an item of furniture as you do in real places. It is even quicker to do so in this system.”

In a leading question asking which features of the system were particularly useful, one practitioner stated: “In addition to other things, I liked to be able to print out or save the products that I picked. When this feature fully works, it will be one of the important features of the system. It will enable you to get something concrete out of the on-line experience you had.” Another mentioned: “It was nice to be able to compare the scale of furniture with the office space intended. It is very helpful to work in a customised office environment. You examine whether products are suitable for the space as if you try them out in your own office.”

In two separate questions practitioners were asked whether interactivity and three-dimensional models are important in presenting product information. They believed that such issues are significant in better representing products and incorporating users in product selection, hence increasing the success of product selections. One said: “I think interactivity is very important. It helps one have a control over the outcome. It seems to me that it is even more important in such a case as buying items like furniture that you don’t buy very often.” Another pointed out: “Interactive sites apply more to the needs of users than other sites. Users are actively involved in the product selection process and personalise products based on their needs. If a consumer cannot go to a store for shopping, s/he can have the second best option using interactive sites.” As for three-dimensional product presentations, one practitioner stated: “They are very important in order to perceive products more accurately. Generally, three-dimensional presentations are more meaningful and understandable than those in two-dimension.”

The next question was about the usability and interface of the system. The experimenters were asked whether it was easy to use the system. They generally agreed that the system was easy to use. One experimenter said: “It seems that the interface is very clear. It tells you what to do. You have the variables on the left side

of the screen and an area on right side where products are displayed in three-dimensions.” Another said: “The system is easy-to-use. Perhaps, it could be further improved if it supports the right-click method. It would be effective to obtain additional product information when you right click on a product in the VRML area.” Finally, the last one said: “I like the fact that the system is very visual. It is good for architects or designers who I suppose will be the main users of the system. I don’t need to spend too much time reading text information. However, it might be difficult for others with different background. A more detailed instruction screen would be useful.”

In their final comments the practitioners raised some valuable suggestions: One said: “I think in addition to its value as a product selection tool, the system has some qualities that make it suitable as a design tool. For example, design firms, particularly interior design firms, can use it as a sketching tool to design an office space and try out new products within it. The tool can also be used to make presentations to clients.” Another stated: “The site is an educating tool other than being an electronic commerce environment. It allows experimentations with products and enables you to learn about various qualities of products through a user-friendly and visual interface, without the sales pressure.”

Practitioners made various suggestions for improving the system. These suggestions are incorporated into the following section.

### **Problem Areas and Future Developments to the System**

Various theoretical and technical problems in addition to improvements with the IPS are listed below. The list contains some of the primary features that would make the system more effective.

1. The system, at the moment, only supports square or rectangular plans. The current Web form interface may need to be changed to offer support for more complex plan types. This issue was also brought to light by one of the experimenters. Perhaps this can be achieved by a grid-based drawing interface like those offered in CAD systems. In this way, users can produce their plans

by drawing directly on gridded canvas instead of entering values into boxes. There are examples of such environments on the Internet. Java is often used for this purpose. Of course, another option is to allow users to upload their own VRML plans to the system.

2. Another related problem is that currently the IPS does not support the definition of wall openings such as doors and windows for designated spaces. It is important to have this capability to create more useful and convincing, hence compelling, VRML environments.
3. For future versions of the system, offering two interface choices is being reviewed: user-specified and pre-defined. The user-specified option is the approach used in the current version of the system in which users themselves create the environment where products are displayed. In contrast to that, the pre-defined VRML interface suggests a showroom environment resembling those of leading UK furniture retailers such as IKEA or Habitat in which a number of products from different manufacturers are presented in the same physical environment. Such an environment can stimulate new ideas and help consumers in selecting a set of products that might go together well. However, this type of interface also raises several concerns having to do with navigational problems in large VRML spaces, difficulty in examining products in isolation, and uncertainty as to how selected products fit in their designated spaces as opposed to a showroom.
4. Currently, users can see different attributes of products such as colour and size variation by clicking on them or through pop-up windows. In the next version of the IPS, the same functionality would be provided for the components including walls, floors, doors and windows that comprise the office space. In this way, users would be able to see and experiment with different wall and floor finishes that would suit the furniture they selected.
5. The current version of the IPS incorporates a small number of products. For this reason, a tabbed menu was deemed sufficient to locate and select products. However, in the future, it would be essential to supplement the

tabbed menu with a search engine especially when more products are added to the system. The search engine issue was also mentioned by two practitioners. The engine should enable a range of search options based on manufacturer names, product names, keywords, product locations and even classification system codes like those used in MasterFormat, CI/SfB and UniClass. It is a common practice to develop search engines in CGI/Perl.

6. An important issue that might influence the usability of the system is the way the “remove” button is used. One practitioner complained about the difficulty of removing a product from the VRML scene. For the moment, this is achieved by locating the product in the tabbed menu, clicking it and pressing the “remove” button. This seems to be a cumbersome process. Perhaps, it would be easier to remove an item directly in the VRML scene. One way of achieving this is through a pop-up window that would be accessible by double clicking (or right mouse button): It could offer an option to remove the clicked item. An alternative option, and perhaps a better one, to remove and even add a product to the VRML scene is by dragging and dropping. However, both double/right mouse button clicking and a dragging/dropping feature are difficult to achieve in VRML and EAI.
7. Displaying information about the products inserted into the VRML area needs improvement. Currently, the Java applet that was designed to extract the product data on the VRML space causes instability and occasional crashes with the system. The source of the problem is being investigated. One should note that this feature was deactivated during the user testing of the system.
8. There are also issues to do with interactions incorporated into the IPS. In the current version, when two or more interactions are added to the same object, two interactions occur at the same time. For example, when clicked to drag a chair on the screen, clicking also results in opening up a pop-up window with fabric options listed for the clicked product. One way to solve this problem would be to differentiate interactions from each other by the number of mouse clicks. For instance, one click can be used for dragging the object on the screen and two clicks for opening up a pop-up window. However, the same

problems having to do with VRML's insufficient support for multiple mouse clicking (as explained above) applies here too.

9. Another interaction related issue highlighted by two practitioners was the lack of information about the type of interactions available. Possible interactions are typically illustrated in VRML by a change of pointer style. However, this by itself does not provide sufficient clues about what a user is supposed to do with an interaction. In other words, the user would not know whether s/he is supposed to drag, rotate or move objects. Some sort of contextual help would assist users to know how they can explore products. It would also be good to provide a single line of text that only appears when a user moves his/her mouse over an interaction and that prompts a user to the next action.
10. The IPS deals mainly with visual aspects of products. However, products also possess tactile qualities such as weight, movement and sound that, from time to time, can be critical in making product related decisions. Ideally, the IPS should be improved to provide support for tactile product information. However, one should note that tactile information is often obtained in real environments by physically touching and observing actual products. It is generally more difficult to represent than visual information, and may require the use of additional computer peripherals like those used in VR simulations.
11. Another significant issue has to do with the compatibility of product colours and textures that appear on the screen with those in real environments. This issue was mentioned by one of the experimenters as well: "When I use a system like this on the Internet one thing that I would want to make sure would be how closely products resemble their real counterparts. Due to the low resolutions of monitors, some of the visual attributes of products can be misleading. In addition to that, the graphic qualities of VRML models are not generally very satisfactory. The reason for this is the need for a compromise between downloading times and the graphic quality of VRML models. VRML files are often intentionally kept small to improve downloading times as a result of low bandwidth problems associated with the Internet. The practitioner above suggested that, to deal with this problem, it would be useful

to have a larger picture of products in the pop-up window to compare the selected product with the VRML model of the same product.

12. Other product information such as CAD data and detailed product specifications can also be useful for building professionals, and the future versions of the IPS should address this issue.
13. The future versions of the IPS might incorporate an additional module that will allow users to communicate directly with product suppliers for pricing and/or ordering.
14. Adding on-line reviews of products and discussion forums to the IPS, as in existing retail environments such as Amazon.com can also be helpful. The survey questionnaire provides a demonstration of the potential of such interaction.

Various technical solutions to the issues listed here are available, and need to be examined carefully. However, it should also be noted that the current version of VRML or EAI functionality is not sufficient to tackle all of the issues highlighted in this section.



## CHAPTER 6: CONCLUSION

This thesis treated building products as essential elements in design and construction. As explained, for the success of a building it is critical to make accurate building product selections. For various reasons such as increasing variety and complexity of products, and changing behaviours of consumers, product selection is no longer a simple task. Any research endeavour that aids building product selection will be valuable for architects and other building professionals.

In view of the above, this thesis has proposed a new method for presenting building product information on the Web. The proposed method utilises the interactive features of the Web and enables mainly architects and other building professionals to make more-informed product decisions. The issues discussed throughout the thesis were demonstrated through a prototype called an Interactive Product Selector (IPS). The IPS serves as a decision support system. The system facilitates the comparison of different building products and relies on the three-dimensional and interactive presentation of building products.

The success and effective use of the proposed system above all is dependent on the Internet itself. There is a need for higher bandwidths that will increase the flow of information and enhance the visual quality of on-line materials. In addition, in order for such systems to work well, it is important that all the individual technologies making up the system are robust, widely accessible and platform independent. Additionally, the success of any system is also dependent on the degree of co-operation between the parties involved in it. To name just a few, it is necessary that product manufacturers and the information broker who maintains the system communicate and co-operate well with each other.



In a broader context, in focusing on the specific problem of product information, this research contributes to a greater understanding of the relationship between design and information, particularly electronic information. The research also incorporates such important issues as: ways of accessing, sorting, browsing, editing and selecting information; challenges presented by the emerging and changing medium of the WWW; coping with the information explosion and increasing media options; e-commerce and distributed practice.

Here is a brief description of the topics presented in the thesis chapter:

Chapter 1 examined the commercial developments on the Web and gave examples from various e-commerce practices on the Web. The chapter introduced building product sector as an area where e-commerce was implemented most successfully in architecture and building. It explained the characteristics of the Web that make it a very suitable environment for disseminating building product information. This chapter also contained an overview of the study area including the problem statement, research objectives, methodology and related studies.

Chapter 2 investigated the importance of the selection of building products in design and construction. The chapter examined existing building product information media and highlighted strengths and shortcomings of different media with a special emphasis given to electronic product information. The relationship between Computer-Aided Design and building product information was also presented in this chapter.

Chapter 3 examined the World Wide Web's promising value in marketing building products and disseminating product information. The chapter presented some basics about the Web, such as how it works, what are its major usage areas, why the Web is a unique medium and which strengths and weaknesses the medium possesses. Chapter 3 also talked about the role of the Internet in architecture and how the Internet is affecting the design of new CAD systems. This chapter finally examined interactivity as one of most important aspects of the Web.

Chapter 4 presented the survey, which is the main method of data collection in this study. The chapter explained the survey methodology and talked about the survey questionnaire, the sample and previous surveys in the research area. The interactive aspects of the survey and a general overview of Internet surveys were also among the issues examined in the chapter. This chapter finally presented the aggregated survey results along with statistical descriptions and illustrations.

Chapter 5 included the Interactive Product Selector (IPS), a prototypic web tool for selecting building products. The chapter explained how the prototype works, how it can assist architects and other building professionals, and it described the technologies and tools deployed in developing the prototype. This chapter also included a section on the user testing of the IPS.

### **Current Problems and Predictions**

In spite of its increasing use, the Web is just one of several media to disseminate building product information, which includes trade journals, CD-ROMs, hard copy catalogues, design display centres and precedents of products in-situ. The Web co-exists with these media. Although the Web makes a significant contribution to decision making related to building products, there will still be a need to visit building display centres and trade shows to physically examine the products, to talk to product experts and sales people face-to-face and to view high resolution pictures from brochures. As one of the survey respondents said: "Nothing tends to be totally replaced. I mean, we'll never get rid of the hard copy commercial library... Although the library is half the size it was two years ago and it will probably shrink further, I don't think it will ever disappear. There will always be some things that you need the physical library or CD-ROM databases for. Most architects use a whole series of different ways of finding things and would be unlikely to throw them away and stick to one. You always need more than one route to find and look at things."

It appears that each product medium has its own semantic qualities and assists in product selection in its own special way. It would be unrealistic to expect one product medium to exhibit all the qualities of all the others. The Web is certainly far from becoming that, and it is questionable whether it will ever reach that point. For this reason, it seems that, currently, it is best to deploy the Web in a way that complements other product media and enhances their value.

This type of hybrid use has many implications, and there are precedents. For example, trade journals and hardcopy catalogues offer pointers to product related information on the suppliers' Web sites. This information generally serves as the direct contact point for interested parties to obtain the latest and most detailed product information. In addition, since the proliferation of the Web among building professionals we have been observing a considerable reduction in the size and information content of product ads. Product suppliers use smaller ads as pointers to Web sites where they provide comprehensive information about their products and services<sup>1</sup>.

It is also a common practice to use product information on CD-ROMs in conjunction with Web sites that provide up-to-date information, and overcome the bandwidth limitations associated with the Internet. For example, information requiring higher downloading times can be provided in CD-ROMs, while the most up-to-date information can be accessible from the Web. Some companies are already taking advantage of this approach. One of which, Euclid Chemical Company<sup>2</sup>, a manufacturer of concrete repair products, sealing compounds and coatings, offers a CD-ROM that contains graphically intensive data such as movie files, slide shows, graphs and diagrams, and also maintains a Web site that complements the CD-ROM by providing changing product information.

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<sup>1</sup> Grandziel, "Web Site Leads: A Step to Sales," *Construction Marketing Today*.

<sup>2</sup> <http://www.euclidchemical.com>

Building trade shows and display centres that rely on personal contact and the exhibition of materials in a physical environment also use the Web to promote their events to a larger audience. Now, visitors to trade shows and building centres can visit relevant Web sites to learn more about participating manufacturers and suppliers, to shortlist the products they are interested in, and even to get an exhibition map to efficiently organise their time during their visits. For an example of such a site, visit <http://www.nationalhardwareshow.com>.

To a great extent, this study also supports the need for a hybrid solution. The IPS is best when used in conjunction with showrooms of manufacturers, building display centres and trade shows where a wide range of different products can be viewed physically. Although the IPS intends to simulate actual products in context, it is still extremely important to see and touch the products in their material form. One critical assistance the IPS offers in selecting building products is to narrow down the choices of products that one has to examine when visiting a product centre. In this way, a practitioner focuses on a few products instead of dozens, and as a result, makes a more informed decision. The system also extends the working hours of physical product sites, as it can be accessible twenty-four hours a day.

As mentioned several times, one of the great challenges of offering VR computer environments for building product information is the bandwidth limitation of the Web. These environments are typically graphic intensive, composed of high-resolution images, multimedia and VRML data. Graphic intensive data demand high bandwidths, hence causing longer downloading times. Unfortunately, currently, broadband communication is not yet widely available to the commercial sector. No doubt this is a great concern for suppliers and on-line catalogue providers when designing their sites. One way of dealing with this, at the moment, is to use low-resolution graphic data. This solution, however, makes compromises in the quality of graphic data, creating, for example, unrealistic, jerky VRML sites. Another way of overcoming the bandwidth problem is to offer hybrid media solutions by combining CD-ROM and the Web as explained above.

It is important to point out at this time that new three-dimensional file formats such as Java3D and X3D, which will be less demanding on Web system resources, are also evolving. These new file formats will be comprised of highly compressed data, resulting in smaller file sizes and faster download times. It is imminent that these evolving formats will replace existing three-dimensional technologies such as VRML. Future research is needed to address what effects these new three-dimensional formats will have on the presentation of building product information and whether these formats will offer solutions to the problems associated with building product sites we are experiencing today.

One of the problems with three-dimensional and multimedia technologies on the Web is the necessity for downloading and installing plug-in software to be able to view data created in these technologies. Several survey respondents also complained that downloading and installing the plug-ins were one of the most disliked aspects of viewing three-dimensional, CAD and multimedia data on the Web. Although Microsoft Explorer and Netscape Communicator offer built-in or installation support for some of these technologies, the support is usually limited and generally available in the CD-ROM version of the software.

As explained briefly in Chapter 2, one of the fast developing technologies that will make a significant impact on building product information is object-oriented technology. As examined earlier, increasingly CAD software relies on object-oriented technologies in offering building product data. The new generation of standards and activities such as STEP and IAI's IFCs are emerging to support the adoption of object-oriented technology. The new object-based CAD software technologies are capable of producing intelligent product models that can be incorporated into drawings. These product models act very much like 'live' objects having behaviours and rules. They can communicate with designers and other objects in drawings<sup>3</sup>. They can even have original design intent, requirements and legislative rules embedded in them. For example, on violation of their original intention, they can react and prompt users to take an action. It will also be possible to swap various

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<sup>3</sup> Augenbroe, "Building Product Information Technology," *Executive Whitepaper*.

models from different vendors to determine the product serving best to meet the goals of a project<sup>4</sup>. It is expected that in the near future, we will see commercial activities from software vendors, product manufacturers and information brokers in this area.

Having talked about standards, it would be appropriate to mention one of the emerging standards for publishing and/or exchanging information, particularly business information, on the Web called the Extensible Mark-up Language or XML. It is quite likely that XML will make a great impact on building product information. XML is a cross-platform, software and hardware independent technology for transmitting information. It is a mark-up language consisting of text delimited by tags as in HTML. However, unlike HTML that is only concerned with the display of information, XML deals with defining the meaning and structure of information. It enables other computer tools to find and use that structured information quickly and directly. Many prominent firms including Microsoft, IBM, Oracle, General Motors and General Electric endorse XML and offer compliant proprietary systems. One possible usage of XML with product information would be to embed multiple views in the same product data. This can help in providing information in varying degree of details for different design phases such as schematic design, design development and construction documents. This type of usage would also be valuable in offering different information content for different project participants.

Lastly, mobile computing is another area that seems to have an important potential for building product information. Mobile computing, nowadays, incorporates small, yet powerful handheld devices, such as palmtops and mobile phones accommodating all communication protocols (including SMS<sup>5</sup> and Bluetooth). These truly portable, hand-held devices can download and exchange information with a desktop/notebook computer and even transmit information between each other through infrared (IR) communications and the mobile phone

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<sup>4</sup> Herold, "Strangers Living Under One Roof," *End User Guide to IFC*.

<sup>5</sup> Small Message Services



network. Many software vendors also support these devices. For instance, there are already various software packages for viewing and marking-up CAD drawings and VRML models. A number of hand-held mobile computing devices also support wireless communication protocols such as WAP (Wireless Application Protocol) and GPRS (General Packet Radio Service) to access the Internet. Perhaps, the most important benefit of mobile computing to building product information is improved access to information regardless of location<sup>6</sup>. Equipped with a palmtop with Internet access, a building professional can access the most-up-to-date, on-line product information while on the move and exchange product information with other building professionals and product manufacturers when needed. Another significant contribution of mobile computing to building product information would be an improvement in the quality of work. One can download the needed product information to his/her machine and take it wherever s/he goes. S/he can compare the product in-situ with the products in digital simulation and inspect the work in progress. The capabilities being explored with the IPS are equally applicable to these emerging mobile technologies, though mobile technologies will provide further opportunities and challenges.

### **Challenges and Lessons Learned**

Finally, the main challenge with this study was to keep up with the constantly changing Internet technologies and the possibilities they brought. Learning new technologies was an important part of this study. It would be interesting to illustrate related web technologies that have evolved during the study and how they have shaped the directions of my research.

When this research began in late 1996, CGI/Perl was the prominent technology to create dynamic and interactive content on the Web. During the initial stages of my research, by integrating CGI/Perl and SQL (Sequential Query Language) technologies, I explored the idea of designing a search engine for building products on the Web. The CGI/Perl technology forced me to produce solutions that

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<sup>6</sup> With clients, in the office, on site, at supplier showrooms and at the sites of exemplary installations



would work on Web servers.

Then, Java came into the picture. In early 1997, through my involvement in the PLA(id) research<sup>7</sup> in Department of Architecture, University of Edinburgh, I became aware of the possibilities offered by Java and JavaScript. These technologies provided an opportunity to move some data input, validation and output operations to client software from Web servers. These technologies also offered various possibilities for intuitive user interfaces and interactions.

VRML 1.0 had been around to display three-dimensional models on the Web since 1994, but the proposal of VRML 2.0 in 1997 opened up the possibilities of offering three-dimensional interactive information on-line. This development allowed me to explore interactions on three-dimensional models. However, the enthusiasm with VRML technology ended in early 2000 with the introduction of binary three-dimensional technologies. Few companies have continued to support VRML technology.

During the end of the 1990s, CAD vendors realised the potential of the Web. They updated their products and offered add-on software to publish and view vector-based CAD information on the Web. The new vector-based web formats proved to be much smaller than their traditional equivalents. This development promised the possibility of including much more compact CAD data with other product information. In fact, several on-line catalogues have begun to exploit this idea.

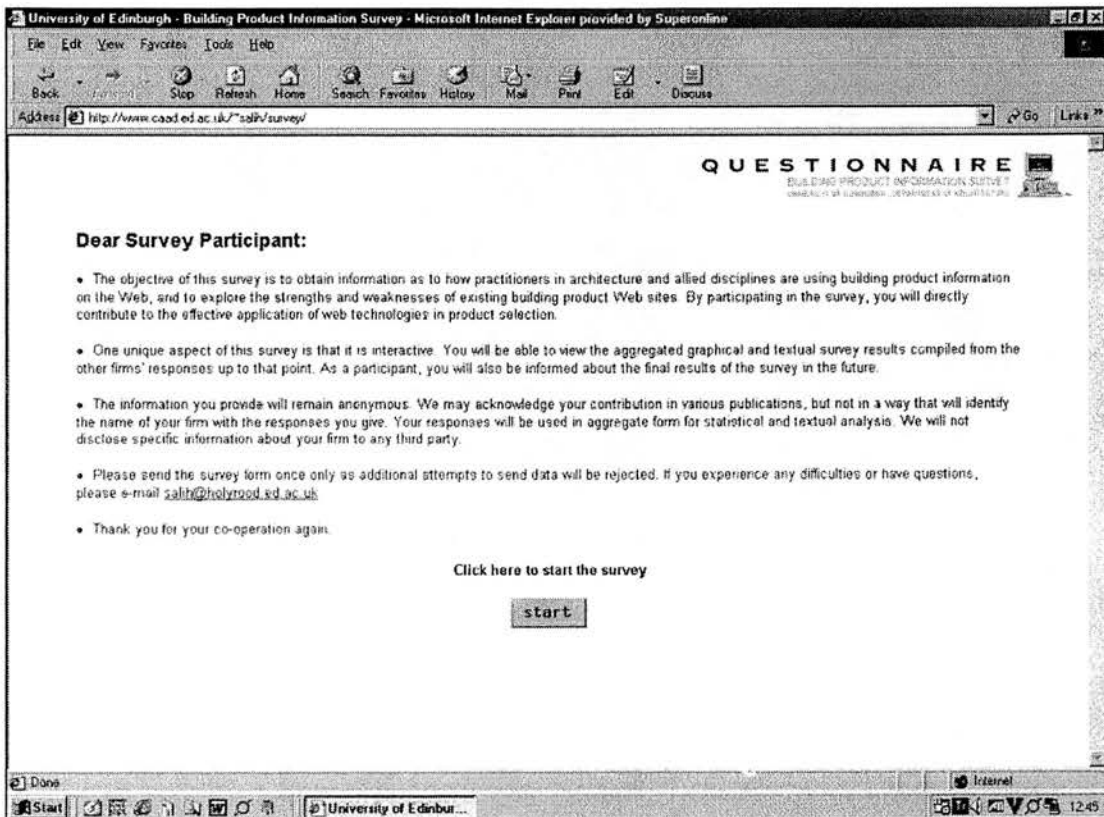
While approaching the end of this research, I realised that a range of new technologies have been evolving. My experience with this research showed that technology can quickly become obsolete on the Web. For this reason, any studies dealing with such a rapidly changing environment as the Web, should take change and obsolescence into account, and such studies should be structured in a flexible manner to take advantage of emerging technologies at any point.

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<sup>7</sup> See Appendix E

## APPENDIX A: SURVEY QUESTIONNAIRE

### INSTRUCTIONS SCREEN



# Building Product Information Survey

UNIVERSITY OF EDINBURGH, DEPARTMENT OF ARCHITECTURE

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## Section 1 - The Firm

**Q-1.1. Please provide the following information about your firm.**  
(This information will remain confidential)

Firm Name:   
 City:  State:  Country:   
 Web Address:   
 Contact Person & E-mail Address:

**Q-1.2. Number of staff, including principals**

1      2-4      5-9      10-19      more than 20

**Q-1.3. Please check the designation that best describes your firm.**

Architecture  
 Architecture/Engineering  
 Architecture/Interior Design  
 Interior Design/Space Planning  
 Architecture/Planning  
 Planning  
 Architecture/Landscape Architecture  
 Landscape Architecture  
 Architecture/Illustration - Graphic Design

Other   previous responses

(please click the box and specify)

**Q-1.4. Is your firm in one place or dispersed?**

One      Dispersed

**Q-1.5. How would you characterise the scope your firm's practice?**

Local      Regional      National      International

## Section 2 - Utilisation of Network and Web Technologies

### Q-2.1. Which of the following network connections does your firm have?

(check all that apply)

Intranet or LAN - Local Area Network (e.g. Novell, NT, Appletalk, etc.)

Internet

Extranet or WAN (Wide Area Network)

ISDN

Other   previous responses

(please click the box and specify)

None (go to [Section 3](#))

Don't know

### Q-2.2. Which of the following services are available through your firm's network?

(check all that apply)


E-mail

Web Access

Shared Storage Area

Central Database Access

Internal FTP (File Transfer Protocol) Site

Other   previous responses

(please click the box and specify)

None

Don't know

### Q-2.3. What was the primary objective of your firm for establishing Internet access?

E-mail

File transfer of project work (i.e. exchange of drawings, documentation, etc.)

Locating professional information

Marketing the firm's services to a wider audience

Collaborating with the firm's branches and other firms

Appearing to use leading edge technology

Other   previous responses

(please click the box and specify)

**Q-2.4. What was the secondary objective of your firm for establishing Internet access?**

E-mail

File transfer of project work (i.e. exchange of drawings, documentation, etc.)

Locating professional information

Marketing the firm's services to a wider audience

Collaborating with the firm's branches and other firms

Appearing to use leading edge technology

Other



previous  
responses

(please click the box and specify)

**Q-2.5. If your firm has Web access (otherwise go to Q-2.9), on average, how many hours a week do you spend on the Web (not e-mail) for work or projects?**

None

1-4 hours

5-7 hours

8-10 hours

more than 10 hours

**Q-2.6. Have you (or colleagues) ever ordered a product or service for your firm through the Web?**

Yes

No (go to Q-2.9)

Don't remember (go to Q-2.9)

**Q-2.7. What sort of products or services do you (or colleagues) usually order for your firm through the Web?** (check all that apply)

Architectural/CAD software

Other software

Computer hardware

Books/magazines/newspapers

On-line newspapers and magazines

Subscription to professional or research information services

(e.g. CSI Digital Library, Northern Light, etc.)

Other



previous  
responses

(please click the box and specify)

**Q-2.8. What are the main reasons you (or colleagues) use the Web when purchasing products or services?** (check all that apply)

Saves time

Convenience

Variety of choices

Ease of product comparison and selection

Quality of graphical presentation

Interactivity and personalised information content

No pressure from sales people

Ease of cancelling orders

Lowest product/service price

Other



previous  
responses

(please click the box and specify)

**Q-2.9. If your firm has a Web page (otherwise go to Q-2.10), what were the main objectives for owning a Web page?** (check all that apply)

As a marketing medium - to present the firm services and reach out new clients

As a sale medium - to sell firm related products such as building plans, illustrations, and promotional materials

As an internal communication medium - to share and exchange information between the departments and branches of the firm

As a collaboration medium - to exchange information with parties involved in the projects of the firm (such as consultants, clients, etc.)

As a bookmark share medium - to provide internal and external users with the addresses (or links) of other web sites containing professional information related to the firm's practice.

Other



previous  
responses

(please click the box and specify)

**Q-2.10. Which of the following Internet technologies have you (or colleagues) used?**  
(check all that apply)

Chat/Online discussion

FTP (File Transfer Protocol)

Viewed a web page containing a CAD drawing displayed in a Web readable format

(e.g. Autodesk Whip's DWF format, etc.)

3D environments (e.g. VRML, QuickTime VR, etc.)

Used a VRML plug-in software

Streaming audio and/or video over the Internet

(e.g. using Real Audio, Media Player, etc.)

Viewed a web page containing a Java applet or JavaScript

Downloaded software from the Web

"Push" technologies (e.g. PointCast, Personalised on-line or e-mail news services, etc.)

Other



**previous  
responses**

(please click the box and specify)

None

Don't know

## **Section 3 - Utilisation of Building Product Information**

(Building product information: Catalogues of information about standard constructional components and materials of the kind found in the Sweet's Catalogue and the Barbour Index used by architects)

**Q-3.1. To which of the following do you (or colleagues) refer to obtain or search product information?** (check all that apply)

Paper based catalogues (e.g. the Sweet's Catalogue, the Barbour Index, etc.)

Trade journals

CD-ROMs

Internet/World Wide Web

Floppy diskettes

Trade shows and exhibitions

Sales Representatives

Other



**previous  
responses**

(please click the box and specify)

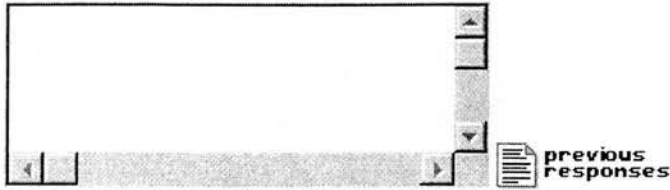
None (go to Section 4)

Don't know





**Q-3.5. Please write the names (and preferably the Web addresses) of the product information sites whose bookmarks you (or colleagues) keep or often visit.**



**Q-3.6. What do you (or colleagues) like best about these sites?** (check all that apply)

Up-to-date information

Well-organised information

Accessibility of information from anywhere

Easy and fast information retrieval

Quality of technical information (i.e. information related to product performance, cost, etc.)

Graphic and multimedia content of the sites

Interactivity/personalisation of the medium

On the Web, users can navigate through product information with individual methods rather than following a hierarchical or linear order (i.e. page after page) as in the case of printed materials (e.g. trade journals, or catalogues)

The downloaded product information can be directly used in the firm's projects or specifications without any change


Compatibility of the product file formats (e.g. DXF, DWF, etc.) with the firm's file standards

Ease of contacting product manufacturers

Ease of making product comparisons and selections

Ease of making product purchases

No pressure from sales people

Other   previous responses

(please click the box and specify)

**Q-3.7. What do you (or colleagues) dislike about the product sites you often visit?**  
(check all that apply)

Outdated information

Disorganised information

Too much irrelevant information

Difficulty in locating information

Incomplete supplier lists

The Internet does not offer a real advantage over the printed media


Insufficient use of interactive, multimedia and 3D technologies which allow users to self-navigate, interact and perceive products better

Insufficient illustration of the visual attributes of products (e.g. colour, texture, etc.)

Insufficient technical information (i.e. information related to product performance, cost, etc.)

The downloaded product information cannot be directly used in the firm's projects or specifications, and it requires modifications


Incompatibility of product file formats (e.g. DXF, DWF, etc.) with the firm's file standards

Other   previous responses

(please click the box and specify)

**Q-3.8. Do you (or colleagues) use any of the following methods for organising bookmarks of product information sites or other Web sites in order to access them easily in the future?** (check all that apply)

Bookmark organiser of the browser

Bookmark manager software   previous responses

(please click the box and specify)

Manually updating the external links in the firm's Web pages

Other   previous responses

(please click the box and specify)

**Q-3.9. Do you envisage that the Internet/Web will be the primary delivery medium for product information in the future?**

Yes      No      Maybe      Don't know

## Section 4 – Utilisation of VRML Software

**Q-4.1. Which of the following software is used in your firm?** (check all that apply)

Multimedia software (e.g. Macromedia Director, Asymetrix Multimedia Toolbook, etc.)

Presentation software (e.g. Microsoft PowerPoint, Corel Presentations, etc.)

Animation software (e.g. Autodesk 3D Studio, Strata Studio Pro, etc.)

Walkthrough software (e.g. Virtus Walkthrough, Autodesk Walkthrough, etc.)

3D modelling software (e.g. Autodesk 3D Studio, Autodesys FormZ, etc.)

CAD or graphical software which can produce VRML output

(e.g. Autodesk 3D Studio, Bentley MicroStation, etc.)

None

**Q-4.2. Do you (or colleagues) create VRML models of the firm's projects?**

Yes      No (go to Q-4.5)

**Q-4.3. How do you (or colleagues) utilise this VRML data?** (check all that apply)

To display the firm's projects on the Web

As an aid to design


To visualise buildings before their actual construction

To create walkthrough and other types of animations of the firm's projects

To make multimedia and interactive presentations

To work collaboratively with the firms' branches and/or other firms.

As a 3D interchange format

Other   **previous responses**

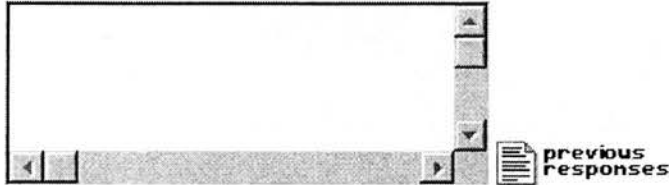
(please click the box and specify)



**Q-4.6.** Do you think that the use of Web based interactive 3D graphic technologies such as VRML and Java can contribute to the product information on the Web?

Yes      No (go to [Q-3.12](#))      Maybe (go to [Q-3.12](#))      Don't know (go to [Q-3.12](#))

If you selected **YES**, please explain how it can contribute.

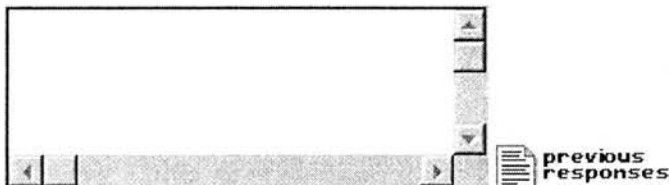


## Section 5 - Comments on the Survey and Feedback

**Q-5.1.** While completing the survey, have you looked at the other participants' comments by clicking the "previous responses" icon?

Yes      No (go to [Q-5.2](#))

If you selected **YES**, how did you find this feature? Did it help you in any way?

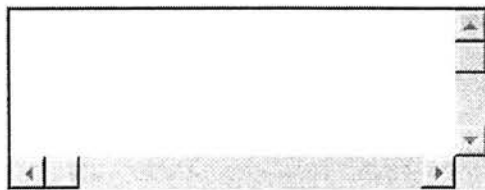


**Q-5.2.** Are you planning to view the graphical analysis of aggregated survey results after sending the survey form?

Yes      No

**Q-5.3.** Do you have any other comments?

(This response cannot be viewed by others)



## **APPENDIX B: SURVEY INFORMATION**

### **INVITATION LETTER**

Dear Sir/Madam,

I am a Ph.D. student at the University of Edinburgh, United Kingdom. As part of my research, I am conducting a survey on the use of Web based product information by practitioners in architecture and allied disciplines.

I visited your firm's web site and decided to invite you to fill out my survey because of your firm's approach to information technology, innovative use of web pages, and/or general characteristics of your firm (i.e. services you offer, staff size, etc.)

Would you be prepared to take part in this valuable survey? If so, I would be pleased to send you the web address of the survey questionnaire.

After completing the survey, you will be able to view the aggregated graphical and textual results compiled from the other firms' responses. In this way, you will have the unique advantage of knowing the current trends towards the utilisation of Internet and product information technologies. As a participant, you will also be informed of the final results of the survey.

It only takes 15-20 minutes to complete the survey. The anonymity of your firm will be protected.

Thanks in advance for your time and co-operation.

Salih Ofluoglu

Ph.D. student  
Department of Architecture  
University of Edinburgh  
United Kingdom

E-mail:

Fax: +44 131 650 6517



**FOLLOW-UP LETTER 1 FOR INTERESTED FIRMS**

Dear Respondent,

I am a Ph.D. student at the University of Edinburgh, United Kingdom. Recently, I sent you an e-mail message to invite you to fill out a Web questionnaire on the use of Web based product information. According to my records, you have shown interest in participating in the survey and I sent you the Web address of the survey site

However, it appears that you have not had a chance to complete the survey yet. I would be most appreciative if you could do so at your earliest convenience.

Thanks in advance for your co-operation and insight.

Salih Ofluoglu

Ph.D. student  
Department of Architecture  
University of Edinburgh  
United Kingdom

E-mail:

Fax: +44 131 650-6517

## **FOLLOW-UP LETTER 2 FOR INTERESTED FIRMS**

Dear Respondent,

I am a Ph.D. student at the University of Edinburgh, United Kingdom. Recently, I sent you a reminder letter to invite you to fill out a Web questionnaire on the use of Web based product information. According to my records, you have shown interest in participating, but have not completed the survey yet.

The survey is accessible at

I appreciate if you could fill it out at your earliest convenience. As a participant, you will receive the final results of the survey. Thanks in advance for your co-operation.

Salih Ofluoglu

Ph.D. student  
Department of Architecture  
University of Edinburgh  
United Kingdom

E-mail: [salih.ofluoglu@ed.ac.uk](mailto:salih.ofluoglu@ed.ac.uk)

Fax: +44 131 650-6517

**FOLLOW-UP LETTER 1 FOR NON-RESPONDENT FIRMS**

Dear Respondent,

I am a Ph.D. student at the University of Edinburgh, United Kingdom. Recently, I sent you an e-mail message to invite you to fill out a Web questionnaire seeking input on the use of Web based building product information. According to my records, your firm's name does not appear among those who completed the survey. I would be grateful if you could fill out the survey as early as possible.

The World Wide Web is increasingly becoming a major delivery medium for building product information. With my survey, I am attempting to obtain information to be used in development of effective web technologies in building product selection. Your input will directly contribute to these efforts.

By completing the survey, you will also be able to view the aggregated graphical and textual survey results compiled from the other firms' responses. In this way, you will have a unique advantage of knowing the current trends towards the utilisation of Internet and product information technologies by other firms in your profession. As a participant, you will also be informed about the final results of the survey in the future.

The survey is accessible at the web address below:

Although the survey may look long, it should only take 15-20 minutes to complete it.  
Thanks in advance for your time, co-operation, and insight.

Salih Ofluoglu

Ph.D. student  
Department of Architecture  
University of Edinburgh  
United Kingdom

E-mail:  
URL: <http://www.caad.ed.ac.uk/~salih/>  
Fax: +44 131 650-6517  
Phone: +44 131 650 2341

**FOLLOW-UP LETTER 2 FOR NON-RESPONDENT FIRMS**

Dear Respondent,

I am writing to ask you again if you are interested in participating in a survey about the use of the Web for disseminating information on building products. I am a Ph.D. student at the University of Edinburgh, United Kingdom. Recently, I sent you an e-mail message to invite you to fill out a Web questionnaire on this theme.

The World Wide Web is increasingly becoming a major delivery medium for building product information. With my survey, I am attempting to obtain information to be used in developing effective web tools in building product selection. The feedback of practitioners like yourself is an essential component of this project.

I will be happy to send the survey Web address to you upon receiving a message from you if you are interested. The survey will only take 15-20 minutes of your time. Thanks in advance.

Salih Ofluoglu

Ph.D. student  
Department of Architecture  
University of Edinburgh  
United Kingdom

E-mail: [salih@arch.ed.ac.uk](mailto:salih@arch.ed.ac.uk)  
Fax: +44 131 650-6517

## APPENDIX C: USER TESTING QUESTIONS

Experimenter's Name:

Experimenter's Profession/Major:

Experimenter's Contact Information (optional):

### SECTION 1: INTRODUCTORY QUESTIONS:

- 1.1- On average, how many hours do you spend on the Internet in a week?
- 1.2- What are the main reasons for you to use the Internet/World Wide Web?
- 1.3- Have you ever visited any building product sites?

### SECTION 2: QUESTIONS ABOUT THE IPS:

- 2.1- Do you find any difference between the IPS and other product related sites, particularly building product sites? If so, could you explain in what ways the IPS is different from these sites?
- 2.2- What features of the system did you particularly like or find useful?
- 2.3- Do you think that interactivity is important in presenting product information? In what ways?
- 2.4- Do you think that three-dimensional models can be useful in presenting product information? In what ways? Have you ever visited any VRML site?
- 2.5- Do you think that the IPS is easy-to-use? Please explain. How? If Not, how do you think that it can be improved?
- 2.6- Is there anything that you did not like about the system or areas that should be further improved?
- 2.7- Do you have any other comments?

**APPENDIX D: SOME BUILDING PRODUCT CATALOGUE SERVICE  
PROVIDERS ON THE WORLD WIDE WEB**

SITE NAME	PRODUCT SEARCH METHOD
<b>AEC DATA LINK COMPANY INDEX</b> Australia <a href="http://www.aec.com.au">http://www.aec.com.au</a>	- company index
<b>AECINFO</b> USA <a href="http://www.aecinfo.com/bpl/">http://www.aecinfo.com/bpl/</a>	- CSI product classification - residential construction format - brief product information and - links to external product sites
<b>AEDILE</b> Italy <a href="http://www.aedile.it">http://www.aedile.it</a>	- links to external product sites
<b>ARCAT</b> USA <a href="http://www.arcat.com">http://www.arcat.com</a>	- CSI 3 Part Specs - AIA CAD details - manufacturers - keyword searching - company profiles and links to external sites
<b>ARCHINET</b> United Kingdom <a href="http://www.archinet.co.uk/archinet/links/prodmenu.html">http://www.archinet.co.uk/archinet/links/prodmenu.html</a>	- UK fixture and furniture companies
<b>ARCHITECT'S FIRST SOURCE</b> USA <a href="http://www.afsonl.com">http://www.afsonl.com</a>	- manufacturer/trade name list - Master format keyword (product names) - Master format code (CSI) - keyword searching
<b>BUILDATA PRODUCT LIBRARY</b> Australia <a href="http://www.buildata.com.au">http://www.buildata.com.au</a>	- product categories - keyword searching - brief product information and - links to external product sites
<b>BUILDER NET</b> USA <a href="http://www.buildernet.com/products.html">http://www.buildernet.com/products.html</a>	- CSI product classification - keyword searching

SITE NAME	PRODUCT SEARCH METHOD
<b>BUILDER ONLINE</b> USA  <a href="http://builder.hw.net/guide/">http://builder.hw.net/guide/</a>	<ul style="list-style-type: none"> <li>- alphabetical list of all products</li> <li>- product category search (32 divisions)</li> <li>- company search</li> <li>- keyword searching</li> </ul>
<b>BUILDING COM</b> USA  <a href="http://www.buildingonline.com/BOL-Manufacturer-stats.shtml">http://www.buildingonline.com/BOL-Manufacturer-stats.shtml</a>	<ul style="list-style-type: none"> <li>- external links to manufacturers' sites</li> </ul>
<b>BUILDING INFORMATION NET</b> Austria  <a href="http://www.bau-info.at/english/home.htm">http://www.bau-info.at/english/home.htm</a>	<ul style="list-style-type: none"> <li>- company Index</li> <li>- alphabetical Product index</li> <li>- brief product information</li> </ul>
<b>BUILDING INFORMATION WAREHOUSE</b> United Kingdom  <a href="http://www.biw.co.uk/BIW/biw_04.htm">http://www.biw.co.uk/BIW/biw_04.htm</a>	<ul style="list-style-type: none"> <li>- keyword searching</li> <li>- product manufacturers and supplier lists</li> <li>- brief product information and</li> <li>- links to external product sites</li> </ul>
<b>BUILDNET</b> USA  <a href="http://www.abuildnet.com/manufacturers.shtml">http://www.abuildnet.com/manufacturers.shtml</a>	<ul style="list-style-type: none"> <li>- links to external product sites</li> <li>- service providers are listed in alphabetical order</li> </ul>
<b>BUILDING WEB</b> Canada  <a href="http://www.buildingweb.com/cp1.html">http://www.buildingweb.com/cp1.html</a>	<ul style="list-style-type: none"> <li>- CSI product classification</li> <li>- keyword searching</li> <li>- brief product information and</li> <li>- links to external product sites</li> </ul>
<b>CAISNET</b> USA  <a href="http://www.caisnet.com/products">http://www.caisnet.com/products</a>	<ul style="list-style-type: none"> <li>- CSI product classification</li> </ul>
<b>CSI RESOURCES LINK</b> USA  <a href="http://www.csinet.org/ad/rlinkhome.htm">http://www.csinet.org/ad/rlinkhome.htm</a>	<ul style="list-style-type: none"> <li>- CSI product classification</li> <li>- brief product information and</li> <li>- links to external product sites</li> </ul>
<b>INTERIOR INTERNET</b> United Kingdom  <a href="http://www.interiorinternet.com">http://www.interiorinternet.com</a>	<ul style="list-style-type: none"> <li>- product index</li> <li>- keyword searching</li> <li>- links to external product sites</li> </ul>
<b>PIRS ONLINE</b> USA  <a href="http://www.insa.com">http://www.insa.com</a>	<ul style="list-style-type: none"> <li>- product classification according to NAFTA countries</li> <li>- product category</li> </ul>



SITE NAME	PRODUCT SEARCH METHOD
<b>PRODUCT SELECTOR</b> United Kingdom	<ul style="list-style-type: none"> <li>- product group</li> <li>- manufacturer name</li> <li>- CI/SfB code</li> </ul>
<a href="http://www.productselector.co.uk">http://www.productselector.co.uk</a>	
<b>RALENTI</b> NEW ZEALAND	<ul style="list-style-type: none"> <li>- product/brand search</li> <li>- company search</li> <li>- links to external sites</li> </ul>
<a href="http://www.ralenti.co.nz">http://www.ralenti.co.nz</a>	
<b>SELECTOR</b> Australia	<ul style="list-style-type: none"> <li>- category index</li> <li>- keyword searching</li> </ul>
<a href="http://www.selector.com">http://www.selector.com</a>	
<b>SPECIFIERS LIBRARY</b> Australia	<ul style="list-style-type: none"> <li>- product classification according to profession</li> <li>- supplier lists</li> </ul>
<a href="http://www.spec-net.com.au">http://www.spec-net.com.au</a>	
<b>SPECS-ONLINE.COM</b> USA	<ul style="list-style-type: none"> <li>- CSI product classification</li> <li>- keyword searching</li> </ul>
<a href="http://www.specs-online.com">http://www.specs-online.com</a>	
<b>SWEET'S GROUP</b> USA	<ul style="list-style-type: none"> <li>- SDDF product classification</li> <li>- company and trade name search</li> <li>- keyword searching</li> </ul>
<a href="http://www.sweets.com">http://www.sweets.com</a>	
<b>SWISS INTERNET BAUBANK</b> Switzerland	<ul style="list-style-type: none"> <li>- keyword searching</li> <li>- links to external sites</li> </ul>
<a href="http://www.dewadata.ch/baubank/">http://www.dewadata.ch/baubank/</a>	
<b>THOMAS REGISTER</b> USA	<ul style="list-style-type: none"> <li>- company name</li> <li>- product/service</li> <li>- brand name</li> </ul>
<a href="http://www4.thomasregister.com">http://www4.thomasregister.com</a>	
<b>YAPI KATALO_U</b> Turkey	<ul style="list-style-type: none"> <li>- company name</li> <li>- product/service</li> </ul>
<a href="http://www.yapkat.com">http://www.yapkat.com</a>	

## APPENDIX E: PLA(id) RESEARCH

### MANAGING BUILDING PRODUCT INFORMATION ON THE WEB

[Proceedings of INCITE 2000: Implementing IT to Obtain a Competitive Advantage in the 21<sup>st</sup> Century, Hong Kong, eds. Heng Li, Qiping Shen, D. Scott and P.E.D. Love, The Hong Kong Polytechnic University, January, 2000, pp. 856-868.]

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*Edinburgh EH1 1JZ*

*United Kingdom*

AND

J. LEE

**Abstract.** This paper outlines the objectives and issues of a research project about on-line product information used by architects, engineers and other design professionals. After identifying some key issues pertinent to web-based product information, we present PLA(id), a system for organising and sharing product information on the World Wide Web. The system has two different versions, each involving different design strategies and development tools.

How are design practitioners using product information on the World Wide Web, and how could they make better use of this resource-rich, highly interactive, and rapidly expanding environment? Product information includes catalogues of information about standard constructional components and materials of the kind found in the Sweet's Catalogue and the Barbour Index. It also includes two-dimensional and three-dimensional geometrical data of the kind presented in CAD (Computer-Aided Design) libraries. Both kinds of information are now available on the Web, circulated and distributed by CAD suppliers, product manufacturers/suppliers, service providers, and CAD users. Some design firms also use the Web for exchanging information about products. We are currently examining these modes of distribution of product information to practitioners, determining what tools are needed to make the process more effective.

Building on work reported in Coyne et al (1998), we identify several key issues highlighting what is required for Web-based product information to be useful to designers, specifiers and documenters. Subsequently, we will examine how each of these issues is dealt with by existing web-based product information services, prior to a consideration of how these services can be extended.

*1. Pointer management:* There is the issue of finding, updating, and otherwise managing relevant WWW pointers (URLs) to product information. Current tools include search engines, Web page download/mirror tools, and bookmark managers. On PCs and

Macintosh computers pointers to web pages can be turned into icons and organised into directories as files. Web browsers can be customised to efficiently cache web pages and handle subscriptions to web pages. Recent versions of AutoCAD, and MicroStation software also allow users to hyperlink components in drawing files to URL pages and other documents. By clicking on the drawing components, users can gain access to images, specifications, and installation instructions from manufacturers' sites. In addition to CAD software, many word-processing and spreadsheet applications recognise URLs. This provides the opportunity for the organisation of pointers in ways relevant to specific tasks and projects, organised as sorted and categorised lists and hyperlinked files in text documents, databases, spreadsheets, and drawing files.

2. *Distributing pointers*: Pointers to web sites can be shared in the same ways that files and directory structures can be shared using standard Novel and AppleShare tools, and the Unix directory structure. There are also tools such as BSCW (Basic Support for Co-operative Work - <http://bscw.gmd.de>), which enable users to set up web pages for sharing files and URLs. Participants within design projects expect to be able to share their product information, a concern which resonates with the emergence of the "virtual office" (Kambil, 1997).

3. *Synchronous sharing*: Along with the development of computer-mediated communication tools generally (such as Timbuktu and NetOp), designers might expect to be able to talk about and manipulate links and view content synchronously, from remote workstations. This involves (i) real-time discussion over links and their content, and (ii) shared organisation of links.

4. *Integration into CAD*: Most CAD systems make use of libraries of information about standardised components, such as the element library system of ArchiCAD by Graphisoft, which uses an object-oriented programming language, GDL (graphic design language), for describing the geometrical and material attributes of elements such as doors, windows, fittings and furniture. Sizes and other parameters can be adjusted as specified in the library programs, and there is a simple-to-use interface for instantiating components into the current project as part of the documentation and modelling process.

There is currently no standardisation of parameterised descriptions for CAD elements across CAD systems. Most users exchange CAD data using *de facto* file standards such as DXF, mainly intended for geometric data. There have been several standardisation efforts such as IGES and STEP to introduce a universal exchange format for CAD data. In addition, the International Alliance for Interoperability (IAI), a world-wide consortium aimed at developing a universal language throughout the AEC (Architecture, Engineering and Construction) industry, is developing IFCs (Industry Foundation Classes) as a basis for information-sharing throughout a building's lifecycle, across disciplines and technical applications. IFCs, based on the object-oriented technology, contain sets of objects that represent buildings and their parts (IAI, 1996).

5. *Design support and product selection*: Product selection is an aspect of design decision making. Designers start to consider products and components before the design is put into the CAD system, and it is an aspect of designing that continues throughout the documentation process.

- (i) Designers need to browse product and material choices, and see them in combination. In the context of Web-based product information there is a need to link URL pointers with the visualisation of products and materials, as with the use

of manually constructed sample boards for testing choices and combinations, and focusing discussions with clients.

- (ii) Product selection is heavily based on precedent. Designers commonly develop portfolios of favourite products that they use repeatedly on different projects. This case-based aspect to product selection can be reflected in the way product information links are managed, but also in the use of tools for searching previously used products according to key attributes. This brings the product library under the purview of database management and search. It should be possible to interrogate a database of Web-based product information.

6. *Distributed CAD*: The need for applications that will support distributed CAD increases as more design firms start to rely on the Web and Intranet sites for communication and collaboration. Understanding the value of the Web, many CAD vendors are providing more Web aware functionality and capabilities in their systems. Many CAD vendors support Web readable data in the forms of VRML and/or special vector formats, which are viewable through special browser plug-ins. AutoCAD and MicroStation also allow users to insert hyperlinks on drawings and browse the Web through their integrated web browsers.

### **The current state of on-line product catalogues**

On-line product catalogues, also known as Web-based catalogues, are the major building product information sources on the Web (Figure 1). The content of information in these catalogues is also similar to that of CD-ROM or paper-based catalogues, and includes information pertaining to performance data, standards, specifications, and installation instructions. Currently there are approximately 30 on-line product catalogues world-wide.<sup>1</sup> This number is steadily increasing.

Existing on-line catalogues tackle the key issues outlined in the previous section as follows:

1. *Pointer management*: On-line catalogues use either a centralised or distributed approach in storing and accessing pointers. In the centralised approach, the information collected from manufacturers and suppliers is stored and offered from a central location, a web server. While most pointers are accessible internally, external pointers to manufacturer/supplier sites are also offered. Whereas, catalogues using the distributed approach, entirely rely on external pointers to manufacturers' sites. All the data, other than brief company and product information, is stored and accessed remotely. Pointers can be layered according to the users' immediate and secondary needs or by associations between products and categories. On-line catalogues generally classify pointers according to MasterFormat or CI/SfB formats, which are popular construction-based information classification methods used in the USA and the UK.

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<sup>1</sup> A list of these sites can be found at "<http://www.caad.ed.a/c.uk/~salih/prodlink.htm>"

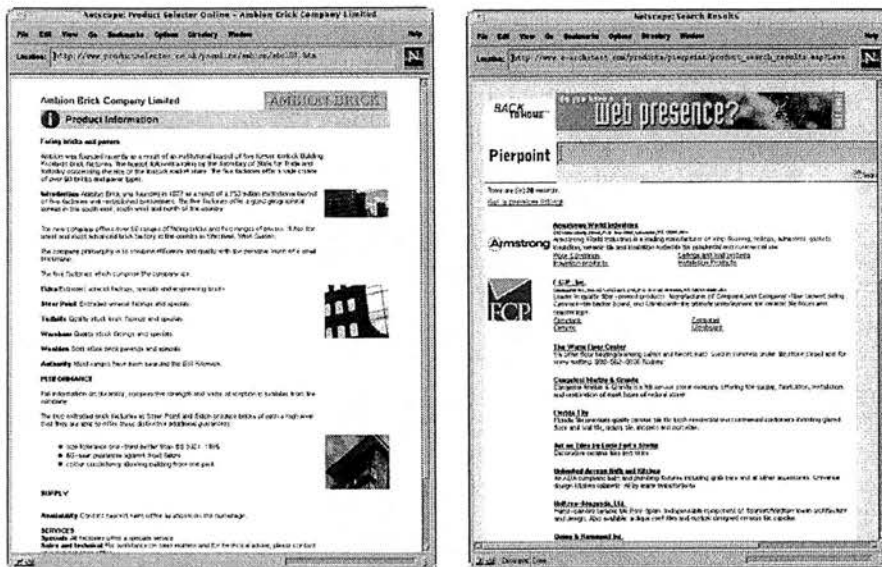


Figure 1. Two On-line Product Catalogues  
Source: Product Selector by the RIBA (<http://www.riba.co.uk>)  
& Pierpoint by the AIA (<http://www.pierpoint.com>)

2. *Distributing pointers:* The organisation of pointers is shared to the extent that anyone can access the on-line product catalogue, but clients are not in a position to make their own organisation of pointers available to others through the catalogue site. Certain e-commerce sites, such as on-line booksellers, provide lists of pointers derived in part from the navigational preferences of their users, but this is limited and has not yet been exploited in on-line product catalogues.

3. *Synchronous sharing:* Synchronous sharing is not generally supported in on-line catalogues. Some sites provide on-line forums in which one can communicate with product manufacturers and building professionals to get product-related feedback. The feedback gained this way is almost instant. Many catalogue service providers offer web forms and e-mail addresses for users to contact them as well.

4. *Integration into CAD:* Many on-line catalogues provide product information in *de facto* file formats. These formats are DXF for CAD drawings, XLS for Excel spreadsheets, and DOC or RTF for word processing documents. CAD Blocks, introduced by Thomas Register in partnership with Autodesk, provides the facility for CAD data to be combined with standard drawings and technical data in a single DXF/DWG file. Geometric and technical data in CAD Blocks can be inserted into AutoCAD or copied and pasted into word processing and spreadsheet applications.

5. *Design support and product selection:* Most on-line catalogues organise and present product information in a format and detail that is useful in construction documentation rather than design development. Some catalogues also provide data/fact sheets, which are usually single-page summaries of products. These sheets can be useful in earlier stages of the design where one only needs to know the key features of the products and compare alternative products without dealing with too much detailed information.

6. *Distributed CAD:* Several on-line catalogues choose to offer product data in Web-readable vector formats. For example, on-line catalogues of the Thomas Register and



Sweets Source present CAD product data in the DWF (Drawing Web Format) format, the web vector format introduced by Autodesk. With the Whip! browser plug-in, available free from Autodesk's web site, this data can be viewed and inserted directly into an AutoCAD drawing.

### **A Product Library Assistant Intranet—PLA(id)**

What tools are needed to provide better organisation of product information for design and documentation? Here we examine two Web-based strategies for organising product links.

(a) The server/client strategy exploits the use of networks of server and client systems, consistent with various features of the emerging virtual office infrastructure, and supported by the Java (Naughton, 1997) development environment.

(b) The local strategy exploits the use of locally run applications, distributed through the Web, systems supported by the current Macromedia/Shockwave development environment (Board et al., 1996).

Each approach offers its own technical and presentational difficulties and advantages. It is apparent that the development tools adopted have a great impact on the research questions and technical problems encountered. We will examine both the Java and Shockwave versions by focusing on the key issues associated with web-based product information.

#### **THE SERVER/CLIENT STRATEGY**

The Java version of PLA(id) (Product Library Assistant [intranet for designers]) involves a CAD element library server with the ability to support and manage multiple distributed clients who require access to heterogeneous multimedia CAD library information on-line. CAD users may use such a system for arranging links to on-line product catalogues. This version of PLA(id) resolves issues of maintaining directories of information at a central server, the passage of information between client and server, cross platform compatibilities, and access by concurrent multiple users. The system allows CAD users to call up graphical directories of elements used in their current design project and examine product descriptions and specifications that are available on the WWW.

1. *Pointer management:* PLA(id) allows users to organise web links graphically and in folders on a WWW Java canvas (Figure 2). The icons representing links can be moved around the canvas and organised in folders. The pointers can also be organised as lists. Users can also select from a palette of icons. The idea is that bookmarks can be organised in ways relevant to a CAD project. In these respects PLA(id) duplicates the functionality of the bookmark organisation of Netscape or Explorer, but this takes place on a web page and in the context of CAD drawings and other images.

2. *Distributing pointers:* The link information and icon locations are stored at a server site, and the information can be accessed through any browser by password. This distributed architecture allows groups of people to share relevant links according to project. We are thereby simulating a form of virtual office organisation in which we act as a server organisation, with a fast server (SUN Ultra), with good connectivity to the rest of the Internet and good processing capability, and our practitioner participants

access our server through the WWW using their standard 33.6-55 kbps Internet connections.

3. *Synchronous sharing:* A further advantage of using a server architecture is that multiple users can share the same work canvas. So if more than one user logs on to the same project they can see the current state of the display. They can also see how other users move their cursor and icons about the screen. PLA(id) is therefore amenable to shared discussion and collaboration in conjunction with other CMC tools.

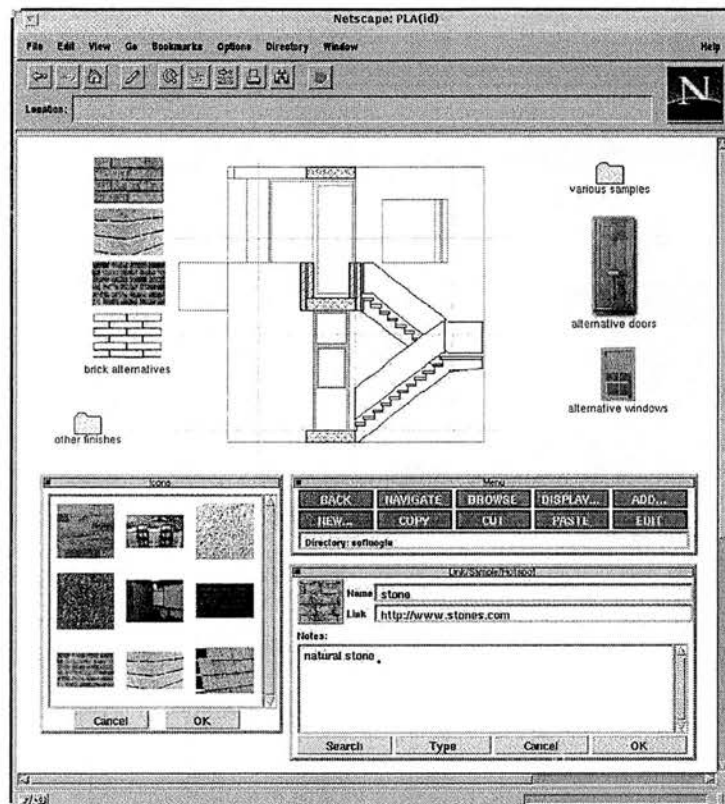


Figure 2. The PLA(id) interface, showing a browser window, the PLA(id) menu, icon palette, dialog box for inserting a new icon, product samples, a project image, and directories.

4. *Integration into CAD:* Most CAD systems generate schedules: lists of elements, materials and quantities pertinent to the current project in tabular format. Such schedules also serve as lists of element library instantiations. Schedules of components (doors, windows, cabinets, etc) can be uploaded to PLA(id). These schedules, which are produced by the designer's CAD system, are parsed on the server to extract each component's attributes. This information is added to a relational database which PLA(id) accesses to create directories of icons relating to each component. PLA(id) allows a particular procedure to be followed in order to integrate such instantiations.

5. *Design support and product selection:*

- (i) *Product and material portfolios:* PLA(id) also provides the opportunity to use a Java canvas as a display area for arranging samples of building products. It is



common practice in architectural and interior design offices to organise samples of materials on a board to test their compatibility, and to show clients. An electronic version of a sample board seems to be a useful and graphically relevant way for designers to organise product information. Clicking on any sample invokes a web site with further information. The user may wish to arrange their own samples from images taken from the web or materials scanned using the office scanner, in which case they can upload images from the user machine onto the server using a CGI file upload utility. Samples can be arranged and sized on the canvas (Figure 3).

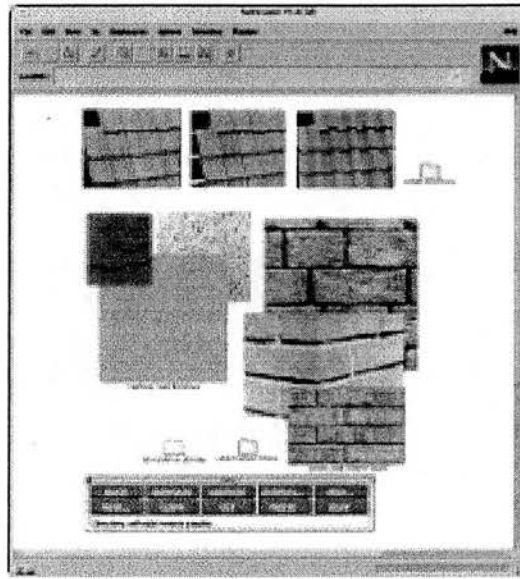


Figure 3. PLA(id) sample board with images and scanned finishes. Samples can be scaled and arranged to test combinations. Double clicking on an image invokes a link to a web site.

- (ii) Precedent and product portfolios and (iii) Interpreting attribute data: PLA(id) automatically iconises elements from the element library for manipulation and display as in Figure 2. How are Web links assigned? The approach is generally through the use of precedent links. All elements are stored as records in the relational database, with attributes, including URLs, as fields. Through PLA(id)'s interface the designer can type in attributes, as notes, relating to preferred attributes (speed of delivery, cost, etc) of the potential suppliers of these building components. All of the attributes are then used to retrieve potential candidate product links, through SQL (standard query language) search, from the libraries of links built up through the designer's use of PLA(id).

*6. Distributed CAD:* PLA(id) functions as a prototypic distributed CAD system in that it makes use of various data structure, manages shared data, has a graphical interface, and takes account of library and project data. It consists of a series of Java applets that run on local computers while maintaining its data on a project-by-project basis on a server machine.

## THE LOCAL STRATEGY

Shockwave is a Web browser plug-in that was developed by Macromedia to enable users to view and interact with Web-based multimedia files. It is currently the most popular Web plug-in for multimedia data and interactive presentations. Shockwave by itself is less a development tool than a runtime routine, a version of a program that allows applications to run without the need of its full-featured version. Shockwave files are usually created using Macromedia Director, a popular multimedia authoring tool. Shockwave presentations can also include commands written in Lingo, Macromedia Director's scripting language, as well as other low-level programming languages through Xtras. Lingo allows many Web-related commands to be incorporated into Shockwave files. In turn, Macromedia files can be compiled for the Windows and Macintosh platforms and distributed on the Web as stand-alone applications.

A version of PLA(id) was developed in Macromedia Director with Lingo support and supplemented with File Maker Pro database software for organising and accessing product related data. Currently, the system acts as a retrieval tool: an interface between users and the database application. It can run as a stand-alone desktop application or a networked application on the Web. It allows product data to be stored locally and externally. It supports both personal and inter-personal access of data. As a result it offers security for sharing data. Here we consider how the Macromedia Version of PLA(id) (currently under development) addresses the six issues discussed above.

1. *Pointer management:* Practitioners download their own version of the software through the Web. In so doing they are able to flag their own pointers for later organisation and manipulation, and to allow others to have access, with permission. PLA(id) maintains both a local and a server version of the database. Pointers and associated product information are primarily organised using the proprietary database (FileMaker Pro). Search is on field content according to product name, category, manufacturer name and the name of the practitioner who entered/organised the data (Figure 4).

The screenshot shows a window titled "Stage" with a search interface. At the top, there are buttons for "ADD", "EDIT", and "SEARCH", followed by radio buttons for "work on-line" (selected) and "work off-line (local search only)". Below this, there are several input fields: "Category" (with a dropdown menu showing "Doors and Windows, window"), "Product Name", "Manufacturer", "Architect" (with a dropdown menu showing "Pirt"), and "Keyword". There is also an "Operator" section with radio buttons for "and" (selected) and "or". On the left side, there is a list of names: LIVINGSTON, Macintosh, Meier, Mies, Murphy, Newton, Orton, Pirt, Queen, Rogers, Richard, Seashin, Soltsess, Terry, and Thompson. Below this list is a row of letters: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z. On the right side, there is a vertical list of categories: General Requirements, Sitework, Concrete, Masonry, Metals, Wood and Plastics, Thermal and Moisture Prot, Doors and Windows, aluminum, wood, Finishes, Specialties, and Equipment. At the bottom right, there is a "SUBMIT" button. The bottom left corner has a "done" button.

Figure 4. Searching product information

2. *Distributing pointers:* The system can run as a stand-alone application or across the network. Pointers can be stored locally and at the server (Figure 5). Networked data can be seen and copied by any client (practitioner), but cannot be modified other than by the users making the entries. This presents a more tightly controlled organisational structure and system of access than the Java version.

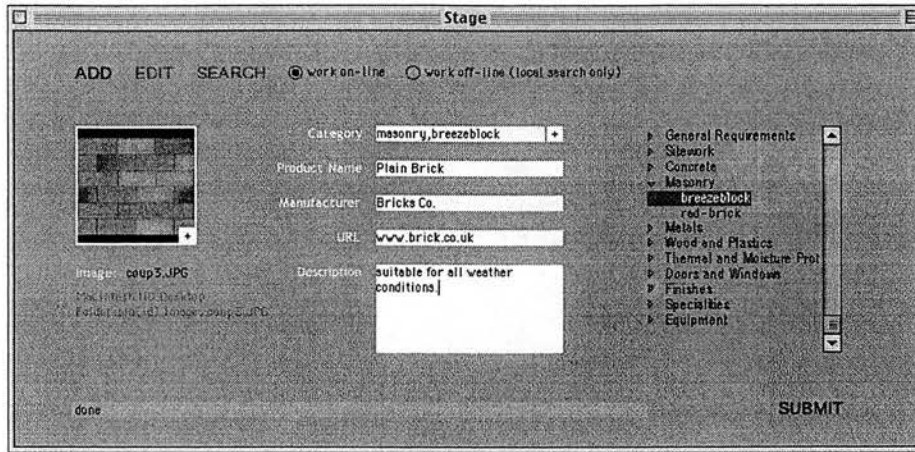


Figure 5. Adding a product to the database

3. *Synchronous sharing*: We are working on a module that will allow designers to create canvases of their most commonly-used products and to exchange them with other participating practitioners.

4. *Integration into CAD*: The local scenario suggests opportunities for the PLA(id) application to interface with the files of locally run software such as a CAD program.

5. *Design support and product selection*: Multimedia tools such as Macromedia Director, Freehand, and Authorware now offer Web capability. They provide environments for the organisation and display of elements known as "cast members", starting from the idea of a "stage" onto which the various multimedia elements are to be placed and with which a user can interact. This provides a series of powerful metaphors that appeal to developers of design applications. Unlike the Java development environment, the default conditions of multimedia tools generally include arrays of images and buttons, which move and with which one can interact. There is the potential for the development of effective design environments for interacting with product information.

6. *Distributed CAD*: This version of PLA(id) covers a further aspect of the fully functional distributed CAD environment in so far as it explores the use of distributed stand-alone applications.

## Conclusion

How might systems such as PLA(id) be used in practice? This depends on the focus of different groups of users, with their various interests, motivations and requirements.

Consideration of each stakeholder is a fruitful way of exposing possibilities, problems and issues connected with the development and use of on-line product information.

CAD systems developers wish to integrate certain features into their CAD systems to make them network aware, such as: a scripting language that interprets HTML; a feature to allow access to Web sites as well as local files through the mechanism for accessing library data; some kind of automated searching/browsing/indexing and filtering mechanism to identify relevant data and put it in a usable form for the CAD system; interaction tools — when the user clicks on an object in the CAD work environment a link to relevant data on a Web site is invoked (the link is part of the object's attribute data); the integration of other CMC facilities accessed through the CAD system interface, such as selecting CAD model objects and gaining synchronous video communication to appropriate personnel; and a facility for automatic download of libraries and software modules as needed from the CAD system supply company.

We are currently focusing on the design practitioner stakeholder, who is interested in how teams of practitioners can use computer-mediated techniques as a matter of course in their day-to-day activity. These are the users of CAD systems who work together on the same projects: architects, engineers, consultants, contractors and manufacturers. Such teams commonly share project data, including CAD models and component libraries.

We have conducted a survey on the web to understand how practitioners and allied disciplines are using web-based building product information sites and to explore the strengths and weaknesses of these sites. 127 firms world-wide have participated in the survey. As of August 1999, all the survey data have been collected and are being analysed. More information about the survey is available at "<http://www.caad.ed.ac.uk/~salih/reslink.htm>" The supplier stakeholder is interested in maintaining Web sites of product information which can be accessed by different network aware CAD systems or CAD systems running in concert with Web browsers. One or more service providers (who could be commercial or semi-public) could co-ordinate such a service and maintain a Web site that contains a directory of links to suppliers. This service provider would be analogous to the one-stop, synoptic product information service such as First Source, but providing information that is more integrated with the CAD system.

Both versions of PLA(id), as promoted through the server/client and the local scenario, have features that serve the developing interests of these stakeholders. The emerging issues are being explored through discussions with the stakeholder communities. Further discussion on these issues can be found in Coyne et al. (1998).

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**APPENDIX F: PRODUCT INFORMATION SURVEY FOR  
A JOINT STUDIO PROJECT BY MIDDLESEX UNIVERSITY AND  
EDINBURGH UNIVERSITY**

- 1- Do you specify product information in your job?
- 2- What existing systems for product information do you use?
- 3- What are the advantages of each?
- 4- Where do you go for general product information?
- 5- How do you find out about new products?
- 6- Do you and your colleagues make use of and share portfolios of preferred products?
- 7- What is the most important information you require on products?
- 8- What is your opinion of building display centres? Do you find them useful and if so, why? How do you make use of them? How often? How do you think they can be improved?
- 9- Building display centres can be replaced by on-line services, do you agree or not? What about the concept of visiting a 3D model on-line using the products of your choice?
- 10- WWW-based product information will become ubiquitous in the future, do you agree?
- 11- How do you imagine web based product information could be made more useful for practitioners?

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