

5. Web based Project Management Systems

5.1. Introduction

The main reason why the construction sector has entered in Internet is the own potential of this market. In fact, the proportion of GNP of the construction market is one of the biggest.

In Europe, the construction sector presents a great fragmentation partly due to the absence of normalization. Internet is a global environment and requires a unified working process.

Theoretically, SMEs are those who cannot afford to implant their own technological systems. SMEs will be the ones who can take profit from a tool like Internet, that will let them manage their company with unnecessary cost.

However, there are a lot of SMEs in the construction sector who think of the online world as something unknown and strange, and, consequently, have more difficulty in adapting to this world.

Recently, there has been intense activity both at commercial and research levels to develop services for the Construction Industry and basically for AEC and the infrastructure that would support them. However, in Spain the creation of specialized portals and the use of web based tools such as WPMS in the construction sector has a considerable delay in relation to other countries.

In this Chapter, an analysis of different services offered to the construction sector will be exposed, from the simplest tools to the most complex and useful ones. Moreover, a study of different WPMS will be shown and some companies of the construction sector will be analyzed in terms of the use of IT for the management of their projects.

5.2. Types of Web Based Software for the Construction Industry

Many web based services have launched in the construction industry over the last eight years, in line with similar trends across all industries. Several of these portals failed within a short time, indicating the tight marketplace within which they are competing, and the lack of known business models for successful systems. These services generally fall into four categories

- Information portals
- Enterprise portals
- Electronic marketplaces
- Web based Project Management Systems / Extranets

5.2.1. Information portals

A *Portal* is a web site targeted at specific audiences and communities. It provides; content aggregation/delivery of information relevant to the audience; collaboration and community services; and services/applications access for the target audience – all delivered in a highly personalized manner.

A portal should conform the following qualifications known as the four C's: Connection to the resources of the Internet through search engines, shopping engines and other utilities; Content in the form of appropriate news, entertainment and instruction for interested users; Commerce involving access to electronic shopping and other commercial activities; and Community of interest defined by ground rules and tools that enable participants to interact.

The demand for portal technology evolved initially out of the need to help consumers in finding information on the public Internet. Very soon after this, the same requirement appeared inside organizations as intranets took hold and employees sought a means for organizing information within the company borders. Since that time the scope and functionality of portal technology advanced to a second-generation of vertical portals. These products focused on indexing and organizing specific types of information and application services primarily for corporate use. Today, portal technology has progressed to the third generation, the e-business portal products are able to provide a common framework of services upon which to build vertical portals and integrate a very broad range of business information and applications both inside and outside the organization.

Information portals are for general use, offering information as main resource, with classified links to other sites, without transaction functionality between companies, although it could be used to find business partners.

Most existing *information portals* are based upon manufactured products. In general, they tend to duplicate paper-based catalogues, in several cases to the extent that they scan paper-based catalogues to provide their service. The benefit of this approach is fairly low; the only added benefit over a paper system (assuming that speed of access to information is fairly comparable) is that updates are immediately visible to all the users.

5.2.2. Enterprise portals

Enterprise portals are centred on the operations of an enterprise, offering information and transaction functionality for stakeholders of a single company. The project management features can be also available, especially in AEC related enterprise portals. This kind of site can be based on Internet, Intranet, Extranet or on a combination of these ones.

5.2.3. Electronic marketplaces

An *electronic marketplace* is a web site which main difference is the supply of transaction functionality between two or more companies. It is usual to offer additional functionalities such as product catalogue management, auctions, reverse auctions, and others. Again, project management can be available in AEC-related e-marketplaces.

Electronic Business includes the electronic trading of physical goods, and that of intangibles such as information, all the trading steps such as online marketing, ordering, payment, and support for delivery, electronic provision of services such as after-sales support or online legal advice, and electronic support for collaboration between companies, e.g. collaborative design.

Electronic Commerce can be considered the subset of the e-business that is focused on e-procurement, e-buying, e-payment, etc., representing 'punctual' operations of short duration.

Some portals are enabling e-commerce for purchase of selected products, and very few are providing for selection of products based on their performance attributes. To increase these services, portals often tie in a selected set of related information services, for example, links to

Standards documents, industry news feeds, and databases of selected professionals in the industry. A major criticism of these sites is their lack of comprehensiveness. This is often true even for their major information content (i.e. manufactured products), but more especially for their associated services, which tend to have a minute portion of the information available to the industry.

5.2.4. Web based Project Management Systems / Extranet

Web based Project Management Systems are web-based applications designed to **store and manage project information**. Quite simply project collaboration applications allow disparate groups of people such as engineers, architects, and clients, controlled access to, and automated dissemination of, information.

The goal of collaboration has always been the same: get things done better, faster and cheaper by bringing together a variety of resources and harnessing their collective knowledge and abilities. Effective collaboration improves productivity, streamlines and optimizes decision-making, and helps to capture valuable intellectual property (Ball 2004).

Systems are designed to improve collaboration between the teams working on a project, reducing potential risks and helping to ensure that the project is delivered on time. They serve as a repository for all the documents, drawings and communications relating to the project and are used by all project participants to access, read, print, and edit material according to authorizations set up by the project administrator.

Solutions are available either as ASP (externally located software paid for on a rental basis) or on an Enterprise Basis billed as license fees and associated maintenance.

Application Service Providers (ASPs) are third party entities that manage and distribute software-based services and solutions to customers across a wide area network from a central data centre. In essence, ASPs are a way for companies to outsource some or almost all the aspects of their information technology needs.

Table 4 shows some examples of WPMS oriented to construction:

Table 4. Examples of Web based Project Management Systems

Web based Project Management Systems	Access
Aconex	http://www.aconex.co.uk
Autodesk	http://www.buzzsaw.com
ProjectNet	http://www.citadon.com
BIW	http://www.biw.co.uk/
Buildonline	http://www.buildonline.com/
Business Collaborator	http://www.businesscollaborator.com
Cadweb	http://www.cadweb.co.uk/
Causeway	http://www.causeway.com/
Constructw@re	http://www.constructware.com/
e-Builder	http://www.e-builder.net/
IronSpire	http://www.IronSpire.com/
Primecontract	https://app.primecontract.com
ProjectGrid	http://www.ProjectGrid.com/
Projectmates	http://www.projectmates.com/
ProjectTalk	http://www.projecttalk.com/
ProjectVillage	http://www.ProjectVillage.com
The-project	http://www.the-project.co.uk/
Unifier	http://www.Skire.com/
Viecon	http://www.bentley.com
VISTA 2020	http://www.marketstreet.com/
4 Projects	http://www.4projects.com/

BIW and ProjectNet are the market leaders relative to project extranets; they have the largest number of users and their system is highly regarded.

Business Collaborator and BIW are the WPMS that clients are most satisfied with and its adaptability offers sophisticated functionalities.

What is interesting about the different offerings is what their functionality appears to be converging. BIW's application now includes flexible functionality to suit individual client business processes, Business Collaborator is developing a more rigid "project extranet" product from its flexible tool kit, etc. Build Online's ability to win major contracts with excellent clients, together with its track record of acquisitions, positions the business well.

In the next section these WPMS that allow Document Management Systems will be analyzed in depth.

5.3. Web Based Project Management Systems (WPMS)

Web based Project Management Systems focus on tools and services that make it easier to manage AEC projects.

The essence of collaboration software is to develop a process whereby documents are all electronic, thus enabling them to be located at a secure central location that can be accessed by those to whom access rights have been given while maintaining business processes, supply chain relationships and organizational hierarchies.

In Figure 11 both situations, traditional project management and WPM are shown. As can be noticed, the basic improvement is the centralization of the information.

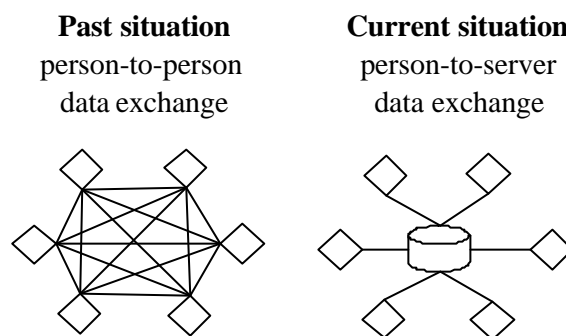


Figure 11. Communication mechanisms between enterprises

On line project management provides an instant, on-demand, secure online solution for every team member to communicate, share documents and collaborate using a standard web browser.

WPMS is an out-sourced Internet-based project information and workflow management service for the design, engineering, and construction industry. It provides specialized tools for all the individuals involved in the building process and enables construction projects to be completed under budget and ahead of schedule.

This service is focused on providing project teams with rapid, secure, and easy access to project information. It promotes the concept of ‘partnering’ – enabling project owners, planners and architects to collaborate and to jointly determine how best to achieve the goals of the project. To implement effective partnering it is critical that all project players remain in regular contact with each other and have access to the same data. To insure effective coordination of the numerous partners that make up the project team, it is critical to get everyone communicating as quickly and efficiently as possible.

WPMS services, which are summarized in Figure 12, include:

- **Document management:** sharing or viewing multiple file formats online, marking-up the documents, downloading and uploading multiple documents, document search or full text search, back up facilities, keeping a document revision history and tracking who accesses what files.
- **Team communication (Project Collaboration and Management):** real time discussion group, project calendar and event planning, team communication (project email or SMS messaging).
- **Business Process Automation:** browser compatibility, plotting, third-party viewer, MAC support, PDA and WAP support, server located in a secure data centre, firewall installed, User ID and password required, different access levels, virus protection.

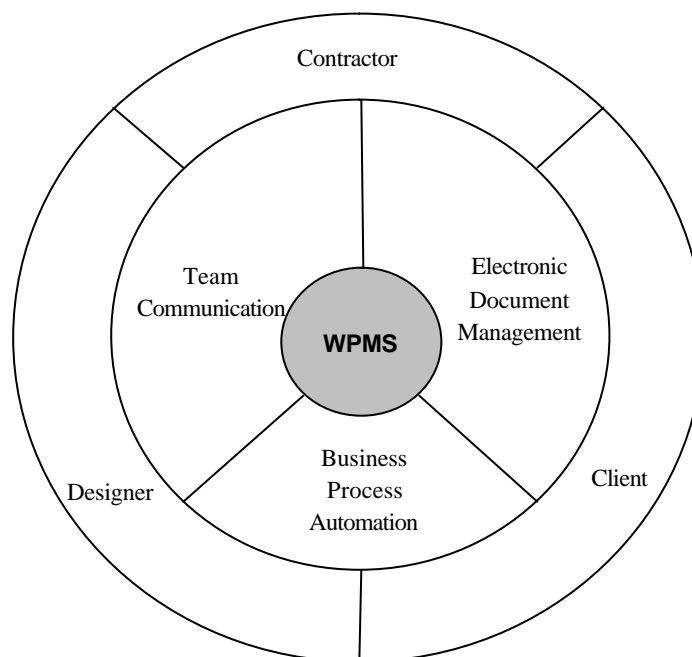


Figure 12. Communication and collaboration schema of WPMS

The heart of some on line project management systems is a **secure document management** and workflow system that stores all project documents and forms. The information repository can be **updated** daily to ensure that everyone has access to current information. It enables everyone in the project team to work from the same page, improving productivity. It helps to accelerate time-to-market, reduce cost, and increase revenues and to minimize rework due to communications errors. With a minimal investment in Internet technology and personnel, WPMS provide the tools for instant information access anytime and anywhere; as it can be noticed in the following

Figure, collaborative software offers any kind of information services (consult, procure, maintain, modify, etc.) throughout the life cycle of the project.

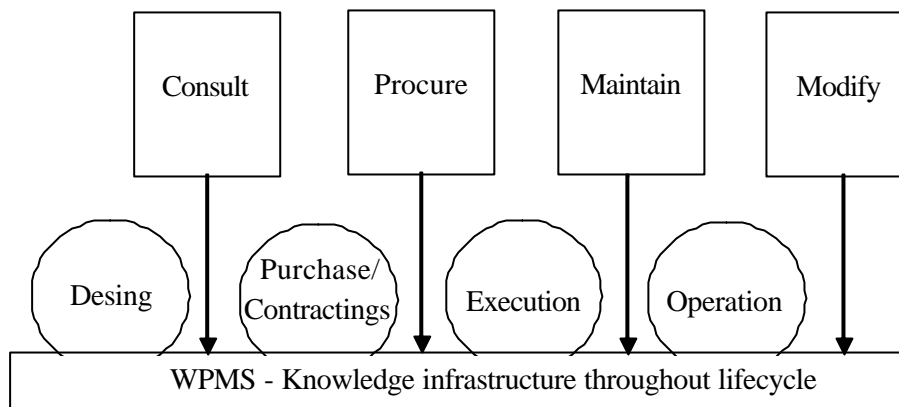


Figure 13. Information services of collaboration software throughout the life cycle of a project

5.3.1. Advantages of WPMS

The adoption and benefits gained in using WPMS within the AEC industry has been studied by Price Waterhouse Coopers and many real and tangible benefits currently being experienced by early adopters have been found (Price Waterhouse Coopers 2002). In this study it's said that overall the use of these tools within the industry, it is in its infancy, with architects, engineers, and general contractors leading the way. Owners, developers and subcontractors currently seem to be slower in their adoption, in part due to limited exposure to the use of these tools and infrastructure issues.

They believe that the benefits currently being realized by early adopters cover only a limited range of the services that can potentially be offered by WPMS; today these benefits centre around:

- Better communication. WPMS improve project progress communication, alignment of business processes increases transparency as barriers to communication are removed; Collaborative systems reduce the amount of re-work by storing not just information but the knowledge that derived it.
- Reduction of costs and wasted time. Printing and postage costs are reduced and also document administration as all documents are stored centrally.
- Improvement of project control. All actions are recorded to be audited and monitored.

- Better access to information and reduction of the response time for RFI (Requests for Information), CO (Change Orders) and specifications clarification.
- Shorten the project life cycle. The fast dissemination of information shortens consultation cycles and speeds up decision making. When you send an electronic document to a website it is immediately available for viewing; likewise, written feedback is available without delay.
- Improvement of connectivity. Potential for interoperability with business applications provides near-term project based perspective.
- Reduction of risk and potential errors. The latest information is always available as soon as it is published, minimizing the risk of working on old information.

These benefits have far-reaching implications for construction projects. By improving project progress communication, all team members are kept informed of issues in a timely manner, project schedules are distributed faster and consequently, less overlapping and/or no show of workers would occur.

If the cycle-time taken to turn around a RFI/CO is shortened, this could have a direct impact on the length of the project: with fewer delays and quicker response times, the life cycle of a project can be shortened. Shortening the life cycle of construction brings benefits such as reduced expenditures in man-hours, equipment rentals, project site office costs and security costs and allows the project team to begin working on new revenue-generating projects.

Finally, by completing the project sooner, tenants can occupy the site earlier and owners/developers can enjoy earlier rental/lease revenue.

As the AEC industry moves to embrace these tools, all participants will realize additional benefits progressively. It's foreseen that as understanding of client needs and adoption increases, vendors will develop product offerings to meet the needs of all industry players; in turn, these will increase overall usage of online project collaboration tools. It's believed that the AEC industry will open itself up and adopt the changes brought about by the development of online collaboration tools.

5.3.2. Limitations of WPMS

There are also drawbacks when an organization decides to work using WPMS.

- Security. The possibility of sharing information in a WPMS demands security measures. The issue of trust is a major issue in the setting up of such a WPMS - some clients would be completely trustworthy whilst others would need to be checked all the time. There is definitely a need to ensure that people is encouraged to see this technology as a benefit rather than a threat.
- Infrastructure and difficult Internet access. Companies need to have the infrastructure necessary to support them (i.e. network systems, hardware, etc.). Most companies don't have this infrastructure and don't want to change their organizations. Moreover, there mostly is no Internet access on site.
- Need for training. Employees must be familiar with technological solutions; otherwise they need to be trained. Some employees are not keen on using new technologies and think they will need too much time to learn and understand it.

5.4. Utilization of WPMS in the Construction Industry

The AEC industry is in the early days of adopting these online collaboration tools; however, early adopters are already realizing some of the benefits to be gained. (Price Waterhouse Coopers 2002).

In general, architects, engineers and general contractors are adopting WPMS and understand the benefits to be gained.

Subcontractors are the least likely users of online tools and, although keen to try this technology, owners and developers are hesitant to adopt it at this stage. Figure 14 illustrates current reasons for adoption.

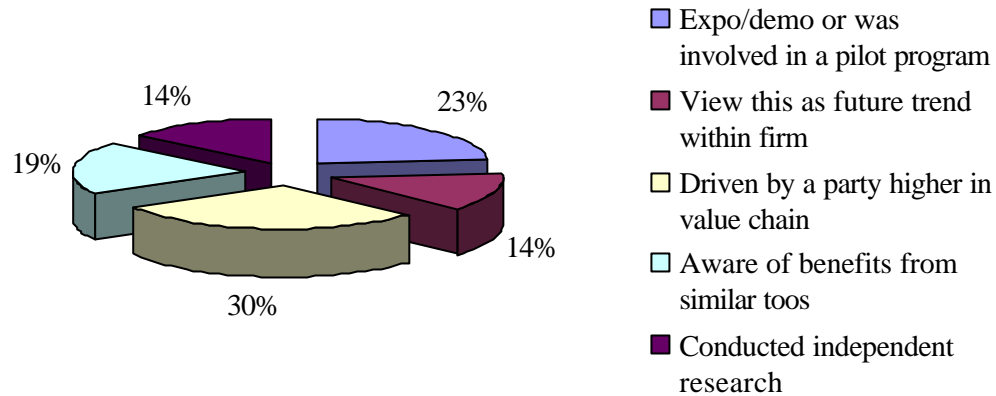


Figure 14. Current reasons for the adoption of on-line collaboration tools

Further reasons for the adoption and non-adoption of online tools are:

- Architects and engineers are most likely to use online project collaboration tools as they:
 - have the infrastructure necessary to support them (i.e. network systems, hardware, etc.)
 - have employees familiar with technological solutions such as computer-aided design (CAD)
- General contractors are also keen adopters of these tools; some of the reasons are that they:
 - have seen some of the associated benefits through demonstrations and marketing efforts.
 - have been mandated to utilize a specific tool by an owner/developer or architect, felt much of the communication frustrations, and could foresee that these tools would help to alleviate this burden.
 - have the infrastructure necessary to support the tools.
- Owners and developers had mixed responses regarding the adoption of online tools. Some were early adopters whereas others were not. Reasons for their positions include:
 - adoption driven by marketing and advertising campaigns
 - resistance attributed to the lack of a critical mass of players within the industry currently using the tools
- Subcontractors have to date been the most resistant to adopting these tools. Those using them were doing so because they:
 - have been approached to be part of a project team using a particular tool
 - have seen advertising/marketing efforts
 - believed that this was the way work is to evolve in the future

Figure 15 highlights the reasons for the non-adoption of online project collaboration tools.

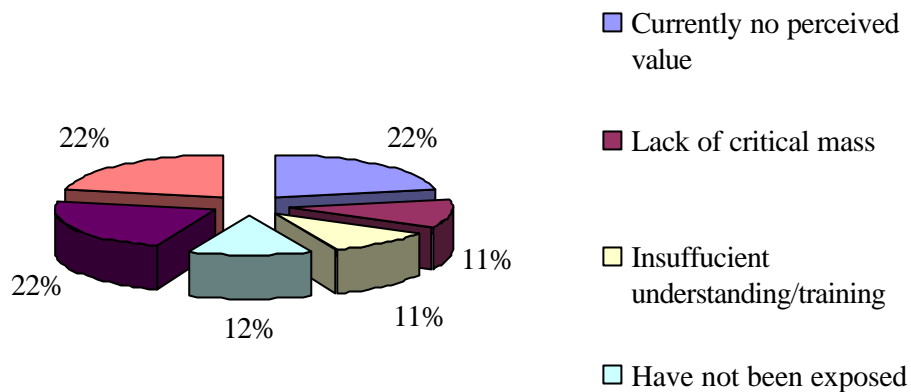


Figure 15. Reasons for the non-adoption of online Project collaboration tools

Collectively, reasons for resistance centered on the lack of exposure and education about these tools within the industry.

As evidenced from the research, the drivers to adoption in the AEC industry are less about understanding the benefits and more about perceived benefits, client recommendation and awareness brought on by marketing campaigns. From the survey carried out, it can be deduced that the AEC industry are majoritarily not early adopters of IT and if they have been so it was basically driven by a party higher in value chain or because they were involved in a pilot program.

5.5. Spanish situation

In Spain, the creation of specialized portals in the construction sector has a considerable delay as compared to other countries but the use of New Technologies is increasing every year.

In 2002, 74,20 % of the construction companies had Internet connexion, and only 21,14 % had web page. In 2003 these percentages increased considerably, 82% of the construction companies had Internet access, and 26% of these companies had web page (Inebase 2004).

5.5.1. Information portals

Most services offered online in the construction industry in Spain are information portals. These are some Spanish Information Portals:

Table 5. Examples of Information Portals in Spain

Information Portal	Access
Aconstruir	http://www.aconstruir.com/
Canal construir	http://www.canalconstruir.com
Calor y Frio	http://www.caloryfrio.com
CEW - Civil Engineering Web	http://www.civileng.com/
Construdata21	http://www.construdata21.com/
Construfácil	http://www.construfacil.com/
Construnario	http://www.construnario.com/
ConstruNet	http://www.construnet.net/
Construred	http://www.construred.com/
En obras	http://www.enobras.com
LaNaveIndustrial.com	http://www.lanaveindustrial.com/
Miliarium	http://www.miliarium.com/
Obracivil.com	http://www.obracivil.com/
Obrasyreformas.com	http://www.obrasyreformas.com/
Rentamaquina.com	http://www.rentamaquina.com/
Solo arquitectura	http://www.soloarquitectura.com
Todo Construcción	http://www.todoconstruccion.com/
Vitrubio	http://www.vitrubio.com/

5.5.2. Enterprise portals

Many large companies in Spain, like '*Fomento de Construcciones y Contratas*', '*IDOM*', etc., have created their own Intranet for the management of their projects.

5.5.3. Electronic marketplaces

The majority of e-marketplaces in Spain do not provide trustworthy information (at least controlled by third parties) about the business size or the number of actual customers. Most of them are in early stages of business plans, or in any case in a stage previous to the consolidation

of their business, and because of that the provided information is highly influenced by their marketing strategy.

The following table shows some electronic marketplaces in Spain.

Table 6. Examples of electronic marketplaces in Spain

Electronic marketplace	Access
BravoBuild España	http://www.bravobuild.es/
Construmarket	http://www.construmarket.com
Obralia	http://www.obralia.com
Buildpro	http://www.hyphensolutions.com/
Supplypro	http://www.hyphensolutions.com/

5.5.4. Web based Project Management Systems / Extranet

Spanish companies that decide to use a Web based Project Management Service tend to rent completely developed WPMS from an Application Service Provider (ASP) for a usage fee, which is normally charged per project, per the amount of computer storage space required, and/or per user.

Although there are many Spanish WPMS as well as others that, being abroad, allow Spanish language, there are very few specific WPMS for the construction sector in Spain. In the following table the only consolidated WPMS for the construction sector in Spain are shown.

Table 7. Examples of Web based Project Management Systems in Spain

Web based Project Management Systems	Access
Obralia	http://www.obralia.com/
ProjectCenter	http://www.bricsnet.es/

5.5.5. Study of different WPMS

After analyzing all the WPMS that are currently available for the construction sector, two of them were studied in depth by means of interviews with their managers.

From one side, *ProjectCentre* from *Bricsnet* was chosen because it's one of the few Web Based Project Management services that have headquarters in Spain and whose software is available in Spanish.

The other one is *Project Net* from *Bidcom*. It was also studied because the *ProjectNet* Extranet Solution is one of the global leaders in collaboration. In this case *Bidcom* is from UK and its services are not available in Spain yet.

5.5.5.1. ProjectCenter

In April 2001, *Bricsnet* presented the first on-line construction Project Management solution in Spanish: *ProjectCenter*. This platform was orientated towards promoters, owners, construction companies, public administrations and engineering companies for the management of projects through Internet. This tool enables previously authorized users to access every documentation of the project.

In Spain, promoters (35%) and engineers (23%) are the main users of *ProjectCenter* for the management of construction projects (Bricsnet 2002).

Amongst autonomic communities, Madrid, Catalonia and Andalusia are the regions that use more these kind of tools.

5.5.5.2. ProjectNet

Bidcom Ltd. is one of the leading providers of online collaboration solutions for the design, engineering, and construction industry. *Bidcom Ltd.*, based in London, provides sales and service solutions throughout Europe. Originally founded in 2000, *Bidcom Ltd.* developed lasting relationships with some of the world's leading companies, including owners, architects, engineering and construction firms. *Bidcom* developed a tool for the management of on-line projects in construction, *ProjectNet*.

ProjectNet is a way for all team members to share and access project documents around the world. It includes project management tools such as RFI's, Submitted Samples, Architect's Instructions, Meeting Minutes, Action Items, Logs, and more.

ProjectNet has over 6.000 active users in the UK. *Bidcom*'s customers include facility owners and operators, architecture, engineering and construction firms (ProjectNet 2002).

5.5.5.3. Conclusions

After analyzing these and other services, we reach the conclusion that the majority of WPMS are addressed to Architecture and Engineering Studies, Contractors and Owners. Clients and Owners basically contract these services to control the functioning of the project and the force the other partners to use it.

The rest of participants like suppliers, quality control entities, etc., habitually use these services not for the management of the project but for consulting. This means that they will have certain accesses and privileges but they won't be the direct users.

All the services follow the same steps to start a project. Firstly, the client must establish the structure and necessities, then they train all the future users, the client, and the partners, and an administrator (from the client) that will make the coordination function is designated. After that, the platform starts functioning and they give on-line and phone-like support to all the involved parties. In all cases, the administrator is the person in charge of giving access to the other partners.

Basically, the information that each participant has to provide is documents in whatever format (.doc, .xls, .pdf, .dwg, etc.), but each web based service has different forms of Invoices, Change orders, etc., where data is filled using the web and the documents are generated automatically.

On the whole, WPMS are only focused on **document management** and **communication management**; other services like electronic transactions are not offered in these tools because of their complexities.

After analyzing some current tools available in the market, different architecture and engineering studies, contractors and owners who are working with some kind of WPMS were studied.

5.5.6. Study of some companies using WPMS

With the aim of having a broad map of the application of WPMS, a study of some companies was carried out. It must be said that solid companies with a high degree of innovation were chosen. This means that this analysis is not to reach conclusions on the use of these tools in SMEs of the construction sector. The majority of AEC SMEs in Spain don't use any kind of Management System and sometimes neither PCs for their day-to-day work.

Grupo JG -an engineering services company- and *IDOM* -an engineering, architecture and consulting company- were preferred as representatives of the designer role in a construction Project. *FCC* was chosen to represent the role of contractor, and *GISA* that of the Client.

5.5.6.1. Grupo JG Ingenieros Consultores

Grupo JG is an engineering services company specialized in electrical and mechanical installations. It was founded in 1970 in Barcelona and currently there are offices in 8 Spanish cities.

Although *Grupo JG* has a WPMS called *COBRA*, it's only an internal service for the organization of the company's information.

COBRA is divided by areas: projects, bids, time and cost, general data, turnover, consultations, accounting and payments.

The 'project area' allows generating new projects or editing the old ones. The nomenclature to define a project is characterized for an initial dependent on the delegation, 3 correlative digits, and the starting year of the project. For example, B00103 is the first project undertaken by the Barcelona Delegation in 2003. Each project includes the options of Payments, General Data, Attributes (class, type, surface, and budget), Contacts (architect, acoustic consultant, promoter, etc.), Prevision (person, hours, etc.), Images, Results (comparison between the expected results and the real ones to do a balance of the project), and web link. All *Grupo JG* workers have access to *COBRA* to fill in their personal data like the hours they invest in a project, but other information such as biddings, contact persons, etc., is restricted to some persons. The 'bidding area' allows creating new offers or consulting the state of the offers. Other options are the management of hours and costs, introduction and control of the collaborators' hours and costs. Relating to 'general data', information like contacts, collaboration data, help, etc., is available and can be edited. In the 'turnover area', the allowed people can insert, control and consult the turnover. There is also an area of 'general people consults' (working charges of a current project, costs, etc.), bids (total, accepted, etc.), costs graphs, hours, etc. Another functionality is the 'accounting and payments' that includes consultations from companies and delegations.

In conclusion, *COBRA* is basically a human resources and project accounting control and management system, which allows the classification of the basic information of the projects in each delegation. It works as an Intranet but some areas of information can be viewed on the web, so it works partially as an Extranet. Moreover, they are working in some projects that were required by the client to use some collaboration platform.

5.5.6.2. *IDOM Architecture, Engineering and Consulting*

IDOM is a leading multidisciplinary group in the fields of engineering, architecture and consulting, with more than 1000 employees distributed in 22 offices in eleven countries and three continents.

IDOM Architecture, Engineering and Consulting opted for creating their own WPMS focused on the specific characteristics of their projects. With this application they aimed to solidify the digital management of the company activities processes reducing drastically the paper based storage of information, to facilitate the exchange of information (easy, faster and cheaper), and to improve their working methodology.

The tool is structured as a Lotus Notes database stored in a server of the company and published in Internet (Prosper et al. 2002).

When developing the tool they opted for a simple and friendly application to guarantee fast access to information.

In *IDOM*, a very relevant aspect of having the information in digital support was the easiness of finding information in a multidimensional classification. They have chosen three ways of document classification: firstly, a Decimal Classification due to the way they organize paper based documentation; secondly, a classification for types of documents, sometimes more useful for certain external collaborative spaces; and the third option, by keywords. In all cases, the responsible of the project can choose the classification that better fits both object and participants.

Each agent sharing the project has the previously stored information available, the information that other agents have put at their disposal, and a tool to store information. Document publications between agents can be enclosed by an e-mail message.

They basically store document in .pdf format. When a document comes from different applications (text, images, excel, etc.), the .pdf format helps the readability of the document. The only problem is that it's never editable.

When publishing a document, the person who publishes it should specify its addressee(s) who will be the only people to visualize it; this specification improves information control and flexibility, and avoids overwhelming agents with superfluous information. The management of biddings is also done via Internet.

According to IDOM, this application has been successfully accepted in the company. By the end of 2002, more than 200 projects were using it.

The experience created some problems that can be summed up in:

- The digital management of a project is not easily assumed by all the involved agents. In general terms, the most effective way would be the Client's contractual obligation to use these tools. But, although WPMS were imposed, certain suppliers will have limitations for not having an adequate technical infrastructure.
- The digital edition of documents like a letter is easy to implement. But certain types of reports, or the technical documentation of the project with a complex structure, need a complementary paper based edition.
- Digital management won't avoid paper based communication and documents of specific characteristics. Normally a notice is given by letter, Project Visa are submitted in paper, etc. But it is also a fact that interesting experiences are beginning like electronic Visa (vis@do), digital signature, etc.
- When the information project is stored in the server of a partner company, the other agents can distrust the manipulation of the information. In this sense, the acceptance of the electronic signature can be used as a validation element to increase the trust.

The development of this tool was initially for the management of internal aspects, but for IDOM it can be very useful for external agents. To improve this factor they want to:

- Provide specific formats for some type of documents like reports, minutes reports, etc.
- Create an option to visualize documents. Currently there is only the possibility to open documents with the programmes installed in the PC.

- Create a fast and informal communication modality, like chat, incorporating an agenda for the control of the development of activities.
- Currently, the tool carries out functions as a repository of information. In a near future, they want to incorporate collaboration tools to allow the common generation of documents.

5.5.6.3. *Fomento de Construcciones y Contratas S.A. (FCC)*

Fomento de Construcciones y Contratas, S.A. (FCC) results from the merger in March, 1992, of two prestigious companies: *Construcciones y Contratas, S.A.*, founded in Madrid in 1944, and *Fomento de Obras y Construcciones, S.A.*, created in Barcelona in 1900.

FCC started its business in the field of public services and today its production is highly diversified, since 53% is in sectors other than construction, notable amongst which are those of solid waste collection and disposal, street-cleaning, water supply, maintenance of drinking and waste water treatment plants, cement manufacture, real estate development, parking, urban furniture and fixtures, passenger transport, official vehicle inspection, airport handling, etc.

Early 2001 *FCC* created an Intranet for the management of the company. The solution was a private IP net with the following services: e-mail, web publication, documents transfer, net remote management, and corporative database and Internet access.

In respect to the e-mail, they have a global addresses list which is a public archive system controlled by electronic permissions and forms.

The web publication consists of a Technical Bulletin, Topics of Informatics (relation of applications, specifications and equipment costs, reports and manuals), Training (indexes and texts belonging to internal courses), Quality and Environment (agreements of the Quality Committee, General Procedures, experiences to transmit, improvement equipment), Machinery (internal norms and machinery utilization, norms for the risks prevention, etc.), Spain Construction (list of current sites).

Concerning document transfer, the Intranet includes documents of the Quality System, Drivers and Controllers, and software installations. From the net remote management, remote login, net monitoring, inventory and hardware management can be obtained. In relation to the corporative database, biddings, catalogues of suppliers, and photographs of different sites are stored. The tool also allows Internet access and access to public databases.

Concluding, and based on the study carried out by *FCC* and presented in the seminar *ConstruTIC* (*FCC* 2001), Intranet implantation achieved: faster and better reliability of information distribution, fluidity of communication between Central Services and Sites, information higher quality, awareness of the advance grade of the sites.

5.5.6.4. *Gestió d'Infrastructures S.A. (GISA)*

Gestió d'Infrastructures S.A. (GISA) is a public company run by the *Generalitat de Catalunya*, the governmental institution in Catalonia.

GISA was founded in 1990 and its purpose is contracting, building, maintaining, and producing public works of all kinds, as well as the services which may be installed or developed in conjunction with the infrastructures promoted by the *Generalitat*.

GISA follows a policy to maintain an ongoing process of upgrading its IT systems. Therefore, a total technological and functional renovation of the systems used for the economic, administrative, and financial management of the company, has been carried out.

To accomplish this, *GISA* has incorporated additional servers for data base management, communication and security management, thus configuring an adequate technological infrastructure for the use of the new information systems installed.

The development of an advanced digital signature system for contracts stands out as a technologically advanced project. A plan of actions for IT systems has also been developed, which aims at completing and integrating the systems of all the areas of the company in a way that will facilitate the internal management and the interrelations with external collaborators. To accomplish this there is a communications network which allows users - both company personnel as well as external consultants via Internet - to send and receive messages, documents, and plans without leaving their workplace. Moreover, the information about the tenders that take place periodically, as well as the final concessions and the documentation in an electronic format is offered to the public through *GISA's* Web on Internet (*GISA* 2002).

This extranet allows delivering documentation to *GISA* through the portal in an agile and structured way, publishing monthly reviews and the advance of the site, identifying the different actors participating in each stage of the project and easing the communication between them.

After some time using this service the following results are extracted:

In reference to the usability of the system and based on the improvements suggested by the users, the number of folders and levels should be reduced to a maximum of two and it's necessary to define document forms where the nomenclature and the document structure to publish were established.

Site directors value positively the save of time, and both internal and external workers consider the system very useful to add value to their diary tasks. In a near future they foresee integrated the digital signature.

5.5.6.5. Conclusions

In conclusion, some companies have led the development and implementation of Web Based Project Management System, creating their own platforms. However, most SMEs don't use any kind of Web Based tool, they don't even have a web page nor use PCs for their current work. Considering that the tendency of the sector turns to the use of these management tools, these SMEs will be compelled to start using them.

Nevertheless, big and some of medium companies are investing in creating their own Intranets for the Management of their business, and in a near future these tools will be used as collaborative spaces with other partners of the project.

The main problem will be the differences between these services. Each company is adapting these services to their necessities and, obviously, each firm has different organizational and functional systems. It's therefore necessary a common organizational model to unify all the available systems.

5.6. Summary

ICT represents an authentic revolution in terms of radical change of the current reality; but the users are not only 'new economy' but also traditional companies that must adjust their working processes to this new working model and their necessities to the new competitive advantages that new technologies represent.

AEC and especially SMEs have a considerable potential to benefit from these Information and Communication Technologies. However, despite these promises there are often significant implementation problems associated with the adoption of these tools. Internet can shorten distances, facilitate communication and collaboration, etc., but all this advantages are subject to the fact that all the implicated parts must be prepared to redesign their business. Besides, few

traditional firms would not feel comfortable implementing some kind of Information Technologies in all the aspects of the company, but they should take into consideration how these changes will affect their business trying to redesign part of it.

The Construction Sector is in the early days of adopting these online collaboration tools; nonetheless, early adopters are already realizing some of the benefits to be gained. In some European countries like UK, Finland, etc., architects, engineers and general contractors are adopting online project collaboration tools and understand their potential benefits. In Spain, this evolution is slower but it's envisaged that in a near future the tendency will be the same.

There are lots of tools and portals that offer any kind of service for the construction sector, in line with similar trends across all industries. Although several portals failed within a short time, others are still working. Some of them are only static portals giving information about a company, a service or a product, etc., others let electronic business, others are intranets for the management of internal companies. But, due to the current critical points of team collaboration and information exchange, Web Based Project Management tools are the most challenging for the construction sector. For any given project, many different participants from many different professions, often widely dispersed geographically, are thrown together for a short duration.

WPMS can help organizations to work together better by facilitating information access and sharing, improving the supply chain, leading to better buildings for less money, improving project progress communication, shortening of the project life cycle, increasing ownership and accountability, improving record keeping and documentation, etc.

The main objective of collaboration services is to move away from traditional sequential paper-based systems, thereby breaking down barriers to communication. But it's believed that the benefits being currently realized by early adopters cover only a limited range of the services that can potentially be offered by online project collaboration tools.

As a matter of fact, most Small and Medium Size Enterprises (SMEs) cannot afford investment in research and development and in new technologies, but if they want to be competitive they must gain access to project webs. They are, however, indirectly obliged to do so if they take part in a complex project in which all the other participants are using collaboration tools for the management of their companies and also for the management of the project.

Once these companies are compelled to use WPMS or find it necessary for their functioning, they will have to face different challenges to take advantage of the situation.