INVESTIGATING THE USE OF
PMASP-BASED PROJECT-SPECIFIC WEBSITES AS A
PROJECT MANAGEMENT TOOL IN THE A/E/C INDUSTRY

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Abstract

The A/E/C industry faces the inability to meet client demands of projects completed on time and on schedule due to the minimal collaboration between parties, communication problems, and mistakes. The present project management system in the industry is paper-based, and requires the owners of information to distribute the knowledge at their discretion. This system has inherent delays in information transmission, which lead to miscommunications, mistakes, and costly rework, which in turn, cause increases in the project schedule and budget.

There is a need to fundamentally change the project management philosophy of the industry. Rather than each party maintaining a project management system, there needs to be a single, integrated project-based system. One type of integrated project management systems is project-specific websites. This research focuses specifically on the project-specific websites for project management (PSWS) offered by construction-based project management application service providers (PMASPs). While there are substantial improvements in the project process including cost and time savings by using a PSWS, the industry is reluctant to adopt the new technology. There are numerous barriers to using PMASP-Based PSWS, a large one being implementation.

Through a literature review, a project management questionnaire, investigations of the leading construction-based project management application service providers (PMASPs), and implementation case studies, a chapter on implementation considerations and lessons was developed. The Implementation Considerations and Lessons chapter serves to provide companies a basis for PSWS implementation and use. The chapter contains three parts: background, implementation, and sustainability. The background section identifies the benefits of using PSWS, examines the ability of five construction-based project management application service providers to meet the project management need of the parties, and identifies barriers to implementation. The second part of the chapter details steps to implementing and using the system. The final part describes the sustainability challenges occurring after implementation.

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Chapter 1: Problem Statement

1.1 <u>Introduction</u>

Due to the fragmentation and specialization of the A/E/C industry, project parties generally work independently with limited interaction. The industry uses a paper-based information push project management philosophy. Each party maintains their own project management system and the owner of the information controls access to the information. Whereas the owner controls the information, he distributes, or "pushes," the information to those who he believes need the information. This style of project management often leads to schedule delays, budget overruns, and costly appeals due to miscommunications, mistakes, and rework. To resolve these problems, there is a need to move towards an integrated, real-time information pull project management system. Under an information pull system, users retrieve, or pull, the information that they need on their own. Under information pull, the individual makes the "do I need this?" decision, rather than the owner of the system. The use of online project-specific websites is a way of managing projects under an integrated, real-time system.

Project-specific websites for project management (PSWS) improve communication between parties, accountability, availability, and accessibility of information, reducing schedule and budget overruns. As clients learn about the benefits of this technology, they press for the use of the technology on their project. However, the A/E/C industry is slow in adopting this technology. Barriers impeding PSWS implementation include computer literacy, willingness to change, and trust of technology. Furthermore, there is little guidance in the industry considering implementation and sustainability of PSWS.

There are three primary objectives of this research. The first is to perform a needs and capability analysis between the project management needs of the parties in the A/E/C industry and the capabilities of five leading construction-based project management application service providers (PMASPs). The second part of the research is to look at the present use of project-specific websites for project management (PSWS) in the industry in

terms of benefits, barriers, implementation, and sustainability challenges. The final objective is to identify implementation considerations and lessons for the use of PMASP-Based project-specific websites for project management (PSWS) in the industry.

1.2 **Problem Statement**

The A/E/C industry revolves around projects and the people involved on those projects. Each project is a complex entity, with numerous project participants, design and project management issues, and the controlling factors of schedule and budget. The complexity of the projects leads to specialization, or fragmentation, of the industry. The fragmentation of the industry hinders communication and integration between parties resulting in inefficiencies. These inefficiencies are coming to the forefront, as clients are demanding that projects remain on schedule and under budget. To resolve these issues, there must be improvement in the main component of projects, project management. This section examines the nature of the A/E/C industry, the nature of projects, and the need for improvements in project management.

1.2.1 **Nature of Industry**

The A/E/C industry revolves around people and projects. Projects create an environment for project management improvement. Research indicates that the complexity of the projects leads to the fragmentation and specialization of the industry. Since parties tend to focus their contractual requirements, collaboration between the parties is limited. Whereas collaboration is limited, there are often communication failures. Parties focus more on their work and tend to neglect the effects of changes to their work on the other parties. The lack of communication of these changes and other important design information leads to miscommunications and mistakes that cause conflict, delays and budget overruns (Babcock 2000, Burton 2001, Laiserin 2001, O'Brien 2000).

Since the industry is very information dependent, the communication of this information is a key to success. Project participants need timely and accurate information for decision-making (Tam 1999). However, the communication

between the parties is slow and limited, primarily due to the paper-based nature of the industry. In general, communication occurs through letters, drawings, and other correspondence being signed, sealed, and delivered via hand delivery, mail, or other messenger/courier service. Document storage uses a paper-based customized system in file cabinets. This makes important documents often hard to recover and update, since the electronic versions then need to be found in order to revise. Furthermore, information is difficult for other parties to access when they need information relevant to their work on the project (Fruchter 1999, Pena-Mora 2001). Dr. Eddy Rojas of the University of Washington, on the paper-based industry wrote, "knowledge resides in project participants rather than in the institution" (Rojas 1999). This means that the individual participants are responsible for disseminating and controlling all vital project information in their possession. Time and distance factors and the willingness of project participants to share project information limit the accessibility of information (Ahmad 1999).

The industry utilizes a paper-based, "information push" system. When a project participant has a piece of information regarding the project, it is their job to select who needs this information and how to file it. This often results in miscommunication whereas someone does not receive a vital piece of information or information overload where a participant receives much more information than he needs. The recipient then needs to evaluate all of the information to determine what is truly vital to his end of the project. This system is not able to maintain control over information or retain accountability for who has seen, acted on, revised, or returned what information. There is no means of checks and balances, which leads to lapses in communication, poor understanding, and costly conflicts and overruns in schedule and budget (Angelo 2001, O'Brien 2000, Thorpe 2001).

The overruns in schedule and budget along with party conflicts are not acceptable to clients (Thorpe 2001). Clients need projects completed on this date within this budget, and are not satisfied with the present state of the industry. As clients demand more complex projects on shorter schedules and smaller budgets, the

industry must step up and find means of achieving this goal (Day 2001, Thorpe 2001).

The schedule delays, budget overruns, and party conflicts stem from the nature of projects, whereas projects are the root of the industry. Therefore, it is important to understand the critical aspects of projects in order to reduce these problems in the industry.

1.2.2   <u>**Nature of Projects**</u>

Projects are very complex in nature, requiring specialized knowledge, which leads to the fragmentation of the industry. Professor Feniosky Peña-Mora of MIT wrote that projects are "technically, socially, and economically complex in planning, management, and execution" (Pena-Mora 2001). From project inception through completion and turnover to operations and maintenance, a project is intricate and requires a high level of communication and management to ensure success (Ahmad 1999).

Successful projects depend on three entities, scope, schedule, and budget (Trump 2001). The goal is the completion of the project scope within the specified schedule and budget, as specified in the project contract. The project contracts govern the day-to-day operations and activities on the project. The day-to-day operations require the input and work of a variety of disciplines (Beck 2001, Pena-Mora 2001, Trump 2001). According to Mr. Peter Beck in his article *The AEC Dilemma-Exploring the Barriers to Change*, the multiple disciplines involved have poorly integrated "silos of knowledge" which hinder communication and the smooth flow of project information. Each party involved holds the information they produce in a "silo" and often does not share this information unless requested by another party (Beck 2001). Changes to the information often directly affect other parties, which are unaware of the changes.

In addition, each party involved on a project, including the owner, contractor, subcontractors, construction manager, architect, engineer, and other specialty consultants, has a different set of needs to fulfill their end of the project. In some cases, all parties need project plans, but other times a party may only need a piece of the information to answer an RFI (request for information). The problem lies in that the needs of the parties are not always clear. Therefore, parties often do not receive all of the information they need on a timely basis. However, according to Dr. Eddy Rojas, University of Washington, a successful project requires the "timely transfer of information among owners, project managers, general contractors, trade contractors, cities, inspectors, designers and lawyers" (Rojas 1999). A strong project management and communication plan is key to the success of the project and smooth information flow.

Project management is the management of all the project information and needs of the involved parties. It is a dynamic process whereas the information and needs of the project and parties are always changing due to changes, revisions, and updates. For these reasons, a strong cohesive project management system is essential to project success (Thorpe 2001). In general, however, each party has its own project management system and tools for creation, distribution, and storage of its project information, which limits collaboration and the smooth transfer of information (Hegazy "I: Information" 2001, Thorpe 2001).

As mentioned earlier, the industry mostly operates under a paper-based, information push project management system. As the projects become larger and more complex, the ability to exchange information readily using this system is shrinking. With an information push system, there is an overload of project information. Each piece of information is individually evaluated, dispersed, and then disposed of. Therefore, every person may not receive the information they need because someone else is making the "Do they need this?" decision. Secondly, with a paper-based system, considerable time is spent waiting on requests for information (RFIs), changes orders, and other required

documentation. Since each party has its own project management system and tools, it is difficult to keep track of these documents, leading to delays in project duration and a lack of accountability (Capano 2000, Thorpe 2001).

The paper-based system limits the flexible communication lines needed for project success. Communication is critical to the project. It "bridges the parties to undertake the activities for fulfilling the contract terms and conditions" (Cheng 2001). Since there is a considerable amount of communication and collaboration that should occur on a project, a uniform, project-based project management system may be the solution.

1.2.3 <u>Need for Improved Project Management</u>

Dr. Rojas speaks of the new paradigm for information in the A/E/C industry. Ownership, availability, accessibility, and timeliness of information are crucial components that need to be improved. Under the current system, the party that holds the information owns the information. The information is only available if the party shares it and accessible only when the owning party is available. Once a request for information occurs, there is lag time between the request and receipt of the information. Whereas information is crucial to the project, the limited ability to request and receive this information delays projects and often results in higher costs (Rojas 1999).

Client satisfaction is now the primary focus and measure of success for many A/E/C firms (Doherty 1999). Clients define success as those projects completed on time and under budget. Clients are also demanding increases in the services the A/E/C firm provides. In addition to the classic roles of design and construction, clients look for financial, planning, operations and maintenance services. These changes drive the need for increased collaboration between parties. Therefore, in order to meet these demands, the A/E/C industry must restructure their project management philosophy. The multiple, paper-based systems controlled by the individual parties hinder communication and the

efficient flow of information.   An integrated, real-time project management system, such as PSWS, allows for the increased collaboration needed to meet client demands (Doherty 1999).

Research indicates there is a strong need to reduce costs and delays on projects. Reducing costs stems from pure cost-related items to issues that raise costs. Cost reductions come from retrieval, reproduction, and shipping costs along with travel costs. Personnel cost reductions in terms of hours of repetitive tasks and retrieval of necessary information. Furthermore, claims and litigation often drive up a firm's costs in terms of legal fees, personnel costs, and document retrieval, which become overhead. A reduction in the need for claims and litigation along with reductions in the schedule come from improved accountability (Friedlander 2000, Koprivica 2002, Kraker 2000).   Improving accountability means having the ability to track changes, record communications sent and received, and who has seen, acted upon, and signed what information. Improved productivity also reduces schedule and budget. By reducing the amount of duplicate information and minimizing the lag time for information exchange, then participants can concentrate on the crucial project components and not spend time redoing work or chasing down information (Curry 2000, Friedlander 2000, Koprivica 2002, Kraker 2000, Rojas 1999, Watts 2001).

In summary, there is a need to reduce the costs and durations of projects to keep them within the stated contract limits. In order to achieve this, there needs to be an increase in productivity and accountability on projects, and at the same time, a reduction in costs and litigation. Information must become more accessible and available in a timely manner as well as properly shared among the project parties. These needs require changes to the project management philosophy of the A/E/C industry (Beck 2001, Rojas 1999).

Instead of multiple, paper-based systems for each party involved on a project, there could be a single, integrated, real-time project management system. This

single system would enable all aspects of the project to be monitored, tracked, and accessed online (Doherty 1999). All project information is centralized, accessible by all parties at any given time. This addresses the issues of ownership, accessibility, availability and timeliness of information. The system reduces costs in terms of reproduction and transmission of information as well as personnel hours. The system has features that enable accountability for RFI processes, submittals, and other correspondence issues. A single project management system has the ability to redefine project management and the way the industry operates (Ahmad 1999, Friedlander 2000, Rojas 1999).

However, the concept of real-time, integrated project management has yet to materialize for several reasons. The fragmentation of the industry creates a more challenging environment for collaboration and coordination between the project parties. Furthermore, there is a fear or hesitation towards technology in the A/E/C industry due to the wide range of skill levels involved. In order for online project management to be successful, all parties must be willing to utilize this technology (Kraker 2000, Mitropoulos 1999).

1.3 <u>Purpose</u>

As noted, there is a need to improve project management in the A/E/C industry. There are several integrated, real-time project management tools for firms to choose from including software programs, in-house servers, and leased web space from construction-based project management application service providers (PMASPs). However, the A/E/C industry tends to be slow in adopting new technologies. Therefore, there has not been widespread adoption of these tools.

While previous research focuses on project management problems in the industry and the perceived benefits of project-specific websites for project management (PSWS), little research looks specifically at how the systems meet industry needs and the implementation of this technology. The purpose of this research is to promote the use project-specific websites for project management (PSWS) from construction-based project management application

service providers (PMASPs) as an integrated, real-time project management tool. The research looks at PMASP-based PSWS in terms meeting the project management needs of the industry, the present use of the systems, and their implementation and sustainability

1.4 <u>Objective</u>

The research has three primary objectives. The first is to perform a needs-capability analysis of five of the leading construction-based project management application service providers (PMASPs). Second is to gain insight into the use, implementation, and sustainability of project-specific websites for project management (PSWS) in the industry through current users. The final objective is identify implementation considerations and lessons for the use of project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs).

1.4.1 <u>A Needs-Capability Analysis</u>

The first objective is to determine the usability of the existing project specific websites. Do project-specific websites for project management (PSWS) offered by the leading construction-based project management application service providers (PMASPs) meet all of the project management needs of the involved parties? The goal of this objective is to first determine the project management needs of the various parties involved including the owner, construction manager, contractor, subcontractor, architect and engineer. The second step is to determine which aspects of project management the leading PMASPs offer on their PSWS. An analysis of these two steps determines whether the capabilities of the leading PSWS systems meet the needs of the industry parties.

1.4.2 <u>Explore Use of PSWS in the Industry</u>

Real-time, integrated project management is a potential solution to the current inefficiencies, communication challenges, and project schedule and budget overruns. The second objective of this research is to explore the industry's use of project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs).

The study of PSWS usage focuses on the benefits, barriers, implementation steps, and sustainability challenges that users encounter.

1.4.3 Identify Implementation Considerations and Lessons for PMASP-based PSWS

The third objective is to identify implementation considerations and lessons for firms in the A/E/C industry with a desire to use project-specific websites for project management. This objective focuses on project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs). The first part of the Implementation Considerations and Lessons chapter includes background information on the benefits of and barriers to PSWS use and a need-capability analysis. The second part of the chapter is a detailed implementation plan. Finally, the chapter describes the sustainability challenges faced after implementation. The identification of implementation considerations and lessons comes from previous research and the results of the first two objectives.

1.5 Objective Methodology

Together, several different methodologies achieve the above objectives.

- A literature review of previous work performed in the areas of project management needs, problems, and potential solutions, provides a background and foundation for the research.

- Questionnaire responses from various individuals in the A/E/C industry regarding their project management needs establish the needs of the project parties.

- Investigations of five leading construction-based project management application service providers (PMASPs) explore the capabilities of the systems in terms of project management.

- Case studies of companies who use Constructware, a leading construction-based project management application service provider, provide insight into their experiences with project-specific websites for project management (PSWS) in terms of benefits, barriers, implementation, and sustainability challenges. Furthermore, several of these companies utilize other construction-based project management application service providers (PMASPs) besides Constructware.

- Compilation of information from previous research, PMASP investigation, project management questionnaires, and case studies identify implementation considerations and lessons for the use of project-specific websites for project management (PSWS) available through construction-based project management application service providers (PMASPs).

1.6 Scope and Limitations of Research

There are numerous types of and uses for project-specific websites along with a range of construction-based application service providers, as illustrated in Figure 1 below. Each of the various construction-based application service providers has different goals and capabilities for its use, as shown in the figure. This research, however, focuses specifically on the use of project specific websites for project management (PSWS) available through construction-based project management application service providers (PMASPs). The PMASPs provide comprehensive project management services to those in the A/E/C industry by addressing all of the "Target Uses" shown in Figure 1 (AGC 2002, Roe 2001).

Target Uses for PSWS Using PMASPs	Construction-Based Application Service Providers								
	Web Design	Software Rentals	Online Meetings	Online Plans	Bidding	E-Commerce	Equipment Management	Project Management (PMASPs)	Other
Public Information	X							X	
Bidding				X	X			X	
Procurement						X		X	
Plan Distribution			X	X				X	
Contract Administration			X					X	
Design Collaboration			X	X				X	
Field Operations				X				X	
Document Management				X				X	
Scheduling								X	
Budgeting								X	
Other		X					X	X	X

Figure 1: Target Uses for PSWS using PMASPs

Furthermore, in the investigation of construction-based project management application service providers (PMASPs), research includes five leading PMASPs: Constructware, Citadon, Autodesk Buzzsaw Professional, E-Builder and Meridian ProjectTalk. While the implementation case studies focus specifically on companies using Constructware, the similarities in the PMASPs make the research and the implementation considerations and lessons applicable to the family of PMASPs. Furthermore, several of the case study companies utilize other construction-based project management application service providers (PMASPs), besides Constructware, increasing the applicability of the research.

1.7 <u>Report Outline</u>

The report consists of ten chapters.

Chapter 1: Problem Statement

This chapter introduces the problem, the objectives of the research and the research methodology.

Chapter 2: Literature Review

This chapter explores previous research on the topic. It looks at project management in the industry and the need for improved project management. The literature review explores online project management, in general, and then specifically focuses on application service providers and the PSWS they offer. Then, the review examines the researchers' views of the benefits, barriers and implementation of PSWS.

Chapter 3: Methodology

This chapter details the five-step methodology used to achieve the three objectives detailed in Chapter 1.

Chapter 4: Needs-Capability Results and Analysis

This chapter focuses on the first objective, a needs-capability analysis of PSWS. Based upon the Project Management Questionnaire results and previous research, the chapter identifies the project management needs of the parties in the A/E/C industry.

The chapter also contains an examination of the project management capabilities of the leading PMASPs. The analysis between the project management needs of the parties and the capabilities of the PMASPs completes this chapter.

Chapter 5: Present Use of PSWS Results and Analysis

This chapter provides a summary of each implementation case study. The summary of the case studies looks at the benefits, barriers, implementation, and challenges of PSWS that the companies face. The analysis of the results looks at whether the PSWS are truly "single points of access" and whether users post information because it is vital to the project, or "just-in-case" someone needs it.

Chapter 6: Implementation Considerations and Lessons

This chapter merges the information gathered through the literature review, project management questionnaire, PMASP investigation and implementation case study and identifies implementation considerations and lessons for the use of PMASP-Based PSWS. The chapter provides background insight into the benefits of PSWS and the barriers to implementation. The chapter then gives a detailed implementation plan for implementing PMASP-Based PSWS and describes potential sustainability challenges.

Chapter 7: Conclusions and Recommendations

The final chapter in this report summarizes the findings of the research and provides recommendations for PSWS improvements and future research.

Chapter 8: References

This chapter contains a list of references included in the report.

Chapter 9: Appendix A

This appendix contains the Implementation Case Study.

Chapter 10: Appendix B

This appendix contains the Project Management Questionnaire.

Chapter 2: Literature Review

2.1 <u>Present State of Project Management in the Industry</u>

The A/E/C industry revolves around people and projects. The effective management of the projects and the people involved are crucial to the success and growth of the industry. Presently, the industry primarily operates under a paper-based project management system. Under this system, each party retains ownership and controls the availability and accessibility of its project information. However, project information overlaps between parties and the information generated by one party affects the work of the other project parties. Therefore, effective communication of all project information is crucial to the success of the project (Roberti 2001, Rojas 1999).

The paper-based system is often referred to as an information-push system. With an information push system, there is an overload of project information. Each piece of information is individually evaluated, dispersed, and then disposed of. Therefore, every person may not receive the information they need because someone else is making the "Do they need this?" decision. In addition, the linear flow of information leads to information distortion. Secondly, with a paper-based system, considerable time is lost waiting on requests for information (RFIs), changes orders, and other required documentation. It is difficult to keep track of these documents, which often leads to delays in project duration and a lack of accountability (Thorpe 2001).

In the past, paper-based project management was the primary way to manage a project. However, technology innovations over the years produced numerous project management tools ranging from software programs, online applications, hand-held devices, satellite and wireless technology and others. The present means of project management are not able to meet the current demands of clients who see the promise of the new technologies. To succeed, firms in the A/E/C must reexamine and restructure their project management philosophy incorporating new technologies (Hegazy "II: Collaborative" 2001).

2.2 <u>Need for Improved Project Management</u>

As projects become larger and more complex, the ability to exchange information on a timely basis using this system is shrinking. The paper-based project management system cannot meet the demands of today's projects. There is a tremendous amount of information on a project that is always changing. The transmission of information needs to be quick and accurate to all the parties affected so that work can proceed and delays are minimal (Ahmad 1999, Rojas 1999).

However, the industry mostly operates under a paper-based, information push project management system. This system has limitations in terms of information ownership, availability, accessibility, and timeliness. The party who creates the information owns it and controls availability and accessibility. Other involved parties must rely on the owning party to transmit all necessary information or prepare requests and wait for receipt. Under the present project management system, there is not effective management of all the project information. The ineffectiveness of the system leads to mistakes, miscommunications, delays, and cost overruns (Burton 2001, Rojas 1999, Thorpe 2001).

Client satisfaction is now the prime focus and measure of success for many A/E/C firms. Clients define success as those projects completed on time and under budget (Capano 2000, Day 2001). The current project management practices lead to schedule and cost overruns, which do not please clients. Therefore, research indicates success depends on good project management. Project management must be flexible and able to adapt to the varying roles of project participants depending upon the project delivery method chosen. Furthermore, it must enable clear, effective, accurate, and timely communication and collaboration between the parties to ensure a smooth workflow. However, the present paper-based system cannot effectively manage the increasingly complex projects on tight schedules and budgets that clients demand (Augenbroe 2000, Capano 2000, Day 2001, Thorpe 2001).

There is a need to change the way projects are managed. Project information must be more accessible and available to all parties who need it. According to several researchers on this topic, the shift from the paper-based information push system to an online information-pull

project management system is a potential means of improving communication and the accessibility and availability of information. Under an information-pull system there is a single project-based project management system that all parties use collaboratively as opposed to the multiple project management systems run individually by each project party. This shifts ownership of information from individual parties to a centralized area that is always available and accessible. With online project management, there is generally little to no delay in obtaining information and problems can quickly be resolved. The A/E/C industry must restructure its project management philosophy, shifting away from multiple paper-based systems to a single integrated, real-time system (Rojas 1999, Tam 1999, Thorpe 2001).

2.3 <u>Online Project Management</u>

In order to meet the demands of clients for complex projects delivered on time and on schedule, the project management philosophy of the industry must be reconsidered. Given the current inefficiencies, delays and budget overruns occurring on projects, improvements need to be made to the present project management systems. The industry must move away from the multiple paper-based project management systems towards a single web-based project management system for the project. Rather than each party maintaining their own system for its project data, there needs to be centralized system that manages all project information (Laiserin 2001, Rojas 1999, Doherty 1999).

Online project management is the ability to "share firm and project data online in a variety of methods and for a variety of purposes, using standard, familiar web browser software" (Laiserin 2001). It enables project information to be created, revised, and exchanged through the web making information more accessible, available, and timely. In doing so, these web-centric systems break down organizational boundaries allowing for improved communication, teamwork, workflow, and accountability. The web-based project management systems are a means of alleviating the budget, schedule, and communication problems that plague the industry (Fruchter 1999, Doherty 1999, Rojas 1999).

This section looks at the history behind the Internet, the medium for online project management. It then examines the various types and general benefits of online project management systems and the industry trends with regard to project management tools.

2.3.1   History of the Internet

The Internet, particularly the World Wide Web, is the medium for the exchange of information on the web-centric project management systems. The use of the Internet for communication and collaboration of project information follows the purpose of the Internet when it was developed. In 1960, the United States Department of Defense's Advanced Research Project Agency initiated a project to link computers scattered among diverse military, defense contractors, and university sites. By 1969, four computers successfully exchanged data with each other on the Advanced Research Project Agency Network (ARPANET). ARPANET adopted the now common TCP/IP communication protocols in 1983, and in 1987, became the center of a collection of networks, called the "Internet". The introduction of the graphically based World Wide Web (Web) in 1993 paved the way for commercial use. The Web is the fastest growing segment of the Internet. The Internet and its Web interface are an increasingly popular mode of communication and information distribution. Restrictions of location, time differences, or varying computer operating systems do not affect Internet or Web use. It is an accessible, constantly available medium for communication and information distribution and retrieval (Tam 1999).

2.3.2   Types of Web-Centric Systems

As the use of the Internet and Web increases, new web-based tools, and systems are continuously developed. In terms of the A/E/C industry, the Web has a multitude of uses. Many companies have company web pages that provide information at to their services, locations, projects, personnel and employment information. Electronic mail (e-mail) is a popular form of communication used by members of the industry.

As e-mail has begun replacing regular mail and in some cases phone calls in terms of communication between parties, technology developers see the potential of moving project management online. E-mail has sped up communication in that there is a permanent record of emails sent and received as well as being accessible at all times. The technology innovators feel that the Web could make project information more accessible and available by using the Web for project management purposes (Fruchter 1999, Hegazy "II: Collaborative" 2001).

Online control of many project management aspects occurs in several ways. First, companies may develop simple websites, similar to the websites commonly used, to post vital project information. The sites generally offer information such as public notices and announcements, site photographs and key contacts. Some more advanced sites may have scheduling information, important documents, or file exchange. However, companies are responsible for maintaining, updating, and running these sites. This requires considerable IT expertise and commitment (Laiserin 2001, Unger 2001).

In-house client-server networks, known as intranets, became popular in the 1990s. Client-server networks generally consist of a main server at the company's corporate site that links the branch offices to each other as well as the home office. Software is loaded onto the server and then downloaded from the network to individual computers. Within the company, file sharing occurs through the network, but there is limited ability for external firms to access the network and project information. In some cases with extensive programming, the development of extranets allow external parties to log on to the other company's intranet to access information. However, extranets generally do not allow external parties to post and share their information. Furthermore, client-server applications require extensive investment in hardware and software along with considerable IT expertise and commitment (Laiserin 2001, Unger 2001).

The third option is to use a construction-based project management application service provider (PMASP). PMASPs are an external source that creates a project management application, accessible through an Internet web browser. The provider is responsible for hardware, software, maintenance, and upgrades. The companies who use PMASPs simply log onto the project management system through a standard web browser and access the project-specific website (PSWS) for their projects. The application and all data are stored on the provider's servers, requiring little IT staff for the companies. Furthermore, companies are not responsible for expensive hardware, software, servers, or upgrades (Laiserin 2001, Unger 2001, "What" 2001).

2.3.3 General Benefits of Web-Centric Systems

Web-centric systems are a means of improving project management. The systems address the four key information issues identified by Rojas: ownership, accessibility, availability, and timeliness. The systems cross organizational boundaries, improving communication, workflow, and document accessibility. They provide a centralized access point for project information that is available all day, every day. Ownership shifts from individuals to the project. While all three online project management options have their pros and cons, they all serve to improve access to project information (Augenbroe 2000, Baker 2000, Rojas 1999).

2.3.4 Trends in Online Project Management Use

The trend in the industry is shifting away from project intranets/extranets for project information to construction-based project-management application service providers (PMASPs). PMASPs offer extensive project management programs accessed through a standard web browser. They require little IT investment and no hardware or software upgrades or maintenance. Therefore, PMASPs tend to have a lower total ownership cost than client-server applications and offer more features per dollar of cost. In addition, all project parties can easily use PMASPs

for many project management aspects, requiring little maintenance or IT work by users (Unger 2001, Unger 2002)

2.4 <u>Construction-based Project Management Application Service Providers</u>

Construction-based project management application service providers (PMASPs) appear to be the project management trend for the future for the A/E/C industry. PMASPs offer a comprehensive project management program, accessible through the Web by all project participants, with little IT investment. This section first provides a comprehensive definition of PMASPs. The study examines the history of PMASPs and emergence of the few leading construction-based project management application service providers (PMASPs). A comprehensive look at five leading construction-based project management application service providers (PMASPs) explores their capabilities, features, and clients.

2.4.1 <u>Definition of Construction-Based PMASP</u>

A construction-based project management application service provider (PMASP) is a "dedicated web hosted collaboration and information space" for A/E/C projects (Augenbroe 2000). The outside provider creates a project management application accessible by users through a standard Web browser. The providers are responsible for all hardware and software investment, maintenance, and upgrades. Users only need a standard web browser and generally a minimum amount of RAM for their computers. This shifts responsibility for the server and application from A/E/C companies to external providers resulting in less IT investment for individual A/E/C firms. Companies using these programs pay a per seat user fee for access to the application and then any necessary training sessions (Doherty 1999, Unger 2001, "What" 2001).

The PMASP provides a project-specific website for project management (PSWS) for each project. The site is the interface to the PMASP's applications that allow for project document creation, upload/download, storage, tracking, and file exchange. Management of project documents such as drawings, specifications, RFIs, submittals, schedules, correspondence, and progress reports is online. It is a

means of sharing information via the Internet while still limiting access to that information. The leading construction-based project management application service providers (PMASPs) may also offer a variety of advanced options include online meeting, site video/photo, document redlining capabilities and other management functions. The capabilities of the PMASPs are always expanding as new functions and integration abilities are developed (Babcock 2000, Baker 2000, Capano 2000, "What" 2001).

The project specific websites for project management (PSWS) provide a centralized, accessible, reliable means of transmitting and storing project information. Since access to the application is through the Web, information is available 24 hours a day, 365 days a year from any computer with an Internet connection. All project members have access to the same information in a reliable, easily retrievable manner. With a centralized, single project management system for a project, all project parties in the design and construction process are able to collaborate and efficiently share project information (Baker 2000, Doherty 1999, "What" 2001).

2.4.2   <u>**History of Construction-based Project Management Application Service Providers (PMASPs)**</u>

Construction-based project management application service providers (PMASPs) emerged in great numbers around 1997. These dot coms including companies such as Constructware, Buzzsaw, Red Ladder, Buildpoint and more came all at once. Many were developed by venture capitalists who were seeking short financial gains. Investors were overzealous in their goals, and planned on a much faster adoption process than that which has occurred in the industry. The flooding of the market and the lack of interest by these capitalist to sustain viable dot-coms led to the demise and consolidations of most of the PMASPs ("Demise" 2001, Jurewicz "Consolidations" 2001, Jurewicz "Five" 2001).

Over the past few years, the PMASP market has shrunk in the A/E/C industry as the numerous failures and consolidations have occurred. The PMASPs that survived have a strong potential for continued success. Now that there are just a few leading construction-based project management application service providers (PMASPs), there is a greater chance for PMASP usage to take hold in the A/E/C industry. The survival of the leading PMASPs comes from their dedicated investors and their focus on the needs of their clients and the industry as a whole (Jurewicz "Consolidations" 2001, Jurewicz "Five" 2001, "Demise" 2001).

2.5 Benefits of Using PMASP-based PSWS

Research indicates that project-specific websites for project management (PSWS) bring many benefits to the industry. Using PSWS available from construction-based project management application service providers (PMASPs), there are improvements in communication, productivity, and risk management. In addition, there are cost and time savings associated with PSWS use. Furthermore, there is an increase in competitive advantage over other firms.

2.5.1 Communication

Research indicates that good communication is critical to project success. Rojas believes that information management in terms of accessibility, availability, ownership, and timeliness of information influences communication. Rojas believes that PSWS address and improve these four aspects of information. The PSWS provides a single point of access, or a central repository, for project information. Ownership of the information shifts from the creating party to the project, increasing the accessibility of the information. Information is now available 24/7 from anywhere with an Internet connection rather than only when the owning party makes the information available. All parties have access to the latest drawings, schedules, documents, and other vital project information at the same time. This reduces miscommunications and inefficiencies in communication. Furthermore, the PSWS is an information pull system as opposed to the current information push system. With information pull, users

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access information, as they need it, eliminating out of phase work and irrelevant information. They receive vital information "just-in-time," rather than waiting to receive requested information (Beck 2001, Curry 2000, Day 2001, Friedlander 2000, inSite 2001, Koprivica 2002, Kraker 2000, Rojas 1999, Thorpe 2001).

2.5.2 <u>Productivity</u>

Increased productivity is another benefit of PSWS according to leading researchers. The PSWS simplifies the project management process making team members more efficient.   The creation and distribution of information occurs once, rather than multiple times, as various parties request the information. Information is in one integrated system, rather than being in multiple companies' logs, requiring multiple entries. In addition, there are improvements in change management, which improves productivity (Hegazy, "I: Information" 2001, inSite 2001).   The change process, including making, managing, and distributing the changes, takes hours rather than days. The reduction in time allows other team members to always be working with the most recent information, rather than making mistakes that require rework. There are also productivity improvements in RFI and submittal tracking, which reduce the turnaround time of these issues. The tracking feature notifies users when there are issues requiring their attention and allows other parties to know who is responsible for bottlenecks. The online tracking process reduces the turnaround time of these issues by enabling instantaneous knowledge of document status and approval decision (Hegazy, "I: Information" 2001, inSite 2001, Koprivica 2002, Roe 1999).

2.5.3 <u>Time and Cost Savings</u>

Use of a PSWS system result in savings in project time and costs. Sharing the information online reduces the amount of paper utilized, which leads to fewer misplaced documents and fewer delays waiting for documents to arrive. On the same note, postage and delivery costs are less since users can simply download documents as needed. In terms of project closeout, project information is stored on CDs rather than in boxes in storage. Besides paper costs, there are reductions

in personnel costs. Employee travel costs decrease since project monitoring, meetings, and daily reports are available online. Furthermore, there is a lesser need for IT staff since the PSWS require less IT investment, particularly in infrastructure and maintenance (Ahmad 1999, Friedlander 2000, inSite 2001, Roe 1999).

One small company in Connecticut, Clarke-Tamaccio Associates led a project team of nearly forty members, representing thirty firms on a high school restoration and renovation project. Using Autodesk Buzzsaw, a project-specific website for project management, the firm experienced an overall time savings of fifteen percent and a fifty percent reduction in the printing and postage costs (Firek 2001).

Other industries, automotive for one, have also found that online project management and collaboration leads to signification time reductions during the design and concept phase. During the design of the 2002 Jeep Liberty, Johnson Controls, Inc. reduced their design time by a third. Appliance manufacturers such as Whirlpool have also turned to online project management to streamline the design process. In addition, Ingersoll-Rand, a global manufacturer, has designers in China, Europe, India and the United States collaborating on refrigeration units, air compressors, rock drills and paving equipment amongst other products. Ingersoll-Rand has found that the collaboration results in lower design and engineering costs and allows them to "design anywhere, build anywhere" (Konicki 2002).

2.5.4 **Competitive Advantage**

Since PSWS improve communication and productivity on projects, the company is better able to meet the demands of projects completed on schedule and budget (inSite 2001, "Portal" 2000). The ability to consistently meet these demands is an important asset that sets one company apart from another. The PSWS also provide improved client care. There is an increase in client satisfaction because

the project is subject to fewer delays due to communication problems and waiting for information, building in cost and schedule certainty. Furthermore, the client can be given access to the site and be able to track the project, view drawings to determine if changes need to be made, and potentially track project progress through site photographs or construction web-cams that are part of the online project management system (Ahmad 1999, Babcock 2000, inSite 2001, "Portal" 2000).

Furthermore, the use of PSWS may be a marketing tool. As clients become more aware of these tools, many require them as part of the contract conditions. A company who uses PSWS can build global project teams as well as build projects around the world. They also are better able to meet the project budget and schedule and provide improved client care during and after the project. Having experience with PSWS makes a company more appealing to a potential client (Ahmad 1999, "Portal" 2000, inSite 2001).

2.5.5   Risk Management

Risk management is an important part of any project. The proper management of risks limits delays, budget overruns, and claims between parties. Researchers believe that PSWS have the ability to improve the management of these risks, building in cost and schedule certainty and reducing claims. In terms of schedule and budget certainty, the PSWS improvements in communication, change management, and information exchange lead to time and cost savings. Furthermore, the improved change management and RFI/Submittal tracking features help these processes run smoother, leading to fewer delays and costly rework (Angelo 2001, Day 2001, Koprivica 2002).

The RFI/submittal tracking feature as well as the improved change management may reduce the number and extent of claims between parties. By tracking project status online, accountability rises. No one can hide from this system, as it is easy, for example, to track the status of an RFI or how long the engineer has held shop

drawings. Notification of changes is immediate and project information is always up-to-date. There is no question as to whether or not a party has access to the latest version of the drawings or documents (Day 2001, Capano 2000, Roe 1999).

2.6 Barriers to Using PMASP-based PSWS

The nature of the industry and projects is a barrier to the use of project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs). Due to the complexity of projects, there is extensive fragmentation in the industry. The fragmentation creates a more challenging environment for cooperation and collaboration between the parties. Therefore, parties are unwilling to use a single integrated project management system (Fruchter 1999, Kraker 2000). Researchers tend to divide the barriers to PSWS use into two categories: technological issues and people issues.

2.6.1 Technological Issues

Technological issues include the tangible areas of hardware and software and legal/security issues in terms of the use of PSWS. One concern over PSWS is changes to hardware and software. Companies question the extent of changes, need for maintenance, and the reliability of the technology. A common worry is what happens in the event of hardware or software failure. Another barrier researchers focus on is the lack of industry standards and compatibility of PSWS with existing business processes. Numerous software programs perform functions such as word processing, CAD, scheduling, estimating, accounting, design calculations, and project management. There is concern over whether the PSWS will support all of the existing processes (Firek 2001, Friedlander 2000, Jurewicz "Obstacles" 2001, Kraker 2000, Rojas 1999).

Furthermore, there are barriers in terms of the security of PSWS and the legal standing the PSWS has in court should claims or other issues arise. There is concern that unauthorized parties will have the ability to view, modify, or delete project information that they are not entitled to. In addition, there are questions regarding liability for lost information and data backups. There are legal questions over responsibility for and confidentiality of information. In addition, researchers advise of legal issues regarding signatures and audit trails for claims (Friedlander 2000, Pena-Mora 2001, Watts 2001).

2.6.2   **People Issues**

People issues are the primary barriers to the use of PSWS. The barriers span from the nature of the industry down to the individual user. Researchers indicate that resolving the people issues is a critical part of implementing PSWS.

2.6.2.1 Industry

The fragmentation of the A/E/C industry is a large barrier to the use of an integrated project management system. Parties tend to focus on their end of the contract rather than on collaboration between parties. Furthermore, the fragmentation also results in a lack of industry standards meaning each party performs work their own way. Integrating these individual systems is challenge (Fruchter 1999, Koprivica 2002, Kraker 2000). Furthermore, as Konicki writes, "if your partners don't use it, it's a lot less useful to you" (2002). If not all the project parties can agree on a single system to use, the companies and the project will not reap the benefits of the PSWS (Kraker 2000, Mitropoulos 1999).

2.6.2.2 Support

With any new technology, management must support the use of the technology and provide the necessary resources to encourage its use (Koprivica 2002, Phair 2000). The construction industry spends relatively

little money on technology according to Mark Roberti, in *Construction Chaos*. Roberti presents data from the research firm Gartner that shows the construction companies spend, on average, only $835/employee on information technology. In comparison, manufacturing firms spend $3500/employee and financial services companies spend $27,000/employee (Roberti 2001).

2.6.2.3 Fear of Technology

The construction industry has a mix of project parties ranging from suppliers to architects/engineers to contractors to owners. The mix of parties has an equally diverse level of technology experience. Those with little experience may have a fear of using technology. Furthermore, even those with technology experience may have fears over the security and reliability of information on PSWS (Thorpe 2001).

Gerald Smith and Avi Wiezel report in their work *The Construction Industry's Adoption of the Internet*, that the majority of the industry is "early and late majority" adopters of technology. Driven by a strong sense of practicality, these groups wait to see how others make out, and in the case of the late majority, need lots of support and an established standard. No established standard or support mechanism is in place yet. A recent study in *Internet World* showed that currently only four percent of small to mid-sized firms are using project intranets as a means of collaboration but 39% indicated a desire to utilize them (ASPs 2001). The lack of an implementation standard or guide is one barrier these firms face.

2.6.2.4 Unwillingness to Change

Researchers indicate that individuals in the A/E/C industry are reluctant to adopt new technologies. Many feel that the existing paper-based methods of project management work fine and there is no need for change. Users need to know that the PSWS will meet their needs and meet the promises

the PMASPs make. Others see PSWS as just another corporate procedure to follow, which creates more work for themselves (Augenbroe 2000, Burton 2001, Koprivica 2002, O'Brien 2000, Phair 2000).

2.6.2.5 Trust/Willingness to Share

Under the PSWS system, there is a shift in the ownership of information. Ownership shifts from the creator of the information to the project whereas there are increases in the availability and accessibility of information. There are questions over responsibility for the information and the ability to create, access, edit or delete information. Furthermore, parties are reluctant to enter information into a centralized system. The PSWS improves accountability and responsibility for information, meaning that parties know who is responsible for delays or other problems. Individual users are not comfortable with someone keeping an eye on them at all times. They also fear that the lead company many deny access to the information in the event of a claim (Augenbroe 2000, Koprivica 2002, Phair 2000).

2.6.2.6 Implementation Process

As noted earlier, research shows that the A/E/C industry is slow to adopt new technologies. Many in the industry need an established standard, or precedent, to follow in adopting new technologies. They need proof that the system works and meet their needs. Without a standard to base their own use on, companies must develop their own implementation and use procedures. Researchers indicate that the lead company must be able to bring all project participants aboard for full project implementation of the PSWS. Furthermore, parties must consider the learning curve for each project participant and how productivity will be affected during implementation (Capano 2000, Firek 2001, Phair 2000, Stark 2001).

2.7 <u>**Implementation of PMASP-Based PSWS**</u>

Little research focuses specifically on the implementation of project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs). Previous research touches on implementation of technology in general such as creating a plan, system selection, use, and need for training. There has not been a complete study on implementation or a detailed guide developed for PSWS. However, many researchers find the lack of online project management use to be a problem. Konicki states that there is a critical need for mass adoption of this technology since "if your partners don't use it, it's a lot less useful to you". Therefore, the implementation of project-specific websites in a majority of firms is necessary for the industry to reap the benefits of online project management (Konicki 2002).

2.7.1 <u>**Creating a Plan**</u>

In implementing technology, researchers feel that it is important to address company needs and goals by developing a plan for implementation. The plan provides a framework for the use of the technology within the company and the goals provide incentive to use the technology. Goals and needs may include resolving existing problems such as schedule and budget overruns or business expansion into new locations and work areas. The improvement plan formulates the means of achieving the company needs and goals. It is a detailed organization strategy for improvement, which considers departmental input, resources, barriers, and support. Departmental input ensures that the plan meets the needs of all users and builds support for the new technology. In addition, the plan must identify all the necessary resources for use of the technology and the barriers that may occur so that users are prepared for use of the new technology (Curry 2000, Harrington 2001, Hegazy "II: Collaborative" 2001, Jurewicz "Five" 2001, Mitropoulos 1999, O'Brien 2000).

2.7.2 <u>**System Selection**</u>

Research shows that the selection of the right system for the company or project influences the successfulness of PSWS implementation. Companies must choose

a system that meets the needs of all project parties involved in order for all parties to use the system. The system should also integrate with existing business processes. Second, it is important to look at the fine print of a PSWS system for issues such as responsibility for information on site, liability for lost data, system server failure, and PMASP failure. In addition, the PMASP should offer extensive training and support for users to familiarize them with how the PSWS works and resolve problems (Doherty 1999, "Fine" 2001, Kraker 2000, Ledford 2001, Stark & Smedley 2002).

2.7.3   Use of PSWS

O'Brien explored PSWS implementation issues from a practitioner's viewpoint in his research. O'Brien describes the need to focus on the users and the challenges they pose. The implementation of PSWS should define which features of the PSWS are mandatory to use and which are optional. He describes the need for new job descriptions and detailed instructions for use to create regulations for PSWS use. He stresses the importance of requiring PSWS through evaluations or mandatory policies in order for there to be widespread PSWS use (O'Brien 2000).

Other researchers indicate that owners and lead parties need to write PSWS use into contracts. Indicating PSWS use in the contract strengthens its use on projects, allowing parties to reap the benefits of the systems. Contracts include issues such as mandatory use of PSWS features, responsibility for posted information, recuperation of costs, and liability for information. In addition, there is a need to map information flow on a project to set appropriate notifications, permissions, and access controls. ("Fine" 2001, Friedlander 2000, Kraker 2000, O'Brien 2000, Tam 1999).

2.7.4   Training

Many researchers also indicate the importance of training for the implementation of new technologies. New users need a basic training course to increase their comfort level with and raise support for the technology. Customized training

based on levels of computer literacy and PSWS use provides users with the training they need to be able to successfully use the PSWS. Through training, users feel management supports the technology and will provide an environment that promotes use of the technology (Capano 2000, Harrington 2001, Koprivica 2002, Stark "Hidden" 2002).

2.8 <u>Conclusions</u>

Researchers find that the measure of success for projects is completion on time and on budget. In order for a project to be successful, the transmission of information between parties needs to be quick and accurate. Parties must receive all the information they need in a timely manner to prevent miscommunications, mistakes and rework that lead to schedule and budget overruns. However, the A/E/C industry operates under a paper-based project management system. Under this system, each party retains ownership and controls the availability and accessibility of its project information. It is an "information push" system whereas the owning party "pushes" information onto other parties at their discretion. Therefore, parties may not always receive the information that they need or become overloaded with unnecessary information.

The present project management system leads to schedule and budget overruns due, in part, to poor communication and collaboration between the parties. There is a need to improve project management by shifting away from the paper-based system to an online, integrated project management system. Rather than multiple systems, all project information is in one location, accessible 24/7 by all project parties. All parties are able to access the information they need in a timely manner, reducing the miscommunications, mistakes, and rework.

There is a trend in the industry towards the use of project-specific websites offered by construction-based PMASPs as an integrated project management system to improve project management. The PMASPs host the project management application and provide web space for the creation, storage, distribution, and management of project information. Research shows that PSWS provide benefits in terms of improved communication, productivity, and risk management. In addition, there are time and cost savings and an increased competitive

advantage. These benefits help parties complete projects within the specified schedule and budget.

However, there are barriers to the implementation of PSWS. The barriers fall into the categories of technological issues and people/cultural issues. Technological barriers include hardware and software issues along with security and integration with existing business processes. People/cultural issues are the bigger barriers to PSWS implementation. The issues include the nature of the industry, upper management support, fear of technology, unwillingness to change, willingness to trust and share information, and the implementation process itself. Researchers provide some insight into how to implement the PSWS. In order to implement PSWS systems, companies must create a plan, select a system, develop policies and procedures for PSWS use, and provide training.

Chapter 3: Methodology

The research focuses on project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs). Achievement of the three objectives of the research: a needs-capability analysis of PSWS, the present use of PSWS in the industry, and identification of implementation considerations and lessons is the result of a five-step methodology.

3.1 Literature Review

The literature review was an on-going process over the past year. The breadth of topics examined is broad as are the resources utilized.

3.1.1 Topical Areas Examined

The literature review entails the review of previous research performed in the following areas:

- Nature of A/E/C industry and projects
  - Current use of technology in the A/E/C industry and other industries
  - Present means of project management in the A/E/C industry and other industries
  - Project management needs of the various parties
  - Project collaboration between parties
  - Measures of project success
- Barriers to project integration and technology implementation
- Online project management
  - Types
  - Features and Benefits
  - Projects managed through project specific websites
- Implementation of technology, specifically PSWS for project management
- Challenges after technology implementation

The purpose of the literature review is first to gain an understanding of the nature of the industry and projects. This includes the project components, relationships within the industry, critical issues and factors, the project management needs of the various parties, and problems that routinely occur under current processes. The present state of the industry also encompasses the current use of technology within the industry and the comparison of this use with that of other industries. Similarly, the literature review examines the project management practices in the A/E/C industry, in terms of systems and tools used and collaboration between parties as well as practices in other industries. The literature review looks at what defines a successful project and what the key components of a successful project are as defined by the industry.

The focus of the literature review shifts to investigate the barriers to new technologies and integration within the industry. It investigates the technological and people issues that hinder the implementation and use of new technologies and well as collaboration between the various project parties.

The literature review then looks at online project management tools and systems, focusing on what is available, the system capabilities and limitations, and the benefits of online project management. It seeks to understand what online project management can do for the industry in terms of meeting our needs and solving existing problems. Furthermore, projects that utilized online project management provided insight to how it works.

In addition, the literature review includes the implementation of technology. This topic focuses on the planning, implementing, and managing of the new technology. It seeks to identify the crucial steps and components of successful technology implementation in the work environment. While research primarily focused on project specific websites, the examination of technology implementation is in general.

The final topic in the literature review is the challenges faced after the implementation of the technology. The research serves to determine if the challenges are the same as the barriers beforehand or if new issues arise.

3.1.2 <u>Media Types</u>

In performing the literature review, numerous media types yielded a wide range of information. Research found in leading journals included the areas of construction, engineering, project management, computing, technology, leadership, and information management. This allowed for a focus on the construction industry but expansion into the components and issues in the industry. The generalized areas such as technology and management provide information on what is occurring in other industries. Besides journals, leading periodicals and conference proceedings were also references. These include periodicals focused on construction, technology, computing, legal issues, management, and related industries such as transportation and proceedings from conferences on construction and technology. Furthermore, information provided by the leading PMASP providers as well as their websites was a valuable resource.

3.2 <u>Project Management Questionnaire</u>

The questionnaire focuses on the project management needs of the various parties on a project. The selection of a questionnaire format for this step came from the need to have more rigid responses than open-ended. The questionnaire provides a basic list of needs for companies to consider as well as the opportunity to indicate additional needs. The questionnaire includes needs for all the parties as to gain an understanding of a party's impression of another party's needs. Responses were received from seven of fifteen companies: one general contractor, one construction manager, three-architect/engineer and construction manager, and two architect/engineer. The companies cited their perception of project management needs for each of the project parties involved.

A needs-capability analysis compared the results of the questionnaire and project management research to the offerings of five leading construction-based project management application service providers (PMASPs). The analysis determined what needs are well met, partially met, and not met by the leading PMASPs studied. The questionnaire is in Appendix B.

3.2.1   Identification and Selection of Participants

The pool of firms for this questionnaire comes from the participants of the implementation case study and other contacts. Since the focus of this study and questionnaire is on the project management needs of the parties, the use of online project management was not a requirement. Questionnaires were returned by seven companies: two of the case study participants and five additional firms.

3.2.2   Types of Firms

A broad range of firms was necessary to obtain data regarding the needs of all the parties involved. The firms again range in their roles, including construction managers, contractors, architects, and engineers, as well as in their specialties. The firms vary in their size and location to gain diversified responses.

3.2.3   Topical Areas Covered

The project management questionnaire focused on the needs of the project parties including the owner, construction manager, contractor, subcontractors, architects, and engineers. For each party, their needs in terms of contract administration, document management, meetings and communication, claims and litigation, and inspections were directly addressed. There was also a section left for "other" needs. In addition, the firms' current use of project management tools and the needed improvements to these tools were also a focus of the study.

3.2.4   Results and Analysis

The questionnaire results, merged with the project management need information gathered from the literature review, form a detailed list of project management

needs as described in Chapter 4: Needs-Capability Results & Analysis. The questionnaire results are the reference "Project Management Questionnaire," documented as "Project Management".

3.3 PMASP Investigation

The investigation of construction-based project management application service providers (PMASPs) occurred in two stages. First, a general study of construction-based PMASPs gave background information on the use and benefits of PMASPs. The five leading PMASPs investigated in detail are: Constructware, Citadon, E-Builder, Autodesk Buzzsaw Professional, and Meridian ProjectTalk.

3.3.1 Topical Areas Examined

The study of construction-based project management application service providers (PMASPs) provided a background into what PMASPs are and how they developed. Research looked at the history of PMASPs in terms of how they developed and how the leading providers emerged. The research then looked at the definition of an PMASP in terms of what is and what it provides in terms of a project management tool. Information on the features and benefits of PMASPs in terms of improving project management and meeting the project management needs of the participants was gathered.

The details of PMASPs including costs, training, and support were important topics as well. In addition, research looked at the barriers presently limiting the use of PMASPs, the implementation of PMASPs and the challenges after implementation.

3.3.2 Media Types

References in the investigation of construction-based project management application service providers (PMASPs) come from several resources. First leading journals in the areas of construction, computing, management and technology provide an informative background into PMASPs. The journals and

other news articles from industry magazines provided information on the history, features and benefits, barriers and implementation of PMASPs.

Publications directly from the leading PMASPs and their websites provided a detailed background of each individual PMASP. Information gathered from these publications included features and benefits, costs, training and support. The publications also yielded information on implementation and barriers.

3.4 Case Study: Implementation of PMASP-Based Project Specific Websites for Project Management

Case studies provide more hands-on experience and commentary than the journal and news articles. The selection of a case study format for this portion of the research comes from the need to gain open-ended responses to a wide variety of topics. Open-ended responses enable the responders to express their thoughts and experiences freely, rather than in a rigid framework like a questionnaire. Case studies of companies who actively use project-specific websites for project management (PSWS) available through construction-based project management application service providers (PMASPs), namely Constructware, provide information about the barriers and implementation of PMASP-based PSWS on a project and company-wide basis. Constructware is the basis for the research since it is a leading PMASP in the industry and has a long satisfied client list. The companies in the case studies have experienced the problems and challenges of implementation and PSWS use. Several of these companies utilize similar PMASP-based PSWS from providers other than Constructware as well. The questionnaire used for the case study is located in Appendix A.

3.4.1 Identification and Selection of Participants

Constructware is one of the leading construction-based project management application service providers (PMASPs), as identified by the A/E/C industry. Therefore, the case studies on those firms who use Constructware as their integrated, real-time project management tool. The online client list of Constructware provides potential firms to participate in this case study. From this list, requests for assistance went to approximately fifteen of the companies

requesting their participation in the study. Based upon their willingness to participate in the study and complete the questionnaire developed for this research, the questionnaire was sent to seven leading companies in the A/E/C industry. Of those seven companies, six returned the questionnaire.

The results and analysis of the case studies are located in Chapter 5. The case study results, combined with information from the literature review, identify implementation considerations and lessons as detailed in Chapter 6. The six companies are referred to as Company A-F. A description of each company is as follows:

Company A: The first firm is a general contractor with approximately 170 employees. The firm, with an annual revenue of $500 million, is part of a larger family of companies, with a total annual revenue of $2 billion. Their specialization is new/renovation construction on hotels, office buildings, hospitals, retail, data centers, churches, schools, transportation, high-rises, and apartment buildings. This firm has been using project management tools from the Constructware group since August of 1995. Company A uses other construction-based project management PMASPs if required by the client.

Company B: The second firm provides complete turnkey projects from project programming through post-occupancy services. The firm has annual revenues of $250 million. This company performs architectural, engineering, and construction services in the areas of distribution, food and beverage, industrial, government, education, and justice. The firm has been a client of Constructware since 1999. In addition to Constructware, Company B uses other construction-based project management application service providers.

Company C: The third firm, a design-builder, is a division of a larger parent company with a strong architectural background. The design-build division, representing about 2% of the total company's work, has approximately $400 million of projects underway. The design-build division provides design and construction services worldwide on a variety of project types in the corporate, commercial, public, and institutional markets. The firm has been a Constructware client since 2001. In addition, to Constructware, Company B uses other construction-based project management application service providers.

Company D: The fourth firm is a general contractor with annual revenues over $2 billion. Their work spans all ends of the industry including industrial, correctional, sports, health care, corporate, educational, residential, commercial, hospitality, mass transportation, highways, interiors, and renovation. The firm has been a client of Constructware since 2000. Company D has looked at other construction-based project management application service providers for test evaluation purposes only.

Company E: The fifth company is a program and construction management and design firm. They provide architectural, engineering, facilities management, interior design, construction management, and program management services. The company works in the areas of airports, corporate, education, government, health care, high tech, industrial, judicial, mass transit and sports. Their annual revenues are over $200 million. The firm has been a Constructware user since December 1998. Company E has not standardized on Constructware and continues to utilize other

construction-based project management application service providers such as E-Builder, Meridian ProjectTalk, and Citadon.

Company F: The sixth firm provides architectural, engineering and construction management services. The company is divided into eight business units: architecture and planning, civil engineering, construction, energy engineering, facilities engineering, interior design, operations engineering and structural engineering. They specialize in offices, commercial and retail facilities, manufacturing plants, warehouses, distribution centers, and product development facilities. The firm became a Constructware user in March 2000. This company does not use any other construction-based project management application service providers.

3.4.2 Types of Firms Involved

The firms selected to participate in the case study included contractors, construction managers, architects, and engineers, the primary parties involved on a project. Their roles range from the concept and planning stages through construction and facilities management. The companies work in both the private and public sectors performing projects in the areas of education, healthcare, airports, commercial, retail, industrial, government, residential, and more. In addition, the firms have diverse locations around the country.

3.4.3 Topical Areas Covered

The case studies focus on gaining insight to the use of project-specific websites for project management (PSWS) in the industry. The study looks at the areas of benefits, barriers, implementation, and sustainability challenges of PSWS systems available from leading construction-based project management application service providers (PMASPs). While the companies selected all utilize Constructware, a leading PMASP, four of the six companies also utilize other comparable PMASPs as well.

The goals of the research and the background information gathered during the literature review form the basis for the topical areas and questions for the case study. The following list shows the topical areas covered in the case study:

- Barriers to the Use of PMASP-based PSWS
- Site Development and Costs
- Implementation of PMASP-based PSWS
- Site Access and Security
- Benefits of PMASP-based PSWS
- Challenges of PMASP-based PSWS

The section on barriers focuses on what barriers a company faces in planning to use and implementing PSWS. What the companies did to overcome each barrier was also part of the study. Site development and costs studied the financial side of implementation along with site control, access, and set-up. The responsibility for each of the tasks, project set-up, and responsibility for costs were included in this section of the questionnaire. The section on implementation focused on the steps taken to institute the PMASP into projects and the company. The purpose of the implementation section was to identify the steps taken to successfully implement and use project websites for project management purposes. In studying the benefits of project websites, the goal was to determine whether the use of these sites actually improved project management and if so, it what areas. The challenges of the sites identified what problems and issues remain after implementation, and what aspects of the tools the creators need to improve.

3.4.4 <u>Results and Analysis</u>

A summary of the results of each case study is in Chapter 5: Present Use of PSWS Results and Analysis. Also in Chapter 5 is an analysis of the results in terms of whether or not project-specific websites for project management (PSWS) are a

"single point of access" and whether the posting of information on the PSWS is to fulfill a need or "just-in-case" it is need.

3.5 <u>Identification of Implementation Considerations and Lessons for PMASP-Based PSWS</u>

A compilation of the information gathered through the literature review, project management questionnaire, PMASP investigation, and implementation case studies identifies implementation considerations and lessons for the use of project-specific websites for project management (PSWS) available through construction-based project management application service providers (PMASPs). The Implementation Considerations and Lessons chapter has three sections: background, implementation, and sustainability. In terms of background, the chapter addresses the benefits, needs-capability analysis, and barriers of using PMASP-based PSWS. The second part details the implementation steps for PMASP-based PSWS, and the final part focuses on the sustainability challenges of PMASP-based PSWS after implementation.

Chapter 4: Needs-Capability Results and Analysis

This section first describes the results related to the first objective. It details the project management needs of the parties and the offerings, in terms of project management, of the leading PMASPs. A needs-capability analysis of the information follows.

4.1 Project Management Questionnaire Results

The questionnaire responses indicate that the parties have a general set of project management needs and then parties have party-specific needs. However, the needs are grouped together since a PSWS needs to have the capability to meet the needs of all parties involved. The questionnaires found that parties need contract administration capabilities including specifications, scheduling, budgeting, project status, invoicing, and payment. They also have document management needs in terms of RFIs, submittals, correspondence, drawings, daily reports, and project progress photos. There are design needs including change management and RFIs/submittals. In terms of field operations, procurement, inspections, punch lists, daily reports, safety, RFIs, submittals, and changes are also important needs. Additionally, scheduling, budgeting, financial services, and claims/litigation are also project management needs. Furthermore, parties need the ability to manage all project delivery types including design-bid-build, design-build, dual architect design, architect/engineer-owners representative-general contractor, and architect/engineer-owners representative-multiple primes. Figure 2 below tabulates the results of the project management questionnaire. The project management questionnaire is available in Appendix B.

	Project Management Needs of Project Parties						
	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6	Company 7
Bidding & Estimating							
Bidding		X	X	X	X	X	
Estimating		X	X	X	X	X	
Contract Administration							
Specifications			X	X			
Bonds/Insurance/Funding			X		X	X	X
Project Status	X	X	X	X	X	X	X
Claims/Litigation	X	X	X	X	X	X	X
Meetings	X	X	X	X	X	X	X
Documentation							
Management	X	X	X	X	X	X	X
Authenticity	X	X	X	X	X	X	X
Notification	X	X	X	X	X	X	X
Signatures	X	X	X	X	X	X	X
Design Collaboration							
Change Management	X	X	X	X	X	X	X
RFIs/Submittals	X	X	X	X	X	X	X
Field Operations							
Procurement		X	X			X	
Inspections	X	X	X	X	X	X	
Punch Lists			X			X	
Daily Reports	X	X	X	X	X	X	X
Safety			X	X	X	X	
RFIs/Submittals	X	X	X	X		X	X
Change Orders		X	X	X	X	X	X
Scheduling	X	X	X	X	X	X	X
Budgeting	X	X	X	X	X	X	X
Invoicing/Payment	X	X	X	X	X	X	X
Project Closeout	X		X	X	X	X	X
Is Complete Online Project Management Possible?	Yes, but need face to face	Yes, if adhere to policies & procedures	No	Yes	No, need signatures	No, need right people, software, equip., training & support	No

Figure 2: Project Management Questionnaire Results

4.2 Project Management Needs of the Project Parties

In order to produce a project on schedule and on budget, the parties involved must work efficiently to complete their end of the project. However, given the fragmentation of the industry, there are numerous parties involved on a project including owners, architects, engineers, construction managers, contractors, and subcontractors. With multiple parties working on a single project, management of work is crucial. To manage its work, each party has a set of project management needs. While some of the project management needs of the parties are the same, there are specialized project management needs for certain parties as well. Furthermore, companies need the ability to manage several projects at once and manage company-wide operations that impact an individual project. The needs of the project

participants are compiled from the literature review, project management questionnaire, and implementation case study results.

4.2.1 <u>Bidding and Estimating</u>

Owners, or their construction managers, need to be able to create bid packages, set-up plan rooms, and manage request for quotes (RFQs). Then contracts must be written and administered between the owner and the parties involved: architect/engineer, design-builder, or contractor (Augenbroe 2000, Rakow "Always" 2001, Zipf 2000, Company A, Company E).

Contractors, design-builders, and architects/engineers need the ability to view projects available for bid, select projects to bid and generate estimates. In terms of estimating, one needs to be able to look at cost data from similar projects and adjust for inflation and location to obtain an accurate estimate. The bidding process may also involve evaluating and selecting subcontractors (Jurewicz "Killer" 2001, Rojas 1999, Company A).

4.2.2 <u>Contract Administration</u>

Generally owners hold the contracts with the parties performing the work, be it the architect/engineer, contractor or design-builder. In addition, contractors hold contracts with subcontractors. Administering the contract to ensure all conditions are met is an important part of the project management process.

4.2.2.1 Specifications

Parties holding contracts need to ensure that all of the contract specifications are met. This means easily tracking of submittals for shop drawings and easy comparison with the specifications. Therefore, specifications need to be in an accessible quick, searchable format. In addition, parties must ensure the staffing requirements of the contract in terms of MBE/DBE/WBE are met (Project Management).

4.2.2.2 Bonds/Insurance/Funding

Owners need to check that the parties have the appropriate bonds and insurance to perform the work. Similarly, contractors need to check the status of subcontractors. Owners also need to manage their funding sources to have the appropriate funds when needed (Project Management).

4.2.2.3 Permitting

Many projects require permits from local, county, state and federal officials depending on the size and scope of the project. Parties need a quick, standard permit application procedure as well as means of tracking the permits through the approval process (Augenbroe 2000).

4.2.2.4 Progress Reports

In administering the contract, the parties must have knowledge of project status at all times to ensure schedule and budget needs are met. Status reports may need to be in a variety of formats: charts, graphs, textural summaries, or photos, depending on the audience. Parties need a quick way to determine individual and multiple project status and create progress reports in the forms mentioned. Project status is generally given in relation to the project schedule and budget based upon the status of pending project documents such as RFIs, submittals, change orders, and claims (Ahmad 1999, Angelo 2001, Rojas 1999, Project Management).

4.2.2.5 Claims/Litigation

Parties need to know the dispute claims resolution procedure for their project. To resolve the claim, parties need an adequate paper trail of project events to determine problem responsibility. This paper trail includes project documents, RFI and submittal information, daily reports, and change orders. Parties need to be able to quickly locate this information in the event of a claim. Furthermore, the ability to anticipate problems or resolve problems before they reach the claim level is an

important need of parties (Ahmad 1999, Jurewicz "Killer" 2001, Project Management).

4.2.3   <u>Documentation</u>

The creation, management, and distribution of project documents is crucial to the success of the project. Parties need to manage all of the documents related to a project to ensure all parties have the information they need when they need it. Furthermore, parties must ensure the authenticity of documents and inform other parties when changes or new information affects their work.

4.2.3.1 Management

Document management is a common thread among all project parties. The parties require access to all project information relevant to their work. This includes documents such as drawings, specifications, correspondence, RFIs, submittals, progress reports, and meeting minutes. In addition, parties need to receive notification of changes that affect their work and effectively manage these changes. Furthermore, parties must have control over information necessary to their work, maintain document accountability, and track documents to alleviate bottlenecks (Angelo 2001, Augenbroe 2000, Company A, Project Management).

4.2.3.2 Authenticity

It is important to verify that the information posted online is valid. Parties need to know who creates and posts the information as well as who makes changes to the information. Parties need to know that they have the current version of documents and whether or not changes are in process (Angelo 2001, Zipf 2000).

4.2.3.3 Signatures

Documents such as drawings, contracts, invoices, and payments must contain signatures to confirm their authenticity. Means of verifying

signatures and seals so that the records are admissible in court for claims is another project management need (Zipf 2000).

4.2.3.4 Notification

Notification of project events that impact a party's work is crucial to the prevention of errors and time-consuming, costly rework. Parties need notification of changes to the design or change orders by the owner that impact work. Furthermore, notification of issues requiring attention, through a personal reminder system, also helps the project progress smoothly without bottlenecks (Angelo 2001, Jurewicz "Killer" 2001).

4.2.4 <u>Design Collaboration</u>

The design of the project is a crucial part of the process. Not only does one party, or a collaboration of parties create the design, but the design also affects other aspects of the project, namely construction.

4.2.4.1 Communication

Communication during the design process is essential. The lead design party must communicate with the owner as well as its specialty designers to ensure the scope of the work is met and the design is feasible. Parties must have access to the most recent version of the document in order to hold efficient meetings about the design (Augenbroe 2000, Project Management).

4.2.4.2 Change Management

Designers and owners need the ability to redline and edit drawings and capture the design rationale. Redlining drawings in a collaborative environment captures the changes at once rather than passing the drawings around and then compiling changes. Once changes are made, the effective management of these changes is crucial to the project. The communication of changes between disciplines in a timely, accurate

manner is crucial since a change in one area generally affects the work of others. Tracking who has what version of the drawings is crucial to limiting mistakes and rework. (Angelo 2001, Augenbroe 2000, Hegazy "I: Information" 2001, Project Management).

4.2.4.3 RFIs and Submittals

RFIs and submittals are generally directed toward the designers from the contractor. The designers need to effectively manage these documents through quick evaluation and response. The need is for a detailed, searchable RFI and submittal database to track submittal, response, revision, and approval of these documents (Augenbroe 2000, Jurewicz "Killer" 2001, Company A, Project Management).

4.2.5 Field Operations

The management of the construction process is crucial to meeting the project budget and schedule. The parties must know what is going on with the project on a daily basis.

4.2.5.1 Procurement

A large component of the construction process is procurement of materials. Contractors need to know the price, availability and delivery time of all the materials needed to complete the project at all times. Furthermore, order tracking and history helps the contractor monitor the status of materials (Jurewicz "Killer" 2001, Rakow "Always" 2001, Project Management).

4.2.5.2 Daily Reports

Daily reports monitor and measure progress to determine potential problems or delays early. The daily reports are the basis for updates to the budget and schedule and maintaining cost control (Company A, Project Management).

4.2.5.3 Inspections

The inspection process requires that the inspector knows the specifications of each material or procedure. The inspector needs a field reporting system to record the results of his inspections. The inspection results need to be transmitted to the appropriate parties for information purposes as well as resolving of problems (Project Management).

4.2.5.4 Punch Lists

After inspections are made, there are often punch list items to complete before final approval is given. It is important for the contractors and subcontractors to know what needs to be done, and for the other parties to track the status of these issues (Project Management).

4.2.5.5 Safety

Development of a safety plan is generally mandatory for any project. Implementation and enforcement of this plan is essential to ensure the safety of all workers on the project. Furthermore, a reporting and tracking system is needed for safety violations and problems (Project Management).

4.2.5.6 RFIs/Submittals

RFIs and submittals play a role in the field operations process as well as design. Contractors must create, manage, and track these documents to receive the necessary information and approvals needed to continue work. Tracking of these documents proves important to maintaining the schedule and provides documentation in the event of claims (Augenbroe 2000, Jurewicz "Killer" 2001, Company A, Project Management).

4.2.5.7 Change Orders

> Change orders generally come from the owner to the contractor. Clear documentation of these orders is necessary for accountability purposes. Furthermore, management of these changes is important to determine the impacts on budget and schedule (Augenbroe 2000, Rojas 1999, Company A).

4.2.6 **Scheduling**

Scheduling is an important project management need. Meeting the contract established completion dates may mean the success or failure of a project. There is a need to create, manage, and update schedules throughout the project. The schedule is imperative to resource allocation and is tied to cost control (Ahmad 1999, Angelo 2001, Company B, Project Management)

4.2.7 **Budgeting and Cost Control**

Budgeting is the other primary determinant of project success, along with scheduling. Parties need to create a budget and then track this budget along the course of the project. There is a need to monitor expenditures to ensure the project is not running over budget or to make adjustments to get the project back on budget. Cost control requires cost forecasting as well (Ahmad 1999, Angelo 2001, Project Management).

4.2.8 **Accounting**

Accounting is a crucial business practice on not only individual projects, but also company-wide. Parties need to create and maintain time sheets for all employees to create invoices for payment. Furthermore, the resources and materials used are the basis for invoices. Invoices are sent to the appropriate parties for money collection and then payments must be tracked upon receipt (Augenbroe 2000, Jurewicz "Killer" 2001, Company D, Project Management).

4.2.9   <u>Project Closeout</u>

In terms of closing out a project, all project records must be compiled and stored in the event of future problems, maintenance, renovations and repairs. Claims and litigation must be resolved and all final payments requested and made (Ahmad 1999, Rakow "Technology" 2001).

4.3 <u>Leading PMASP Investigation</u>

This investigation focuses on five leading construction-based project management application service providers (PMASPs): Constructware, Citadon, Autodesk Buzzsaw Professional, E-builder and Meridian ProjectTalk. Each of these systems has a common core of project management tools, but they all have varying advanced options. Figure 3 below summarizes the PMASPs capabilities in terms of project management needs. An "X" indicates that the PMASP has this ability, while a blank box indicates that the PMASP lacks this capability (Jurewicz "Consolidations" 2001, Jurewicz "Five" 2001).

Project Management Capabilities of the Leading PMASPs					
	Constructware	Citadon	Autodesk Buzzsaw Professional	E-Builder	Meridian ProjectTalk
Bidding & Estimating					
Bid Process					X
Estimating					
Contract Administration					
Specifications	X	X	X	X	X
Bonds/Insurance/Funding					
Permitting					
Progress Reports	X	X	X	X	X
Claims/Litigation	X	X	X	X	X
Documentation					
Management	X	X	X	X	X
Authenticity	X	X	X	X	X
Digital Signatures					
Notification	X	X	X	X	X
Design Collaboration					
Communication	X	X	X	X	X
Change Management	X	X	X	X	X
RFIs & Submittals	X	X	X	X	X
Field Operations					
Procurement					
Daily Reports	X	X	X	X	X
Inspections					
Punch Lists	X	X	X	X	X
Safety					
RFIs/Submittals	X	X	X	X	X
Change Orders	X	X	X	X	X
Scheduling					X
Budgeting & Cost Control					
Budget	X*				X*
Forecast/Track Costs	X*				X*
Accounting					
Project Closeout	X**	X**	X**	X**	X**
*Does not integrate with existing budgeting/cost control software; may require double entry					
**Only includes the project information that was on the PSWS					

Figure 3: Project Management Capabilities of Leading PMASPs

4.3.1 <u>Constructware</u>

Started in 1997, Constructware ASP surpassed the two million mark of user log-ins and had over 20,000 user licenses sold in 2001. Private and public owners, general contractors, architects, engineers, subcontractors, and construction managers utilize Constructware. Leading Constructware users include A. Epstein and Sons, Clark Construction, J.A. Jones, and Pepper Construction.

The Constructware ASP suite has several toolsets incorporated into its program. Toolsets include Design Collaboration, Document Management, Cost Management, Reporting, and Personal Organizer. The Design Collaboration toolset effectively manages the design phase of a project. It provides storage, distribution, and tracking of drawing files and e-Review, which allows for simultaneous review and mark-up of drawings. Document management includes a centralized database for all project documents as well as date and time stamping for document tracking. The toolset tracks documents such as RFIs and submittals and provides notification mechanisms for updates and changes. The Cost Management toolset, introduced in June 2002, provides users the ability to track, manage, and forecast project costs across multiple projects, programs, and company divisions. It gives information such as cost to complete, budget vs. actual costs, and other key indicators of project health at any time. It is customizable to any type of accounting and contractual structure including multiple project, phased construction, cost-plus, and unit cost work. Reporting enables the creation and viewing of project status reports at any time. The reports provide information as to what is done, what is pressing, and what is late as well as responsibility for these items. Furthermore, the Executive Dashboard allows a user to see a summary of multiple projects at once. The personal organizer toolset keeps a user up-to-date on his responsibilities, issues that affect his work, and when a response from him is required.

Constructware has developed several specialized programs. One, Constructware for the Subcontractor creates, stores, and tracks RFIs, transmittals, change orders, purchase orders, pay applications and correspondence in a single centralized database. Recently launched is Constructware ET, which provides high-speed satellite bandwidth and Internet service for remote job sites.

Constructware recognizes the importance of training and implementation in the successful use of the program. The solutions group customizes implementation

and training services to meet the project or company needs. Several levels of training are available based upon the skill level and size of training group. Product Orientation provides an overview of Constructware and the role of the system administrator. Private training occurs in-person or online and addresses specific company needs through hands-on instruction on product features, functionality and usability. An extensive five-day training program trains the company's Constructware leader/administrator/trainer to fully utilize Constructware, provide on-site support, and develop in-house training programs (Constructware).

4.3.2 **Citadon**

Citadon is the result of several mergers over the years. It started with Bidcom and Cephren (formerly Blueline Online) in 1997. These two merged in March of 2001 to form Citadon. In January 2002, Citadon introduced the fifth generation of their online application, in Citadon CW. Citadon's clients include owners, contractors, and engineers. Leading A/E/C companies including BE&K, Bechtel, Fluor and URS/O'Brien Kreitzberg have signed on as Citadon users.

Citadon provides extensive document management services. Citadon CW enables users to create, share, review, redline, and track project documents. The application supports over 240 file formats including AutoCAD, Microstation, MS Office, pdf, jpg, and others. In addition, it automates the creation and distribution of project updates, changes, revisions, RFIs, RFQs, and submittals. Features also include version control and document check-in and checkout, which provide document histories and audit trails. Furthermore, a searchable database allows users to quickly search for needed documents by name, date, file type, or author.

Citadon differs from other PMASPs in that it provides three workspaces. First, the organizational workspace provides a place for the lead party to communicate internally before the posting of information to the project workspace. The project workspace contains all the project information from all involved parties and is

accessible by all parties. A private workspace is available to each of the external project parties to communicate internally on documents and issues before posting to the main project workspace.

Citadon offers systems integration and technology consulting to assist users with implementation of the technology and integration with existing business processes.   Training is available on three levels: getting started workshop, advanced Citadon CW, and Citadon CW Administration.   The first two levels focus on the users depending on the capabilities. The final level is for the Citadon administrator in each firm. In terms of support, Citadon offers customer support, online user guides, software downloads, Fans and the latest product information (Citadon CW).

4.3.3   **Autodesk Buzzsaw Professional**

Autodesk Buzzsaw Professional was just released in September 2002, and builds off Autodesk Buzzsaw, which was originally introduced as ProjectPoint.   The Professional version finally brings Buzzsaw up to the level of the other players in the field.   Autodesk Buzzsaw offers a centralized project management system with a unified project directory, tiered access permissions and the ability to management multiple projects online.   The primary use of Buzzsaw is as a centralized data and document storage place.   It also enables the viewing and markup of CAD, Microstation, and other file formats, file version tracking, change notification and threaded discussions.

Autodesk Buzzsaw Professional has Autodesk Buzzsaw as its core and adds many additional features. In addition to the document storage and viewing capabilities of Buzzsaw, Buzzsaw Professional serves to enhance communications. Buzzsaw Professional provides central management of RFIs, submittals, and other correspondence through standard and customized forms, central logs, and advanced searching.   In addition, Professional has reporting and notification capabilities and provides a document audit trail through tracking.   With the

critical addition of the RFI and submittal correspondence features, Buzzsaw can now compete on a similar level as the other leading PMASPs.

Buzzsaw has a support network in place and provides WebEx training and on-location instruction training for users. Since Autodesk Buzzsaw Professional is relatively new, the client list for Autodesk Buzzsaw was used. Buzzsaw's clients include large and small contractors, architects/engineers, owners, and real-estate developers. Respective clients include Toys 'R Us, The Walt Disney Company, DPR Construction, and Clarke/Tamaccio Architects. Since Buzzsaw is just expanding its capabilities, it is difficult to determine which A/E/C entity will become the primary focus (Autodesk Buzzsaw Professional).

4.3.4 E-Builder

E-Builder, founded in 1995, is one of the oldest PMASPs on the market, and backed by the McGraw Hill Construction Information Group. Owners appear to be the primary group adopting E-Builder, and therefore E-Builder continues to focus on this area. School systems such as Miami-Dade and Fulton County, Georgia have used E-Builder for extensive renovation projects. Office Depot has joined the E-Builder client list to open new stores more quickly and efficiently.

E-Builder's primary project management tool is TeamBuilder 5.0. TeamBuilder has document and drawing management functions that manage, track and organize project files as well as offer redlining tools for plan revisions and a check-in/check-out tracking process for those revisions. In terms of project workflow, TeamBuilder creates and manages RFIs, submittals, punch lists, daily logs, and standard or customized forms. It provides the ability to set different security levels for different users and instant notification via e-mail of new documents, calendar event, revisions, or issues needing attention. Online meetings, team discussions, and a project calendar are also features of TeamBuilder.

Used in conjunction with TeamBuilder are five sub-programs. ConstructorCAM offers a high-tech monitoring system that provides continuous on-site progress video, which creates a digital project history. Team Site enables companies to develop a public relations site for the project that gives progress reports, site photos, contact information, and important public information. E-Builder Desktop creates on information summary from multiple TeamBuilder projects. E-Builder Neighborhood enables users to upload/download files to different TeamBuilder projects without logging into each one. The user simply drags and drops the files to the appropriate folder in the Neighborhood. Similarly, E-Builder PrintDriver sends files directly from the program right to the appropriate folder in E-Builder Neighborhood.

In tune with its owner client list, E-Builder has developed two specialized functions. Retail Development Manager aids owners by streamlining site selection, lease negotiation, design, and construction of new retail stores. The Education Development Managers focuses on school construction and renovation to control costs, minimize delays and improve record keeping (E-Builder).

4.3.5 Meridian ProjectTalk

Meridian ProjectTalk is an PMASP that provides online access to all the features of Meridian Prolog. While Meridian ProjectTalk is the newest of these five, their Prolog basis strengthens the product. The client list includes public and private owners, developers, large and small general contractors, architects, engineers, construction managers, and design builders. Contractors appear to be the largest group using ProjectTalk and include Turner Construction Company and Hensel Phelps. In addition, Median ProjectTalk was the system selected by the Arizona School Facilities Board for its extensive renovation project.

ProjectTalk offers multi-project control, allowing users to oversee several projects at once as well as track their individual tasks through the Personal Action Item Manager. ProjectTalk offers four levels of membership: Project Management,

Scheduling, Collaboration, and Basic. The basic membership is more for investigation of ProjectTalk as well as news from Meridian. It allows one to see what ProjectTalk has to offer before subscribing.

Project Management function is geared towards general contractors and construction managers. This membership provides purchasing control, document management, field management, reports, and cost control features, which enable project control from beginning to end. With purchasing control, one can manage and track all of the activities that need to be completed before the company submits a bid for a project or before award of a contract to a subcontractor or a vendor. Document management encompasses correspondence, issue management, RFI/Submittal tracking, and change order management. Field management includes job site conditions, safety management, daily reports, tracking staff hours, inspections, and increased quality control. The reporting feature creates, customizes, and generates reports and queries over multiple projects. Cost control can create records for all of the contracts, purchase orders and invoices, as well as track potential changes and actual change orders for prime contracts and subcontracts.

One benefit ProjectTalk has over other PMASPs is its scheduling feature, geared towards the owner, contractor, architect, engineer, and subcontractor. The Scheduling function can integrate with Microsoft Project, Primavera Project Planner (P3), and Suretrak Project Manager. The scheduling membership allows for cost planning, resource management, schedule planning and schedule collaboration. Cost planning tracks profit and loss on a project, department or company level and determines project costs for resources for invoice preparation and cost projection. Resource management tracks and schedules resources based upon availability and skill level. Schedules can be created, tracked, updated, and analyzed through the schedule planning and collaboration functions.

The collaboration level focuses on the owner, architect, engineer, and subcontractor who do not have a large level of project control. This level has the document management, field administration and report functions described earlier. It also offers team collaboration, providing a forum for sharing information.

Meridian offers consulting, training, and support services to its clients. Through consulting Meridian assists in the implementation process as well as customization of reports and integration with existing processes. Training is offered over the web through WebEx, in the classroom, or through custom classes for corporations having a large group of trainees. The support services include a knowledge base, technical bulletins, and FAQs about the most common and difficult problems. There are also online user guides available (Meridian).

4.4 Needs-Capability Analysis

While there are numerous project management tools available, companies are likely to only choose those that meet their needs. One issue lies in the fact that different parties have a different set of needs. Since parties collaborate on projects, a project-based project management system needs to meet the needs of all parties, not just the needs of a particular party. The chart below shows the level at which the project management needs of the parties are met by the leading construction-based project management application service providers (PMASPs). Based upon the Figure 3: Project Management Capabilities of the Leading PMASPs, a percentage of how the leading PMASPs meet the project management needs was calculated. Figure 4 below shows the ability of the PMASPs to meet the project management needs of the parties. Descriptions of each need and the capability of PMASPs to meet it, follow the chart.

Project Management Need vs PMASP Capability
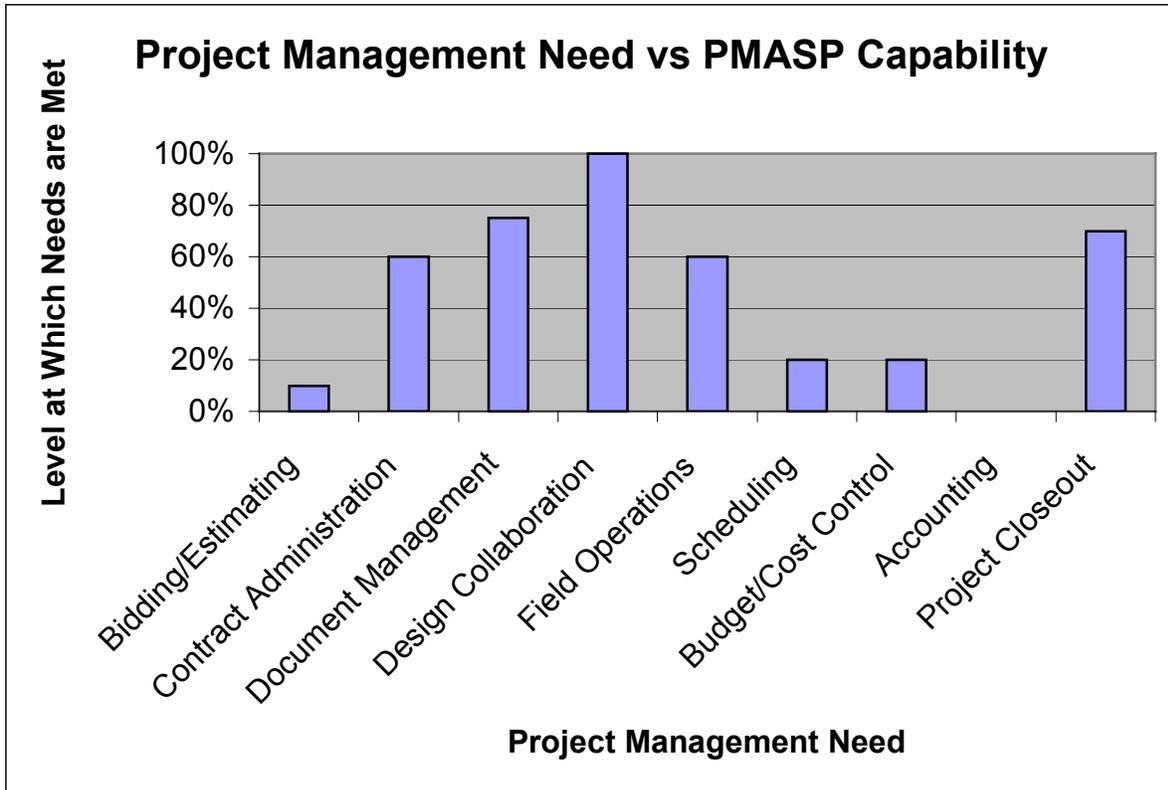
Figure 4: Project Management Need vs. PMASP Capability

4.4.1 Bidding and Estimating

Project bidding is one area in which the present leading PMASPs lack. While there are a few websites, such as BB-Bid (www.thebluebook.com) that offer bidding services, the bidding process has not been integrated into the leading PMASPs. Some PMASPs may give companies the ability to develop bid forms including RFQs, but they do not provide owners the ability to create bid packages, online plan rooms, or track proposals. Furthermore, the PMASPs do not provide a system for contractors or architects/engineers to search requests for proposals or submit online bids. In terms of estimating, the PMASPs generally lack the necessary resources as well. Companies want the PMASP to integrate with their existing estimating software to maintain their past history of estimates. Currently, there is only limited integration between PMASPs and existing software tools, primarily due to proprietary rights of the estimating software developers.

4.4.2 Contract Administration

Administering the contract to ensure all conditions are met is an important part of the project management process. The PSWS tools available from the leading PMASPs meet some of the project management needs of parties in terms of contract administration.   The PMASPs offer document management and RFI/submittal tracking features that aid parties in meeting specifications.   In addition, reporting features create progress reports and detail project status.   In terms of claims and litigation, the PSWS provides an adequate paper trail through easy document discovery, documented communications, and RFI/submittal tracking.

However, little, if any, integration has occurred between PSWS and permitting or bonds, insurance and funding issues. Management of these issues is still paper-based and requires the collaboration of parties outside of the A/E/C industry.

4.4.3 Document Management

Document management is the basis for the PSWS systems.   They provide a central repository for project documents that is accessible at any time from anywhere with an Internet connection. The system enables users to have access to the information they need instantaneously instead of waiting on the other parties to pass the information to them.   The PSWS offer RFI and submittal tracking features that effectively manage the process. The tracking process enables those involved in the RFI/submittal process to know the status of the document at any time and where bottlenecks lie.   Furthermore, the systems have the ability to notify users whenever the posting of new documents or changes to documents occur so that all users have the latest version.   In terms of authenticity, PSWS systems document who posted the document and who has revised it.   However, digitized signatures have not been included in PSWS to this point.

4.4.4 Design Collaboration

The features of the PSWS system serve to improve the design collaboration process as well. Research indicates that improvements in communication with the PSWS systems are due to users having the latest document versions and quick access to other necessary documents. The PSWS also has important contact information for the parties involved. Furthermore, some PSWS have online meeting capabilities and the ability to redline drawings in a collaborative setting. The change management process is more effective in that all users have access to the latest documents rather than requesting them, or not knowing about a change, and then rework being required down the road. According to research, improvements in the RFI/submittal process for the designers come from knowing when a document requires their attention and keeps a record of the approval status of the documents.

4.4.5 Field Operations

As with contract administration, PSWS meet some, but not all of the field operation project management needs. PSWS offer reporting features including daily reports that the contractors can complete to record the day's activities. As described earlier, the RFI/submittal tracking feature allows instantaneous access to the submittals as well as their approval status. The systems are able to track punch list items as well. Along with change management during the design process, the PSWS also aid the change order process during construction. All revised documents and drawings are available online for all necessary parties to access.

However, the PSWS do not currently offer several aspects of field operations. Procurement is an important aspect of field operations that has significant affects over the schedule and budget. While Meridian ProjectTalk offers purchasing control as part of their project management membership, there is not widespread procurement in the PMASPs. In terms of procurement, the PMASPs need to offer a link to multiple suppliers and real-time pricing, availability, and delivery

information. Inspection capabilities are also not an advertised feature of PSWS systems. While there are other inspection technologies being developed, such as PDA devices, these systems have not been incorporated into PSWS. In addition, safety is an important part of field operations, but no safety violation or safety management program has been integrated into PSWS.

4.4.6 Scheduling

Only limited incorporation of scheduling into PSWS is available. Generally, schedules can only be posted online for information purposes only. No updating or changes to the schedule can be made through the PSWS. The data must be entered directly into scheduling software. However, Meridian ProjectTalk now offers a scheduling membership that integrates with Microsoft Project, Primavera Project Planner (P3), and Suretrak Project Manager. The other PMASPs studied do not yet offer scheduling integration.

4.4.7 Budgeting and Cost Control

Budgeting and cost control are available through PSWS to an extent. While there is no integration yet with existing budgeting and cost control tools, Constructware and Meridian ProjectTalk offer cost management features. These PSWS are able to track, manage, and forecast project costs across multiple projects, programs, and company divisions. It gives information such as cost to complete, budget vs. actual costs, and other key indicators of project health at any time. However, these systems do not integrate with existing budgeting and cost software, so double entry may be necessary.

4.4.8 Accounting

Accounting is a crucial, complicated part of a company. Generally companies have sophisticated accounting systems specialized to their company. Therefore, there is no integration of accounting systems with PSWS.

4.4.9 **Project Closeout**

When all users use the PSWS system, the PSWS creates a complete project record. Generally, the lead party creates CDs with all the project information for storage and later reference.

4.5 **Conclusions**

The analysis shows that the leading construction-based project management application service providers (PMASPs) offer a range of features. There are project management needs that the PSWS systems meet well. However, there are others that the systems either partially meet or do not meet. The chart below summarizes the ability of the PMASPs to meet the project management needs of parties.

Level at Which Project Management Needs are Met by the Leading PMASPs			
	Needs Fully Met	**Needs Partially Met**	**Needs Not Met**
Bidding & Estimating			
Bid Process			X
Estimating			X
Contract Administration			
Specifications	X		
Bonds/Insurance/Funding			X
Permitting			X
Progress Reports	X		
Claims/Litigation	X		
Documentation			
Management	X		
Authenticity	X		
Digital Signatures			X
Notification	X		
Design Collaboration			
Communication	X		
Change Management	X		
RFIs & Submittals	X		
Field Operations			
Procurement			X
Daily Reports	X		
Inspections			X
Punch Lists	X		
Safety			X
RFIs/Submittals	X		
Change Orders	X		
Scheduling		X	
Budgeting & Cost Control			
Budget		X	
Forecast/Track Costs		X	
Accounting			X
Project Closeout		X	

Figure 5: Level at Which Project Management Needs are Met by Leading PMASPs

Chapter 5: PMASP-Based PSWS Use Results and Analysis

This chapter details the results of the implementation case studies in terms of the following aspects of project-specific websites for project management (PSWS): use, goals and benefits, barriers, implementation, project setup and sustainability challenges. The case studies focus on those PSWS available from construction-based project management application service providers (PMASPs). It then analyzes two aspects of PSWS use: "single point of access" and "just-in-case" information. The "single point of access" section looks at whether the users of the PMASPs feel that the PMASPs meet their claim that their PSWS are a "single point of access". In terms of "just-in-case," the section looks at whether users post information because it is needed or "just-in-case" someone needs it.   The results of this chapter, merged with the information from the literature review, help identify implementation considerations and lessons, as detailed in Chapter 6.

5.1 <u>Summary of Case Study Results</u>

The case studies focus on companies who utilize PMASP-based project specific websites for project management purposes (PSWS).   All six of the case study participants utilize Constructware, but four of the six use other similar construction-based project management application service providers (PMASPs) as well. The case studies look at the areas of PSWS use, goals and benefits, barriers, implementation, set-up, and sustainability challenges. The following charts summarize the responses of the six case study participants.   The implementation case study is in Appendix A.

5.1.1   <u>PMASP-Based PSWS Use</u>

The case studies find that all the companies use the PSWS for document management. Furthermore, there is substantial use of the PSWS for contract administration, design collaboration, and field operations depending upon the company's areas of work.

PMASP-Based PSWS Areas of Use						
	Company A	Company B	Company C	Company D	Company E	Company F
Contract Administration		X	X	X		X
Document Manangement	X	X	X	X	X	X
Design Collaboration		X	X			X
Field Operations	X	X	X	X	X	
Estimating	X*			X*	X*	
Purchasing	X*	X*				
Scheduling		X*			X*	

*Limited use of PSWS in this area

Figure 6: PMASP-Based PSWS Areas of Use

5.1.2 Goals and Benefits of PMASP-Based PSWS Use

The case studies indicate that there are numerous goals and benefits to using PSWS. Primarily companies see improvements in the flow & accessibility of information, collaboration, communication, change management, RFI/Submittal turnaround, claims discovery process, knowledge of project status and reporting across projects. Other benefits include cost and time savings, ability to standardize procedures, and increased productivity and competitive advantage. The table below shows the benefits and goals of each case study company.

PMASP-Based PSWS Goals and Benefits						
	Company A	Company B	Company C	Company D	Company E	Company F
Single Database	X	X	X	X	X	X
Improved Flow & Accessibility of Info	X	X	X	X	X	X
Improved Collaboration	X	X	X	X	X	
Improved Communication	X	X	X	X	X	X
Improved Change Management	X	X		X		X
Faster RFI/Submittal Turnaround	X	X		X	X	X
Increased Productivity	X				X	
Company Standards	X		X	X		
Increased Competitive Advantage				X	X	X
Easier Claims Process (Discovery)	X	X		X	X	X
Improved Knowledge of Project Status	X	X	X	X	X	X
Reporting Across Projects	X	X	X	X	X	
Cost and Time Savings	X	X		X	X	X
Reduce IT Investment	X					

Figure 7: PMASP-Based PSWS Goals and Benefits

5.1.3 Barriers to PMASP-Based PSWS Use

The companies indicate that there are several barriers to the implementation of PSWS. The common barriers that the companies encountered were user

willingness to change, training, computer literacy, and the implementation process. Furthermore, integration with existing processes, willingness to share information, meeting the needs of all parties, and upper management support are also barriers. The chart below shows the barriers seen by each company.

Barriers to PMASP-Based PSWS Implementation						
	Company A	Company B	Company C	Company D	Company E	Company F
Integration with Exising Processes	X		X			
User Willingness to Change	X	X	X	X	X	X
Willingness to Trust & Share Info				X	X	X
Training	X		X	X		X
Computer Literacy	X	X		X		X
Does Not Meet Needs of All Parties			X			
Implementation Process	X		X	X		X
Lack of Upper Management Support		X			X	

Figure 8: Barriers to PMASP-Based PSWS Implementation

5.1.4 Implementation of PMASP-Based PSWS

The case studies indicate that designating a PSWS champion, carefully selecting a PSWS system, and determining usage of the system are important steps in the implementation process. Furthermore, establishing policies and procedures for PSWS use, and providing users with training and support also impact the success of implementation. Additionally, two companies indicate the need to identify goals and the need for improvement early in the implementation process. The chart below shows the key implementation steps identified by the companies.

Implementation of PMASP-Based PSWS						
	Company A	Company B	Company C	Company D	Company E	Company F
Identify Goals & Need for Improvement	X	X				
PSWS Champion	X	X	X	X	X	X
Select PSWS System	X	X	X	X	X	X
Determine Usage of the System	X	X	X	X	X	X
Establish Policies & Procedures	X	X		X	X	X
Training	X		X	X	X	
Support	X	X	X			X

Figure 9: Implementation of PMASP-Based PSWS

5.1.5 Project Set-up with PMASP-Based PSWS

From the case studies, it appears that have a system administrator and establishing user profiles and access control are important steps in project set-up for PSWS

use. Additionally, the project must establish notification requirements and responsibility for the project information before beginning to use the PSWS. The companies indicate that PSWS use should begin early in the project. The chart below shows the project set-up requirements for PSWS as indicated by the case study companies.

Project Set-up With PMASP-Based PSWS						
	Company A	Company B	Company C	Company D	Company E	Company F
System Administrator	X	X	X	X	X	X
Designate When to Start Use	X				X	X
Establish Responsibility for Information	X	X		X	X	X
Establish User Profiles & Access	X	X	X	X	X	X
Establish Notification Requirements	X	X		X	X	X

Figure 10: Project Set-up With PMASP-Based PSWS

5.1.6 Sustainability Challenges of PMASP-Based PSWS

After implementation, the case study companies find that there are sustainability challenges. The barriers of user willingness to change and integration with existing business processes remain as challenges. Additionally, companies find that the PSWS is not truly a single point of access for project information. Other challenges the companies encounter include maintaining support, determining which PSWS features to use, variations in the learning curve for users, providing training, and internet connectivity at remote sites. The chart below indicates the sustainability challenges each company faces.

Sustainability Challenges for PMASP-Based PSWS						
	Company A	Company B	Company C	Company D	Company E	Company F
Willingness to Change	X	X	X	X	X	X
Generate and Maintain Support		X				
Determining which Features to Use				X		
Integration with Existing Processes		X	X	X	X	X
Not a Single Point of Access	X	X	X	X	X	X
Variation in Learning Curve	X		X			X
Training	X	X	X			
Internet Connectivity at Remote Sites		X			X	

Figure 11: Sustainability Challenges for PMASP-Based PSWS

5.2 <u>Company A</u>

Company A is a general contractor with approximately 170 employees. The firm with an annual revenue of $500 million is part of a larger family of companies, with a total annual revenue of $2 billion. Their specialization is new/renovation construction on hotels, office buildings, hospitals, retail, data centers, churches, schools, transportation, high-rises, and apartment buildings. This firm has been using project management tools from the Constructware group since August of 1995. Company A uses other construction-based project management PMASPs if required by the client.

5.2.1 <u>PSWS Use</u>

Company A is a general contractor with 25 active projects on Constructware, already completing 23 others with Constructware. The primary use of the PSWS is for field operations, but estimating and purchasing use the site as well on a limited basis. Online project management aspects include RFIs, Correspondence, daily reports, submittals, transmittals and document management. Currently, anything associated with money or requiring a signature remains paper-based.

5.2.2 <u>Goals and Benefits</u>

They chose to use PSWS for several reasons. They want a single database for all users on a project to improve collaboration and communication. The tool enables customers to be more involved on projects and give the clients and employees 24/7 access to documents. The company also sees PSWS as a means of establishing company standards across different branches and reducing information technology costs. Furthermore, the PSWS offers increased efficiency by reducing the repetition of tasks and producing reports across projects. The company selected Constructware based upon their previous business relationship with Constructware, who developed the company's first document management system.

In terms of benefits, Company A sees improvements in the flow and accessibility of information. Project participants are better to determine what information they

need and do not need. Users find that it takes less time to retrieve information. There are faster RFI turnaround time, resulting from improvements in the response and notification of RFIs. Regular updates of the dates and status of submittal items are viewable by clients and consultants. The company is more competitive since the client has 24/7 access to all project information, there is a reduction in the number of claims, an easier claims process, and time savings in the RFI process and other document distributions. Furthermore, the PSWS provides instantaneous project status in terms of what is done, pending, or overdue and who is the responsible party.

5.2.3 <u>Barriers</u>

The company faced many barriers in implementing and using the PSWS. They encountered technological issues such as integration with accounting and scheduling programs. People issues such as training, willingness to change, computer literacy, and the implementation process are greater barriers than the technological issues.

5.2.4 <u>Implementation</u>

In terms of implementation, the company feels that first the company must identify realistic goals and areas that can bring value to the company. Upper management must provide support and the resources needed, in terms of computers and connectivity for the PSWS. Next, the company must select the implementation team, choose project pilots, and organize training by department. Training and maintaining support are important parts of the PSWS implementation process. Having a PSWS champion improves the implementation process. Furthermore, the company must establish policies and procedures governing PSWS use. These policies and procedures identify the PSWS features to be used based upon which features add value to the project. Those features that add value become mandatory for users. Furthermore, there should be standards for information posting. Information posted should be vital to the project, not just in case someone needs it.

5.2.5 Project PSWS Set-up

In Company A, the system administrator is responsible for organizing and setting up with PSWS. The project's PSWS starts at the estimating level for hard bids, and the operations level for negotiated work. Constructware is responsible for having the site running 24/7 and virus control. Several project team members are responsible for data entry, site access and control, and supervision. In general, the user who creates or posts information is responsible for its validity. Profiles for users, based upon their role, determine access control. For example, general contractors can create RFIs, but architects/engineers can only respond to RFIs. The ability to upload, download, delete, view, and modify documents depends upon the user's role on the project. Individual users have unique passwords for access to the system. In terms of notification, the individual user decides whether or not to send email when a document is created or uploaded. Furthermore, automatic reports can be setup to send to one or multiple users. Notification procedures are based upon company requirements.

5.2.6 PSWS Challenges

Challenges remain after implementation. One challenge the company still faces is involving as many parties as possible. It is difficult to train everyone and agree upon responsibilities and expectations for all users. Users have to learn a new system to do existing processes. Some users are unwilling to accept the change. In addition, the learning curve varies per user, with those with limited computer skills struggling the most. Furthermore, the PSWS is not a "single point of access" due to limited integration with existing business processes and the unwillingness of all parties to participate.

5.3 Company B

The second firm provides complete turnkey projects from project programming through post-occupancy services. The firm has annual revenues of $250 million. This company performs architectural, engineering, and construction services in the areas of distribution, food and

beverage, industrial, government, education, and justice. The firm has been a client of Constructware since 1999. In addition to Constructware, Company B uses other construction-based project management application service providers.

5.3.1 PSWS Use

Company B, which provides complete turnkey delivery, has three active projects on Constructware, having completed twenty. The construction, design and program management divisions utilize Constructware, along with limited use by the scheduling and purchasing departments. Their primary use of the PSWS is for document management, RFIs, correspondence and daily reports. Again, signatures and project records remain paper-based.

5.3.2 Goals and Benefits

The goals of Company B in using PSWS is the ability to provide a "one-stop" site to get all team members, both internal and external, on the same "page". It provides remote access to data so that all parties have the same information. The company selected Constructware as their PSWS due to its scalability and Constructware's willingness to consider client input in development of their product.

In terms of benefits, the company sees an improvement in the flow and accessibility of information. To an extent, users are better able to determine what information they need or do not need. However, it does take less time to retrieve information. The company sees cost and time savings in postage/shipping costs, administrative labor, and historical documentation retrieval time. Communication between parties improves through PSWS use due to information flow and project status reports. The PSWS provides better knowledge of project status at all times in terms of what is done, pending or overdue, and the responsibility for each item. In terms of claims, the company has not seen a reduction in the number of claims, but the PSWS creates an adequate paper trail and makes the claims process easier.

5.3.3 Barriers

The barriers that Company B faces are primarily people issues. They include user resentment to a new system, unwillingness to change by other project parties, lack of upper management support, and computer literacy.

5.3.4 Implementation

In terms of implementation, the company follows the following steps: identify the need for PSWS, select a PSWS, implement the PSWS, follow-up with implementation, and be sure to designate a PSWS champion.

5.3.5 Project PSWS Setup

Company B relies on an in-house administrator to start up projects. The organization of the site is based on the PSWS interface. Individual users are responsible for posting the vital project information and maintaining the RFI/submittal logs. Users and their managers are responsible for the validity of information posted. Those documents requiring signatures are issued via paper copy and then generally scanned into the system. Select mangers in the various disciplines determine and establish access control and permission levels. Individual passwords allow access to the system features the individual needs to access. Generally, all core team members have the ability to post information, while the ability to view and edit information is based upon the user's level of access. Users post information because there is a need for it. Notification of new information or changes is through e-mail from the PSWS.

5.3.6 PSWS Challenges

Company B finds that user resistance to change remains well after PSWS implementation. Users do not understand the need to move to an online project management system. In addition, it is difficult to coordinate project parties, provide connectivity to remote sites, and generate and maintain support for the system. The lack of computer skills for some project participants is another challenge. The company finds that the PSWS is not a "single point of access"

whereas some aspects of project management remain paper-based due to integration and liability issues.

5.4 Company C

Company C, a design-builder, is a division of a larger parent company with a strong architectural background. The design-build division, representing about 2% of the total company's work, has approximately $400 million of projects underway. The design-build division provides design and construction services worldwide on a variety of project types in the corporate, commercial, public, and institutional markets. The firm has been a Constructware client since 2001. In addition, to Constructware, Company B uses other construction-based project management application service providers.

5.4.1 PSWS Use

Company C, a design-builder, has one project underway on Constructware, having completed one. This company does not use Constructware to the extent of the other companies in the study. Due to problems with implementation, success with the PSWS has been limited. They use the PSWS for document management, RFIs, Correspondence, and progress reports. Scheduling, estimating, and accounting remain paper-based.

5.4.2 Goals and Benefits

This company sets a high goal of complete online project management through the PSWS. They want to improve collaboration between all parties including the owner, architect, engineer, subcontractors, and construction managers. Furthermore, they want the ability to coordinate projects and offices worldwide. The company selected Constructware based upon their secure financial backing, automatic updates, and the people that work there.

Company C has seen limited success with Constructware due to implementation problems. However, they feel that the PSWS allows them to have project control at any point over RFIs, costs, correspondence, and project progress.

5.4.3 <u>Barriers</u>

Company C seemingly encounters the most barriers of all the companies in using PSWS. They find that the nature of the industry, broken, aggressive and face-to-face is a barrier. Contractors and architects are not always willing to collaborate or to learn the system. There is an unwillingness to change from the present way of doing things and the PSWS is seen as another corporate procedure. Furthermore, they find that the products designed for the contractor do not meet the needs of the architect/engineer and visa versa, so integration remains difficult. There is limited integration of the PSWS with existing business processes like scheduling and accounting. In addition, subcontractors and other individuals lack the necessary computer skills to use the system. In some cases, they feel the program is not always intuitive and some tasks could be done in Microsoft Excel or Word faster.

5.4.4 <u>Implementation</u>

In terms of implementation, this company struggles. They have not designated the right person to lead the implementation. The present administrator feels the PSWS champion has to want the job, be construction-oriented, have the time to keep up with changes, and have the personality to promote PSWS use.

5.4.5 <u>Project PSWS Setup</u>

Company C does not have a clear PSWS set-up plan which also hinders the successfully use of the system. Generally, the responsibility lies with the in-house administrator. The senior project managers are not IT friendly, so they rely on their secretaries to post the information to the site.

5.4.6 <u>PSWS Challenges</u>

Company C faces many challenges in using the PSWS system since they do not have a good implementation plan. There are issues with learning to use the system. It is difficult to train everyone involved and there are constantly new

updates and changes to the system to learn. The users find it difficult to keep up with these changes. Not all project parties are willing to use the system, which limits the benefits of the system. There is a strong resistance to change from the existing system to a new one. The company finds that the PSWS is not a "single point of access" because not all parties are willing to use the system and there are integration issues with existing business processes.

5.5 Company D

Company D is a general contractor with annual revenues over $2 billion. Their work spans all ends of the industry including industrial, correctional, sports, health care, corporate, educational, residential, commercial, hospitality, mass transportation, highways, interiors, and renovation. The firm has been a client of Constructware since 2000. Company D has looked at other construction-based project management application service providers for test evaluation purposes only.

5.5.1 PSWS Use in General

Company D, a general contractor, has thirty projects underway using PSWS, having completed approximately 50 in the past. The operations department is the primary user of the PSWS, with limited estimating use. The PSWS use is in document management, RFIs, correspondence, and daily reports. They feel that approximately 90% of the information participants need is available online. Drawing and specification distribution, applications for payment, and invoices remain paper-based.

5.5.2 Goals and Benefits

Through the PSWS, the company sought reductions in errors from poorly communicated information, RFI processing time, and change management processing time. They want accessibility to project information from remote locations and through browsers, rather than software that requires maintenance. The ability to standardize procedures and increase project communication are also goals of the company in using PSWS. The company selected Constructware

based upon its performance, industry reputation, and willingness to modify and improve product based upon client suggestions.

Company D sees many benefits in using PSWS. There are improvements in the flow and accessibility of information. Users are better able to determine what information they need and do not need. It takes less time to retrieve the information needed. The documentation for RFIs and specification submittal has been condensed to a single application for all involved. The PSWS improves access to project information increasing team collaboration and improving communication between parties. The firm is more competitive because the PSWS allows staff to focus on critical tasks rather than tracking down information or working with incorrect information. Information of project status, what is done, pending or overdue, is available instantaneously without direct involvement of staff. In terms of claims and litigation, the company predicts that the PSWS will reduce the number of claims. In addition, the PSWS creates an adequate paper trail with the system time stamp and simplifies the document discovery process.

5.5.3   Barriers

Company D finds that external users are reluctant to enter information into an application owned by another firm. The external users feel that in a dispute, the lead party could deny access to the information. Furthermore, there is employee resistance to change from the current procedures. There is also a learning curve associated with the PSWS, resulting in lost productivity initially. The lack of expertise throughout the company is another barrier that requires training.

5.5.4   Implementation

In terms of implementation, two individuals administer the use of Constructware. In addition, the company has several PSWS champions in various levels and departments of the company. Their implementation focus is on training. A professional training session is held at the start of every project for project staff.

Furthermore, there is a step-by-step instruction guide available on the company intranet.

5.5.5 Project PSWS Setup

For Company D, a system administrator sets up projects on the PSWS. The project staff, primarily the project manager, is responsible for the posting of information to the site, ensuring all vital information is available, and the validity of posted information. Documents requiring signatures remain paper-based and may be scanned for online posting after signature. User roles define their access and permission levels in terms of posting, deleting, viewing, or editing project information. Each user type: project manager, architect, owner, subcontractor, or other, has its own level of access. Passwords control individual access. Generally, the company tries to have all information on the site so that there is a complete record of project information at the end of the project. Notification procedures are set up so that if a user wants to be notified, he will be.

5.5.6 PSWS Challenges

Company D faces several challenges in using the PSWS. They find participants are unwilling to change from a functioning system and way of doing business to a new system that is not experiencing widespread use. There are also concerns over the shift in the ownership of information that occurs. Determining what features of the system to use and in what order to transfer project management aspects to the new system is another challenge. The company finds that transferring the support departments is more difficult than the shift for project staff. Furthermore, the company finds that the system is not truly a "single point of access" but it gets closer each day. It takes time and resources to fully transfer all aspects of a construction project to a single application.

5.6 Company E

Company E is a program and construction management and design firm. They provide architectural, engineering, facilities management, interior design, construction management,

and program management services. The company works in the areas of airports, corporate, education, government, health care, high tech, industrial, judicial, mass transit and sports. Their annual revenues are over $200 million. The firm has been a Constructware user since December 1998. Company E has not standardized on Constructware and continues to utilize other construction-based project management application service providers such as E-Builder, Meridian ProjectTalk, and Citadon.

5.6.1 PSWS Use

Company E, a program and construction manager, has approximately 150 projects using the PSWS, having completed 160. Of the 160 projects, 122 are part of one large program of multiple school construction projects. They utilize Constructware primarily for their project and construction management functions. The estimating and scheduling reports may be posted in the PSWS but those departments do not access the PSWS themselves. Use of the PSWS is for document management and operations. Approximately 50-60% of the labor-intensive project engineering functions are online. They feel that 85-90% of the information participants need is available online as long as the system is regularly maintained by field staff. Financial services and marketing, along with the bid phase, contract creation, scheduling, and signatures remain paper-based.

5.6.2 Goals and Benefits

The purpose of using PSWS is to make information available 24/7 to the entire project staff and increase their efficiency. The PSWS serves to avoid redundancy of tasks and to build a good library of project information to ease the project closeout process. Furthermore, they feel that the industry trend is towards the use of PSWS, and they want to be at the forefront of benefiting from and understanding the systems. The company selected Constructware based on its extensive use by other large general contractors and construction management firms. Furthermore, they feel Constructware is a proven tool with project and "program" management capabilities.

In terms of benefits, Company E feels that the PSWS improves the accessibility of information and improves information flow to a point. They find that project participants are better able to determine what they need or do not need. It is "no longer what you see is what you get, now it is what you see is what you need." With the PSWS, it takes less time to retrieve information than with the paper-based system. In terms of flow, the company reports that it is difficult to determine if the system is speeding up the flow or if project participants are supportive of the project in terms of sharing answers and information quicker. In terms of communication, the company feels PSWS makes communication more documented and accountable. The company says it sees time savings with the PSWS but determining return on investment is nearly impossible. The company finds that there is less duplication of effort since companies now share logs for RFIs, submittals, and other documents. In terms of project status, the system offers features such as executive dashboard and auto-reports that provide project status information across single or multiple projects instantaneously. These features allow project managers to be more proactive than reactive. While the company has a clean claims/litigation record, they feel the PSWS can provide an adequate paper trail, dependent upon permission set-up, the use of RFIs and daily reports, and other critical features. The company also feels the PSWS increases their competitiveness. They market the concept of using an electronic project management system in winning project proposals and the use of such a system has been a deciding factor on winning projects.

5.6.3 <u>Barriers</u>

Company E finds user resistance to be a large barrier to the use of PSWS. In addition, the justification of costs to owners and upper managers is a critical barrier. Owners ask "why do we need this system this year, when you built us a similar project years ago and didn't need it then?"

5.6.4 Implementation

In terms of implementation, Company E relies on the PSWS administrators in the company. There is an administrator for each of the company's regional divisions. The administrators coordinate with the project manager and the contractual requirements to determine what system to use and which aspects of project management to move online. It is important to implement the system as early as possible, either in the pre-design phase or on the first day of construction. As long as users are comfortable with a Windows environment and Microsoft Internet Explorer, the system is intuitive. In addition, having a project champion improves the implementation process.

5.6.5 Project PSWS Setup

For each division, Company E has a regional Constructware administrator in charge of users, training, implementation, and support for all users in their geographical area. The regional administrator is responsible for setting up projects within their jurisdiction. After set-up, the project manager is primarily responsible for the site, but the author of or individual posting information to the site is responsible for the validity of that information. The system has features in place to ensure messages are sent only from person to person and not readable by the entire project team. Furthermore, the internal versus external feature of Constructware prevents certain documents from being seen or read by people outside of the company. The regional administrator coordinates with the project team and owner to determine appropriate access rights for all users. Permissions are documented so that all users know who has access to what aspects of the site. Nearly everyone has the ability to post information, but there are significant restrictions on the ability to delete information. Viewing and editing permissions are based upon the user's roles. Individuals have custom passwords for access to the site. Users post information because either someone needs it now or they might need it later when they are gone. In terms of notification, the company sets up notification protocols for projects stating, "if you submit a new _____, you must cc: the following parties _____". If these procedures are not in

place on a given project, the user posting the information can select to notify users immediately that new information is available or users will just find the new information when they enter the system.

5.6.6 PSWS Challenges

Company E finds the largest challenge after implementation to be the unwillingness of project participants to change. To resolve this issue, the company tries to write the use of the PSWS system into the contract as a requirement. Furthermore, there is site access trouble when high speed Internet access is not available for a project. However, the company is preparing to deploy satellite ISP to resolve the project. The company does not see the PSWS as a "single point of access" for all project information. There is still a need to refer to boxes to see the actual submittal samples of marble, ceiling tiles, and other materials. In addition, the financial aspects of project management are not available through the PSWS.

5.7 Company F

Company F provides architectural, engineering and construction management services. The company is divided into eight business units: architecture and planning, civil engineering, construction, energy engineering, facilities engineering, interior design, operations engineering and structural engineering. They specialize in offices, commercial and retail facilities, manufacturing plants, warehouses, distribution centers, and product development facilities. The firm became a Constructware user in March 2000. This company does not use any other construction-based project management application service providers.

5.7.1 PSWS Use

Company F, a design firm, has five active projects on PSWS, having completed approximately 125. Use of the PSWS is by the design disciplines (architecture, structural, civil, mechanical, fire protection, interior design) and construction managers. Issued drawings, bulletins, and document management are online while drawings in progress and the other departments, such as financial services,

remain paper-based. They feel that 75% of the information participants need is available online.

5.7.2 <u>Goals and Benefits</u>

This company uses the PSWS to assist with the running of projects. It enables all team members to have the necessary information to successfully do their daily work. They feel the system improves communication and helps them better meet project deadlines. The company selected Constructware based upon its ease of use and secure financial backing.

According to Company F, the PSWS improves the accessibility and flow of information. The posted information is accessible 24/7 through a single point of access. It takes less time to find information and provides better accountability for RFIs and submittals. In terms of competitiveness, the PSWS yields a smoother project cycle. It provides team members with project status reports and creates an adequate paper trail for claims. The company has seen a decrease in the number of claims, which they say, could be from the use of PSWS. The size of the project determines the extent of cost and time savings.

5.7.3 <u>Barriers</u>

Company F finds that not all members are willing to use the system for various reasons including information sharing and learning the new system. There is resistance to change from an existing process that works to a fundamentally new system.

5.7.4 <u>Implementation</u>

In terms of implementation, the company meets with Constructware professionals to set up projects, users, and permission levels. They have internal users trained on Constructware that train site users and contractors. In addition, having a PSWS champion is crucial to the implementation process. They feel it is important to start using the PSWS during the design phase.

5.7.5 Project PSWS Setup

The company's Constructware administrator performs the initial setup of the PSWS for a project. Then those with access to project information are responsible for posting that information. The person who posts the information is responsible for its validity. Job descriptions and roles on a project determine a user's access and permission rights. The rights to view, edit, post, and delete information are contingent upon the user's role. Generally, project managers direct drafters to upload drawings and revisions as they are completed. Submittal tracking occurs through the construction management department that uses Constructware to forward the submittals to the appropriate users. Information is posted because it is needed and crucial to the project. E-mails inform users when new information is posted to the site. Furthermore, the company has one individual responsible for training and user issues.

5.7.6 PSWS Challenges

Company F finds that at times project participants are unwilling to accept the move to an online, integrated project management system. The system is not as beneficial if not all parties use it. Furthermore, the lack of computer skills by users hinders their use of the system. The company finds the PSWS is only a "single point of access" for the information posted. There is still other vital project information that is not yet managed online.

5.8 "Single Point of Access"

The PMASPs advertise PSWS as being a "single point of access" for project information. They state that all project information is available in one place for quick access. However, many users feel differently. The companies in the case study reported that the PSWS is not truly "a single point of access". While much information is available online, there are still issues that prevent a complete shift to online project management. Companies report that scheduling and budgeting functions are difficult to move online due to integration issues with the software. In addition, concerns remain over the authenticity and security of signatures,

which require official copies to remain paper-based. Furthermore, security, integration, and trust issues generally keep all financial documents, including invoices, payments and accounting offline. Therefore, while the PSWS is a great source of basic project information, it will take time before it truly is a "single point of access". It takes time and resources to fully transfer all aspects of a project to a single application. Advances in the capabilities of the PSWS are continuous. In time, the issues with integration and security will be resolved and the PSWS can truly become a "single point of access" (Company A, Company B, Company C, Company D, Company E, Company F).

5.9 "Just-in-Case?"

The second issue with PSWS use is whether users post information because one needs it or "just-in-case" someone needs it. Is the PSWS a functional tool or just a catchall for project information? The companies involved in the implementation study indicate that the posting of information occurs because it is necessary and vital to the project. The goal is to have all information online to create a complete record of project documentation. Through clear instructions and expectations for use, users know what information is to be placed online, and therefore extraneous information does not plague the site (Company A, Company B, Company C, Company D, Company E, Company F).

Chapter 6: Implementation Considerations and Lessons

This chapter provides implementation considerations and lessons for users of PMASP-based project-specific websites for project management (PSWS). The goal of the chapter is to identify implementation considerations and lessons for users of project-specific websites for project management (PSWS) offered by construction-based project management application service providers (PMASPs). This includes such PMASPs as Constructware, Citadon, Autodesk Buzzsaw Professional, E-Builder, and Meridian ProjectTalk.

The chapter consists of three parts as shown below:
- Background Information
    - Benefits of Using PMASP-based PSWS
    - Needs-Capability Analysis of PMASP-based PSWS
    - Barriers to Using PMASP-based PSWS
- Implementation of PMASP-based PSWS
- Sustainability Challenges of PMASP-based PSWS

The first part of the chapter provides background information to project-specific websites for project management (PSWS) from construction-based project management application service providers (PMASPs) in terms of benefits, needs-capabilities, and barriers. The second part of the chapter consists of a detailed list and description of the steps to implementation of these PSWS. The final section examines the sustainability challenges that occur after implementation.

6.1 Background Information

The first part of the Implementation Considerations and Lessons chapter provides a foundation to the use of project-specific websites for project management (PSWS) offered by the construction-based project management application service providers (PMASPs). This part of the chapter looks at the benefits, a needs-capabilities analysis, and the barriers, to using these systems.

6.1.1 Benefits of Using PMASP-based PSWS

As mentioned earlier, the A/E/C industry needs to restructure its project management philosophy in order to ensure continued project success. As clients demand increasingly complex projects under tight budgets and schedules, the A/E/C industry must make their processes more efficient to meet these demands. Research has shown that improved communication, shortened project durations, and cost certainty are essential to successful projects. Further research shows these are among the benefits of online project management. Project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs) have the ability to improve project management, alleviating the miscommunications, delays, cost overruns, mistakes, and inefficiencies. The use of PMASP-based PSWS as a project management tool has numerous benefits in terms of both the project and the companies themselves. The 2001 Client Impact Study performed by Constructware found that the more companies used the PMASP, the more they ranked reducing costs, increasing productivity, reducing claims and litigation, and gaining competitive advantage as being "critically" or "significantly" important.

The following benefits of using PMASP-based PSWS are described in further detail in this section:
- Communication
- Productivity
- Cost and Time Savings
- Project Status
- Competitive Advantage
- Risk Management

6.1.1.1 Communication

Research indicates that the fragmented nature of the A/E/C industry hinders communication between project parties leading to miscommunications, delays, and inefficiencies. Research and companies

agree that good, clear communication is essential to the success of projects. PSWS have the ability to greatly improve communications between project parties by creating a centralized project management system. The PSWS brings together dispersed project teams and job sites, allowing for collaboration. Companies using PSWS, as reported in Constructware's *2001 Client Impact Study,* overwhelmingly report elimination or significant reduction of barriers and delays points in their communications, workflow and the processing of information and documentation.

The PSWS improves the communication process in terms of four key aspects of information: accessibility, availability, ownership, and timeliness of information. By creating a centralized project management system for the project, the ownership of information shifts from the creating party to the project. The project, or more specifically, the PSWS, now controls the accessibility and availability of information. The PSWS effectively manages and stores project information, often in a searchable format, for faster and more direct access to information. The single point of access for project information allows parties access to all the latest drawings, schedules, documents, and other crucial information twenty-four hours a day, seven days a week. Furthermore, all project parties can look at the same information at the same time from various locations.

The timeliness of information stems from the flow of information. The PSWS quickly and accurately distributes project information between parties, minimizing the lag time for important information exchange. It delivers the right information to the right people at the right time. By using PSWS, information is readily available to parties as they need it, rather than only available when another party chooses to distribute the information. It shifts the industry away from the current paper-based information push system to the more efficient online information pull

method. Furthermore, the notification function of PSWS immediately informs affected parties of changes that impact their work or issues and documents that require their attention.

The use of PSWS improves many aspects of communication. Information is more accessible and available on a timely basis. Parties have access to all the information they need at any time. Information is received "just-in-time" rather than late, which reduces errors and the need for timely and costly rework. It is no longer what you see is what you get; now it's what you see is what you need. The individuals accessing the PSWS can select what they need rather than receiving what others think they need.

6.1.1.2 Productivity

Research shows that a second key benefit of PSWS use is increased efficiency. Constructware's 2001 Client Impact Study states that 99% of users use the PSWS for increased productivity. The greatest improvements are in the areas of RFI and submittal turnaround, reduced communication barriers, automated report creation, and the ability to manage more projects. The PSWS allows for tracking of project documents such as RFIs and submittals, to ensure there is no bottleneck. If a party is behind on their role in the RFI or submittal process, the other parties can see this. The PSWS improves tracking of documents and the accountability of parties involved.

Since all project information is in one place, the information is always at hand. The tracking, status, report generation, and other features of the PSWS simplify the management process. Project managers and executives are then able to manage more projects at one time. Researchers believe team members are more efficient due to the reduction in duplication of information. The posting of information occurs once, rather than creating multiple copies and distributing to various parties.

Furthermore, since there is a single project management system, the entering of the same information occurs once, rather than multiple times into various company logs. In addition, there are productivity improvements in change management. Research shows that firms using PSWS are better able to manage changes and distribute those changes in hours rather than days. Some PSWS even allow for the review and redlining of drawings on the Web in a collaborative environment.

There are productivity improvements through PSWS in terms of both management and staff time. The simplified tracking process for RFIs, submittals, and changes makes the process more accountable and requires less work. The quick addressing of these issues allows project participants to focus on other critical issues. Furthermore, the more efficient system allows the effective management more projects at the same time.

6.1.1.3 Cost and Time Savings

The issues of project cost and time are critical components of project success. Currently, the industry is known for budget and schedule overruns, leading to dissatisfied clients. Research indicates that a reduction in project time stems from the improved communication and increased productivity that PSWS provides. Due to the accessibility and availability of project information and other PSWS features, there is generally a reduction in the number of man-hours required for document creation, filing, retrieval, and exchange. In addition, there is a reduction in administrative labor time, allowing the management of more projects simultaneously. The reduction in RFI and submittal turnaround time significantly reduces delays and condenses the project schedule. Project closeout require less time since CDs are simply created for permanent document storage, rather than compiling all project information.

A reduction in project costs occurs in several areas. First, the distribution of documents through the PSWS results in a significant decrease in postage, shipping, paper, and file storage costs. Project closeout is simpler and cheaper since storage of documents is on CDs rather than in boxes and file cabinets. Employee travel costs decrease since the monitoring of projects can occur through the PSWS, which often offers online meeting capabilities, site video and photos, and daily reporting features. Furthermore, a reduction in IT costs, including network applications, updated versions, patches, infrastructure and maintenance, occurs with PSWS use. Users simply pay a per license fee for unlimited use. The provider is responsible for all infrastructure, upgrades, maintenance, and applications. Since there is less of an IT demand within the company, there may be a reduction in IT staff.

Research finds that cost and time savings are key to project success and client satisfaction. The use of PSWS has proven results in terms of savings that enable project completion on time and schedule. Improved communication and productivity and a reduction in IT investment leads to significant savings in cost and time. The companies involved in the Case Studies indicate that PSWS is a cost-effective program that improves the project process.

6.1.1.4 Project Status

Knowledge of project status at any given time is essential to project success. Control over all project aspects quickly identifies project problems that may lead to costly delays. The PSWS provides parties with a better knowledge of what is done, pending, or overdue and the responsible parties. The PSWS gives project teams control at any point over RFIs, submittals, costs, correspondence, and project progress. The tracking and accountability features identify lulls and gaps in the RFI/submittal process and daily reports provide critical project progress

information. Furthermore, all the project status information is available without direct involvement of staff; all information is available online.

In terms of the client, the PSWS increases his involvement in the process. The owner has a day-to-day knowledge of activities and can raise concerns sooner than under the current system where the owner may have little idea of project status. Furthermore, the PSWS is a comprehensive document management system that makes closeout of documents easier. At the end of the project, the owner and parties have a good library of project information, generally burned to a CD for easy use after project completion.

The firms with PSWS experience indicate that projects run smoother under the PSWS than the traditional system since the status of issues is instantaneous. The PSWS allows project managers to be more proactive, addressing issues early before they become a problem, than reactive, addressing issues after they are a problem. The proactive nature reduces costly project delays and improves the quality of projects.

6.1.1.5 Competitive Advantage

The use of PSWS provides firms a competitive advantage over their competitors. Clients demand project completion within the time and budget specified in the contract. The PSWS improves communication between parties, increases productivity, saves time and money, provides continuous status reports and gives the parties better quality control. These four areas increase the probability of completing the project on time and on budget. Furthermore, by knowing the status of all pending issues, the project team is better able to focus on the critical issues at hand and make decisions based upon real-time information.

The PSWS provides increased client care whereas the client has access to the project information and status of issues at all times. The client can be given access to the site and be able to track the project, view drawings to determine if changes need to be made, and potentially track project progress through site photographs or construction web-cams. The PSWS promotes increased client satisfaction, an important marketing tool.

The benefits of the PSWS are a marketing tool in winning work. Companies using PSWS have the advantage of a greater probability of completing the work on time and budget, provide improved customer care, and have the ability to build global project teams and build projects in global locations. Furthermore, as clients become more aware of the benefits of PSWS, the ability to work online often becomes a condition of winning work. Therefore, those firms with PSWS experience are more likely to win the work.

6.1.1.6 Risk Management

Risk management is a crucial area for companies according to researchers. One large claim against the company can cause significant financial difficulties. The primary risks in a project are overruns in budget and schedule and claims and litigation. Budget and schedule overruns often lead to claims and litigation. The use of PSWS allows companies to better manage these risks improving the likelihood that the project will be successful.

6.1.1.6.1 Budget and Schedule

Research shows that the success of a project depends on the ability to complete the project on budget and schedule. As noted, PSWS have inherent time and cost savings as compared to the traditional methods of project management. These savings include communication and information exchange

costs along with reduced RFI turnaround time and improved change management. Users of PSWS find that the PSWS allows daily monitoring of expenditures to keep the project on budget and identify problems early. Similarly, daily reports help keep the project on schedule by identifying work affected by weather or other delays as they happen. Furthermore, the immediate availability of critical decision-making information, real-time project status, and the improved teamwork lessen the likelihood of problems and changes that lead to schedule delays and added costs.

6.1.1.6.2 *Claims and Litigation*

The number and extent of claims is generally dependent upon schedule and budget overruns. As explained earlier, PSWS improve budget and schedule certainty, leading to fewer claims. PSWS users find that the timely access to project-critical information facilitates decision-making and eliminate surprises in schedule delays or budget overruns. Research indicates that the use of PSWS allow for the early identification of problem areas, reducing the probability of schedule and budget overruns, thus lowering the number of claims.

However, sometimes the avoidance of claims is not possible. In those instances, however, the PSWS makes the claim process easier. The PSWS provides a substantial paper trail of project events. First, all information is in one location, easily accessible. This reduces the time and cost of the discovery process for claim material. Second, accountability rises with the use of PSWS. The PSWS provides detailed and accurate records of communications sent and received. The tracking of RFIs and submittals allows no one to hide from the system.

The reasons for delays are known since the system documents who has seen what information, signed off on what documents, and what issues are pending and waiting for responses. The system identifies who is responsibility for the delay in responding to issues. Furthermore, parties cannot claim lack of information since notification of changes is immediate and project information is always up-to-date. There is no question as to whether or not a party has access to the latest version of the drawings or documents. The PSWS makes determining fault for delays and overruns easier due to the increased accountability of the system.

By using PSWS, companies reduce the risk and extent of claims and litigation. Improved budget and schedule certainty lead to a reduction in the number of claims. The improved accountability and adequate paper trail of the PSWS protects companies against claims since fault is clearer. The PSWS also reduces discovery costs and makes the claim process easier. In addition, the PSWS can automate the tracking and analysis of claims.

6.1.2 Needs-Capability Analysis of PMASP-based PSWS

While there are numerous project management tools available, companies are likely to only choose those that meet their needs. Companies look for the project-specific websites for project management (PSWS) offered by construction-based project management application service providers (PMASPs) that meet their needs. One issue lies in the fact that different parties have a different set of needs. Since parties collaborate on projects, a project-based project management system needs to meet the needs of all parties, not just the needs of a particular party. The extent to which a party's needs are met fall into three categories: needs well met, partially met, and not met. In some cases, certain aspects of a project

management need, such as Contract Administration, are well met but others are marginal or lacking. Therefore, the heading Contract Administration may appear in two categories. Figure 12 below shows the project management capabilities of each of the leading PMASPs. Figure 13, which follows, summarizes how the PMASPs meet the project management needs of the parties. The explanations that follow detail which aspects of the needs fall in which category.

Project Management Capabilities of the Leading PMASPs					
	Constructware	**Citadon**	**Autodesk Buzzsaw Professional**	**E-Builder**	**Meridian ProjectTalk**
Bidding & Estimating					
Bid Process					X
Estimating					
Contract Administration					
Specifications	X	X	X	X	X
Bonds/Insurance/Funding					
Permitting					
Progress Reports	X	X	X	X	X
Claims/Litigation	X	X	X	X	X
Documentation					
Management	X	X	X	X	X
Authenticity	X	X	X	X	X
Digital Signatures					
Notification	X	X	X	X	X
Design Collaboration					
Communication	X	X	X	X	X
Change Management	X	X	X	X	X
RFIs & Submittals	X	X	X	X	X
Field Operations					
Procurement					
Daily Reports	X	X	X	X	X
Inspections					
Punch Lists	X	X	X	X	X
Safety					
RFIs/Submittals	X	X	X	X	X
Change Orders	X	X	X	X	X
Scheduling					X
Budgeting & Cost Control					
Budget	X*				X*
Forecast/Track Costs	X*				X*
Accounting					
Project Closeout	X**	X**	X**	X**	X**
*Does not integrate with existing budgeting/cost control software; may require double entry					
**Only includes the project information that was on the PSWS					

Figure 12: Project Management Capabilities of the Leading PMASPs

Level at Which Project Management Needs are Met by the Leading PMASPs			
	Needs Fully Met	Needs Partially Met	Needs Not Met
Bidding & Estimating			
Bid Process			X
Estimating			X
Contract Administration			
Specifications	X		
Bonds/Insurance/Funding			X
Permitting			X
Progress Reports	X		
Claims/Litigation	X		
Documentation			
Management	X		
Authenticity	X		
Digital Signatures			X
Notification	X		
Design Collaboration			
Communication	X		
Change Management	X		
RFIs & Submittals	X		
Field Operations			
Procurement			X
Daily Reports	X		
Inspections			X
Punch Lists	X		
Safety			X
RFIs/Submittals	X		
Change Orders	X		
Scheduling		X	
Budgeting & Cost Control			
Budget		X	
Forecast/Track Costs		X	
Accounting			X
Project Closeout		X	

Figure 13: Level at Which Project Management Needs are Met by the Leading PMASPs

6.1.2.1 Needs Well Met

This category includes those project management needs well met on the project-specific websites for project management (PSWS) offered by the leading construction-based project management application service providers (PMASPs).

6.1.2.1.1 Contract Administration

The PMASPs offer document management and RFI/submittal tracking features that aid parties in meeting specifications. In addition, reporting features create progress reports and detail project status. In terms of claims and litigation, the PSWS provides an adequate paper trail through easy document discovery, documented communications, and RFI/submittal tracking.

6.1.2.1.2 Document Management

Document management is the basis for the PSWS systems. They provide a central repository for project documents that is accessible at any time from anywhere with an Internet connection. The system enables users to have access to the information they need instantaneously instead of waiting on the other parties to pass the information to them. The PSWS offer RFI and submittal tracking features that effectively manage the process. The tracking process enables those involved in the RFI/submittal process to know the status of the document at any time and where bottlenecks lie. In addition, the system provides authenticity of documents by recording who creates, posts and/or revises the document. Furthermore, the systems have the ability to notify users whenever the posting of new documents or changes to documents occur so that all users have the latest version.

6.1.2.1.3 Design Collaboration

The features of the PSWS system serve to improve the design collaboration process as well. Research finds that there is great improvement in communication with the PSWS systems since users have the latest document versions and quick access to

other necessary documents. The PSWS also has important contact information for the parties involved. Furthermore, some PSWS have online meeting capabilities and the ability to redline drawings in a collaborative setting. The change management process is more effective in that all users have access to the latest documents rather than requesting them, or not knowing about a change, and then rework being required down the road. Improvements in the RFI/submittal process for designers come from having the knowledge of documents requiring their attention and a record of the approval status of the documents.

6.1.2.1.4   Field Operations

PSWS offer reporting features including daily reports that the contractors can complete to record the day's activities. As described earlier, the RFI/submittal tracking feature allows instantaneous access to the submittals as well as their approval status. Along with change management during the design process, the PSWS also aid the change order process during construction. All revised documents and drawings are available online for all necessary parties to access.

6.1.2.1.5   Notification

The PSWS systems have notification features that enable notification of users when the posting of new documents or changes to documents that affect their work occur. In addition, the RFI/Submittal tracking features of PSWS offer notification when a document requires the attention of a particular user.

6.1.2.1.6   Project Closeout

When all users use the PSWS system, the PSWS creates a complete project record.   Generally, the storage of project information is on CDs for later reference.

6.1.2.2 Needs Partially Met

This category includes those project management needs partially met on the project-specific websites for project management (PSWS) offered by the leading construction-based project management application service providers (PMASPs).

6.1.2.2.1   Scheduling

The incorporation of scheduling into PSWS is on a limited basis.   Generally, the posting of schedules online is for information purposes only.   No updates or changes to the schedule are made through the PSWS.   The entering of data is directly into scheduling software.   However, Meridian ProjectTalk now offers a scheduling membership that integrates with Microsoft Project, Primavera Project Planner (P3), and Suretrak Project Manager.   The other leading PMASPs do not yet offer scheduling integration.

6.1.2.2.2   Budgeting and Cost Control

Budgeting and cost control are somewhat available through PSWS.   While there is no integration yet with existing budgeting and cost control tools, Constructware and Meridian ProjectTalk offer cost management features.   These PSWS are able to track, manage, and forecast project costs across multiple projects, programs, and company divisions.   It gives information such as cost to complete, budget vs. actual costs, and other key indicators of project health at any time.

6.1.2.3 Needs Not Met

This category includes those project management needs not met on the project-specific websites for project management (PSWS) offered by the leading construction-based project management application service providers (PMASPs).

6.1.2.3.1   Bidding and Estimating

Project bidding is one area in which the present leading PMASPs lack. While there are a few websites, such as BB-Bid (www.thebluebook.com), that offer bidding services, there is no integration of bidding process into the leading PMASPs. Some PMASPs may give companies the ability to develop bid forms including RFQs, but they do not provide owners the ability to create bid packages, online plan rooms, or track proposals. Furthermore, the PMASPs do not provide a system for contractors or architects/engineers to search requests for proposals or submit online bids. In terms of estimating, the PMASPs generally lack the necessary resources as well. Companies want the PMASP to integrate with their existing estimating software to maintain their past history of estimates. Currently, there is only limited integration between PMASPs and existing software tools, primarily due to proprietary rights of the estimating software developers.

6.1.2.3.2   Contract Administration

However, little, if any, integration has occurred between PMASPs and permitting or bonds, insurance and funding issues. Management of these issues is still paper-based and requires the collaboration of parties outside of the A/E/C industry.

6.1.2.3.3 Document Management

The PMASPs do not enable digitized signatures, which means that official copies must still be printed and signed to be official.

6.1.2.3.4 Field Operations

The PMASPs do not currently offer several aspects of field operations. Procurement is an important aspect of field operations that has significant affects over the schedule and budget. While Meridian ProjectTalk offers purchasing control as part of their project management membership, there is not widespread procurement in the PMASPs. In terms of procurement, the PMASPs need to offer a link to multiple suppliers and real-time pricing, availability, and delivery information. Inspection capabilities are also not an advertised feature of PSWS systems. While there is development of other inspection technologies, such as PDA devices, there is no incorporation of these systems into PSWS. In addition, safety is an important part of field operations, but there is no integration of safety violation or safety management programs into PSWS.

6.1.2.3.5 Accounting

Accounting is a crucial, complicated part of a company. Generally companies have sophisticated accounting systems specialized to their company. Therefore, integration of accounting systems with PSWS has not been accomplished.

6.1.3   Barriers to Using PMASP-based PSWS

There are numerous project management tools available, but despite the known benefits of these tools, the A/E/C industry is reluctant to adopt new technologies. The concept of integrated, real-time project management has yet to take hold for several reasons. The barriers to the use of project specific websites for project management (PSWS) available through construction-based project management application service providers (PMASPs) are divided into technological and people/cultural. Each category has a different set of issues that hinder the widespread use and acceptance of PMASPs as the new project management philosophy in the industry.

This section looks at the following barriers:
- Technological Issues
  - Hardware/Software
  - Integration and Compatibility
  - Costs
  - Legal and Security Issues
- People/Cultural Issues
  - Nature of the Industry
  - Support from Management
  - Fear of Technology
  - Unwillingness to Change
  - Trust/Willingness to Share
  - Training
  - Implementation Process

6.1.3.1 Technological Issues

Technological issues are one group of barriers to the use of PMASPs. These issues include the actual technology as well as the resources needed to run it. It also includes concerns over components of the technology.

6.1.3.1.1 Hardware/Software

Changes to hardware and software are one concern of companies. In terms of online project management using client-server systems, substantial hardware and software investment is need. PMASPs, however, require limited computing changes. However, the fear of hardware or software failure is a strong barrier. In addition, concerns over the responsibility for failures, upgrades, and maintenance also hinder use of PSWS.

6.1.3.1.2 Integration and Compatibility

Companies use various software programs for tasks ranging from word processing, CAD, scheduling, estimating, accounting, project management, and design. There are few standards in the industry as to what format documents should be in and what programs companies should utilize. In some cases, the specification of particular CAD program or scheduling software may be in the contract, but there is no industry standard. The barrier then is finding a way to enable the various systems to talk to each other and exchange information. Generally, the PSWS are not compatible with scheduling and budget program. The number of parties involved on a project, the multitude of programs used, lack of industry standards and incompatibility of the PSWS and other crucial software limits the widespread use of PSWS.

6.1.3.1.3 Costs

Many in the industry feel online project management is another added cost. For the PMASPs, there is an annual user fee per license plus the cost of training and support. The opinion in the industry is that the current system works, so why spend

money on a new system. The justification of costs to owners and upper managers is thus a challenge.

6.1.3.1.4 Legal and Security Issues

Legal and security issues are possibly the largest technological barriers to the use of PSWS. There is concern over access to the data in terms of who can view and modify documents, add or delete information, or alter drawings. The responsibility for the information and identification of who created it and who has modified it also raises concerns. The confidentiality of data, in that only the recipients can see the information is another issue.

In terms of liability, the issues of online signatures and the ability of the PSWS to create an adequate audit trail for claims are of high concern. In addition, liability for lost information and PSWS failure raise fears of PSWS usage. The ability to back-up the data is another question in the minds of potential users. Whether or not there needs to be a contract between the PMASP and the project parties is another question to answer.

6.1.3.2 People/Cultural Issues

People or cultural issues are probably the primary barriers to using PMASPs. Cultural issues include personnel support, willingness to change, the state of the industry, and learning capabilities. It involves convincing the people who will be using the technology to put aside their fears and use it. These issues require the most attention.

6.1.3.2.1 Nature of the Industry

The industry itself is a barrier to the use of PSWS in several ways. Due to the complexity of projects, the industry is

fragmented and specialized. The fragmentation creates a more challenging environment for collaboration and communication since there are so many parties involved. Furthermore, there is a lack of industry standards so all parties work in different ways with different programs. Integrating all of the information into one system is a challenge.

In order for online project management to be success, all parties must be willing to use the technology. There is a critical need for mass adoption of this technology. If not all project participants use the system, it is a lot less useful to you. Therefore, the individual parties feel that will not reap the benefits of PSWS unless a majority of firms implements the technology.

6.1.3.2.2 Support from Management

The PSWS is a fundamental change in the project management philosophy of companies. The change requires considerable support within the company, from the top down. Management needs to be technology drivers and implement a culture that encourages PSWS use. However, management has not put this culture in place, leaving those below top management unwilling to utilize the technology as well.

In addition, the justification of costs to upper management is another barrier. Research indicates that the construction industry spends relatively little money on technology as compared to other industries such as manufacturing and financial services.

6.1.3.2.3 Fear of Technology

The fragmented construction industry spans from suppliers to subcontractors to designers to prime contractors to owners and other specialists in between. Within this mix of project participants, there is a wide range of technology comfort levels from daily use of computers to having never turned one on. The fear of technology among some project parties hinders the ability for the entire project team to use PSWS. The true benefits of PSWS are limited if the entire team is not online.

The majority of the industry is "early and late majority" adopters of technology. Driven by a strong sense of practicality, these groups wait to see how others make out, and in the case of the late majority, need lots of support and an established standard. No established standard or support mechanism is in place yet, thus, limited technology adoption has occurred.

6.1.3.2.4 Unwillingness to Change

One of the greatest people issues in the implementation of PSWS is the unwillingness to change of the project parties. Many users feel that the traditional paper-based method of project management still works, and there is no reason to fundamentally change the way they do things. Some employees feel that the PSWS is simply another corporate procedure to follow and will increase their workload. If not all members are willing to use the system, the realization of the full benefits of the PSWS will not occur.

In the industry, there are innovators, pragmatists, and skeptics when it comes to any change, especially technology. The

pragmatists and skeptics need proof that the system works before they are willing to change. The limited use of PSWS in the industry thus far limits their confidence in the system and hinders their willingness to change. Furthermore, they want to know that the system will meet their needs. The extent to which each of the leading PMASPs meets the needs of the user is not necessarily clear.

6.1.3.2.5   *Trust/Willingness to Share*

Another barrier to the use of PSWS is concern over the shift of ownership of the data. Under the present paper-based management system, the company or individual that creates the information owns the information and controls the accessibility, availability, and timeliness of it. The PSWS shifts ownership from the individual or company to the project, increasing the availability and accessibility of the information to anyone with access to it. Questions arise over responsibility for the information and who is able to access, change, or delete the information.

In addition, there is concern by users that the PSWS will affect the claim process. External users are often reluctant to enter information into a system they do not own. They fear that in a dispute, the controlling party may deny access to the data. Furthermore, the use of the PSWS increases accountability and some people do not want someone looking over their shoulder all the time.

6.1.3.2.6   *Training*

With respect to the proposed research, several papers indicate that training is essential to the success of online project

management. However, no general training or implementation program is available. Companies who implement PSWS must determine their own training needs and develop a suitable program. Generally, there is little experience with these programs with a company, which makes training even more difficult. Further questions arise over who performs and pays for the training within the company as well as training for the other project participants.

6.1.3.2.7 *Implementation Process*

The implementation process is one of the hardest barriers to overcome. A difficult step of implementation is determining what program to select. Then how to actually implement the selected program is a daunting task. While many of the project-specific websites do offer support, it is site specific. The website provided support focuses on the technicalities of the site rather than an overall procedure of how to implement online project management successfully into a company. Therefore, companies need to develop their own implementation program based upon their needs and company culture.

Implementation requires many steps and overcoming many of the barriers mentioned in this paper. It is essential to have a PSWS champion who truly wants the system to develop a clear implementation plan. It requires identification of the parties that need to use the system and then getting those parties online. Learning all the ways one can utilize the PSWS is another part of implementation. In addition, the learning curve for each person is different, and consideration of the lost productivity during the learning process is important. Not only

is selecting the best PSWS a challenge, the implementation of the PSWS after selection requires even more effort. Many companies do not have the drive or desire to undergo the implementation process.

6.2 <u>Implementation of PMASP-based PSWS</u>

Implementation of a project-specific website for project management (PSWS) available through construction-based project management application service providers (PMASPs) is a daunting task that determines the successfulness of the system. Implementation is a step-by-step process that must be well planned and managed. Project management is too crucial to the success of a project for implementation of the PSWS to be ad hoc or learn as you go. Companies must plan, expect, and address implementation issues early. A company must have implementation strategies that maximize the likelihood of success while minimizing the consequences of failure. Case studies show that the failure to have an implementation plan leads to the unsuccessful use of PMASP-based PSWS.

Based upon the literature review, PMASP investigations, and the company case studies, this section identifies and describes ten key implementation steps a company should take in order to successfully implement a PSWS. The steps are as follows:

- Examine Present State of the Company
- Create a Plan for Improvement
- Designate a PSWS Champion
- Select a PMASP-based PSWS System
- Determine Usage of PMASP-based PSWS System
- Policies and Procedures
- Training
- Setting up the PSWS for a Project
- Support Network
- Lessons Learned

6.2.1 **Examine Present State of the Company**

An examination of the present state of the company is the first step of the implementation process. The examination consists of two parts: company needs/problems and company goals. The company must identify its project management needs and the ability of its current project management tools to meet these needs. The recognition of key problem areas such as schedule and cost overruns, extensive rework, productivity, claims, and party coordination is essential.

The future goals of the company are the second part of the examination. The business drivers of the company should be clear and the basis for goals. The company's desire to grow in terms of expansion into the global market or the ability to complete larger projects is a potential goal. Other goals may be greater productivity or improved party collaboration to produce better project designs or a smoother construction process. In addition, improved project consistency in terms of meeting the project budget and schedule is an important consideration in terms of client satisfaction. Companies should strive to add value for the customer by providing more construction for the money. Furthermore, a reduction in the number and magnitude of claims is an important goal of companies.

A company must clearly identify its project management needs to know what is presently lacking or where improvements can be made. A clear understanding of the present problems the company faces identifies those areas that need to be improved. The future goals of a company generally involve fixing the present problems as well as company growth and increased client satisfaction.

6.2.2 **Create a Plan for Improvement**

The basis for an improvement plan is the examination of the company in terms of needs, problems, and goals. The plan should identify the ways the company can meet its needs, correct the problems it faces, and achieve the company's goals for

the future. As mentioned, implementation cannot be ad hoc; it must be well planned and managed. This plan creates a detailed organization strategy taking into consideration the company's needs, input from all departments, resources, barriers and support.

6.2.2.1 Address Company Needs

In creating a plan for improvement, the company should focus on those technological solutions that will address the company needs. If the solution does not address the needs of the company, it is not a viable, worthwhile solution. The "core technologies" for a company are those that enable a company to compete in the industry and meet client needs. In selecting "core technologies," consideration of the critical success factors for a company including team organization, risk assessment, features and functionality and deployment schedules is necessary.

6.2.2.2 Input from All Departments/Levels

The plan for improvement needs to consider the company culture in terms of the employees' skill levels and willingness to use the technology. Input from all departments and levels within a company ensure the technology meets the needs of all functional departments. Gaining input from all areas shows management's interest in the employee's opinion and helps to gain buy-in and support for the new technologies.

6.2.2.3 Identify Resources

The successful implementation of new technologies requires clearly identifying all necessary resources during the planning process. Thorough investigation and evaluation of the technology discovers the necessary resources early so there are fewer surprises later. In addition, resources should not just come from the project budget. Utilizing multiple project budgets or company assets allows the company to select better technologies, provide better training and personnel, and "opens the door"

for technology that may not be successful on the first project. The plan for improvement should clearly identify all necessary resources as well as the means for obtaining these resources.

6.2.2.4 Identify Potential Barriers

Any change often has potential barriers that may hinder the success of the change. The plan for improvement should consider potential barriers and means of overcoming these barriers. Potential barriers include technological issues such as the effects of new technology on other dependent organizational systems and people and cultural issues such as resistance to change and a lack of support. Addressing barriers early in the process improves the ability to plan for overcome the barriers, making implementation more successful.

6.2.2.5 Ensure Support

For any change to be successful, it must have the support of those whom the change affects. The improvement plan should take steps to limit the risk of failure and increase the probability of success. This means ensuring support for the new technological improvements before full implementation. In making its decisions, top management should pledge its support and create an environment that promotes use of the new technology to gain support of other employees.

6.2.3   **Designate PSWS Champion**

All of the companies involved in the Implementation Case Study reported that a PSWS Champion is crucial to the implementation process. A PSWS champion takes the lead in the implementation process. The PSWS champion must have certain qualifications in order to perform its tasks, described below.

6.2.3.1 Qualifications

The PSWS champion must, first, be 100% committed to the project, and want the job. Due to the nature of the industry, the individual should be construction-oriented and have some relative technological experience. Being web-savvy and possessing the ability to understand the tool is an important qualification as well. Self-motivation and the ability to stay six or seven steps ahead are crucial to keeping up with changes and updates performed by the PMASP. The champion must have the personality, credibility, and time to develop training programs, promote use of the system, and provide support to users.

6.2.3.2 Task/Role

The PSWS champion is the implementation team leader. It is their job to guide the team towards successful implementation. The PSWS champion is generally the first to learn the program, develop training programs and provide user support. The PSWS champion keeps up with changes in the PSWS and is the go-to person. The PSWS champion may also become the PSWS system administrator as described under Step 8.

6.2.4   **Select PSWS System**

Selection of the most appropriate PSWS system is crucial to the successful use of the system. The system should meet a majority, if not all, of the firm's project management needs. It should also meet the project management needs of the other parties involved on a project, including the owner, contractor, subcontractors, architect, engineer, and construction manager. It is important the decision-making team have a good understanding of the construction industry, the company culture, and project management. If possible, the use of PSWS is more successful if a company can standardize on a specific package. Close analysis of the PSWS choices with regard to the aspects described below with help a company make a better selection and improve the probability of success.

6.2.4.1 Client Server or PMASP

The first decision a company needs to make is whether to use a client-server or an PMASP application. The trend in the industry lends itself towards PMASPs being the predominant PSWS system in the future. PMASPs are generally easier to implement, require less IT investment, are less expensive, and allow for party collaboration.

6.2.4.2 Examine Leading PMASPs

A close examination of the available PMASPs is necessary to ensure the selection of the best system for the company. It is important to consider the following aspects of each PMASP before making a final decision.

6.2.4.2.1   Meets Project Management Needs

The PMASP must meet a majority, if not all, of the project management needs of the parties that will use the system. A system that does not provide the features a company needs will not allow for a total transition to online project management, nor receive the support of uses. The system should meet the basic needs of document management, RFI, and submittal tracking, correspondence, project status reports, scheduling and budgeting. The PSWS should handle both the design and construction aspects of the project as well as all project types and sizes. Furthermore, other functions such as site progress photos and videos, online meetings, and design revisions may be important to the company. The PSWS should enable users to quickly identify new items and pending issues as well as search for the information that they need. The ability to retain information after closeout is also a consideration. A company should identify its project management needs before analyzing the PSWS and then determine whether the PMASP meets those needs.

6.2.4.2.2 Fine Print

As with most items or services purchased, one should read the fine print of the provider. A critical issue is the reliability of the service. Are the servers always up and running? Should there be an agreement between the parties and PMASP to ensure that the PMASP will always be available in terms of features, support, and training?

Another critical concern is where responsibility lies if information is lost or something else goes wrong. Who is responsible for data recovery? Should a company have an escrow account in the event that data recovery is necessary? Does the PMASP provide data back-up, if so, how often? In the event of server problems, how quickly is the PMASP required to make repairs to get the system up and running again? Does the PMASP have liability insurance coverage in the event that the PMASP is acquired, merged, or goes out of business?

These are all crucial questions for a company to ask an PMASP during the analysis process. Guarantees in writing ensure the service is always available and will provide all the features it promotes. The PMASP should provide reliable data back-up on a routine basis to ensure data will not be lost. To alleviate concerns over PMASP failure or acquisition, companies should consider only well-established PMASPs with secure financial backing.

6.2.4.2.3 Client Satisfaction

One way to gain a true perspective into a PMASP is to look at the present clients of the system and its reputation in the

industry. The PMASP client list should have numerous champions that include large companies with numerous users using the system and adapting most of the features. Furthermore, recommendations from comparable companies can provide insight into the right PMASP for the company. Clients of the PMASP should promote its ease of use, user-friendliness, and responsiveness to user input. The PMASP should offer extensive training and support to its clients and help them with the implementation process and any problems that arise. Clients should also be satisfied with the value they receive for the money.

6.2.4.2.4 *Integration with Existing Business Processes*

The ability of the PSWS to integrate with existing business practices is an important aspect of an PMASP. If systems do not integrate, then often times duplication of data entry into different systems is necessary and there are multiple systems to learn and integrate manually.

Presently, PSWS integration with scheduling and budgeting programs is minimal. However, the leading PMASPs are working on resolving the issue. The PMASP consideration should look at the PMASPs willingness to improve its ability to integrate with the company's existing processes in a reasonable amount of time. In addition, the PMASP should offer file conversion tools and support multiple file formats.

6.2.4.2.5 *Training and Support*

The PMASP selected should offer extensive training and support options. The PMASP should be able to adapt training to the company and project needs and provide multiple levels

of training. Both centralized training as well as on-site training is important. In terms of support, there should be a sufficient number of customer representatives compared to the daily activities on the site. The customer service representatives should also be very familiar with the service and able to offer assistance to any issues. Furthermore, the PMASP should be responsive to user suggestions and requests for other training or support options.

6.2.4.2.6 *Changes to Hardware/Software*

The optimal PMASP would require few, if any, changes to existing software and hardware. In some instances, there may be a need for additional RAM or increased Internet connection speed to achieve optimized use of the PMASP. In addition, to easily view all documents, Adobe reader and writer may be necessary.

6.2.4.2.7 *Notification*

One important feature of an PMASP is notification. The notification feature of an PMASP notifies users, usually by e-mail, that there are issues requiring their attention. These issues could be changes or updates to drawings or documents that affect the work of other parties. Notifications sent to users provide reminders of issues that need their attention include RFIs or submittals. The notifications improve the change management and RFI/submittal processes of projects. Without notification, parties may not be aware that crucial changes were made or that there are issues requiring their attention.

6.2.5 Determine Usage of PSWS System

Determining the level of PSWS usage should be a joint decision between all involved parties. When all parties are involved in the decision, they are more willing to support and use the system.

6.2.5.1 Goals of System Use

The goals of system use will primarily dictate for what purposes the PSWS is used. The general goals of PSWS use are to facilitate collaboration between parties, increase productivity during the design and construction phases, and increase schedule and cost certainty. All project participants should be educated on the goals and benefits of PSWS use to establish credibility and build support.

6.2.5.2 Features of System to be Used

The PSWS offer a wide variety of features. Certain features such as document management, notification, project status reports and tracking should be required. However, other features like online meetings and site photos may not be essential at first. Establishing a primary set of features for all parties to use provides a starting point to PSWS use. The basis for the primary features selected comes from the value they add to the project. Once one masters the primary required features, users can choose to learn the more specialized features like online meetings.

6.2.5.3 Online Project Aspects

Clearly, the industry and the leading PMASPs are not ready for the complete online project management. There is still a division line between those project aspects that can successfully be managed online, and those that must remain paper-based for the time being.

The case studies of companies who use PSWS identified the primary areas for which they use PSWS. In the areas of design, construction, field

operations, program management, and construction management, the PSWS has proven successful. However, online management of scheduling, estimating, and financial services has its difficulties and limitations. Some information in these areas is posted online, but for information purposes only.

Document management is the primary use of the PSWS. Documents including drawings, correspondence, meeting minutes, and reports can be stored, accessed, and reviewed online. RFIs, submittals, and transmittals can easily be reviewed, tracked, and responded to online.

6.2.5.4 Paper-Based Project Aspects

As mentioned above, there cannot be complete online management all project aspects at this time. Some aspects must remain paper-based due to integration problems and security issues. There is limited integration ability with scheduling and budgeting programs, requiring these areas to remain primarily paper-based. Security issues such as authentication and signatures limit full online project management. According to the results of the case studies, generally anything requiring official signatures or money remains paper-based, or at least is signed and then scanned for upload to the site. In addition, companies may want to first run the online and paper-based systems in parallel to ensure the online system works.

6.2.6   Policies and Procedures

The implementation of any new system requires detailed policies and procedures governing its use. The implementation of the PSWS is a fundamental change that requires significant thought and consideration to policies and procedures. The following list describes the policies and procedures that should be changed or established for PSWS use.

6.2.6.1 Job Descriptions and Roles

The PSWS fundamentally changes the project management philosophy of the industry. The roles of project participants change in respect to their job functions. To encourage use of the PSWS, revised job descriptions should include the mandatory use of the PSWS. To rewrite the job descriptions, management must first determine who is using the site, and for each position, utilization of the site, and what information they are responsible for placing on the site. Furthermore, the PSWS may create new positions with the company such as PSWS administrators or champions who take the lead in implementation of the system along with handling training and support issues.

6.2.6.2 Contract Conditions and Costs

In order to require the use of PSWS by all project parties, it needs to be a condition of the contract. The contract should dictate which PSWS system to use and what parties have access to which features. The "thou shalt use" clause creates a complete project archive at the end of the project. The establishment of PSWS during bidding informs parties in advance of the required PSWS usage. The contract should also establish which party is responsible for user costs, training, and support for the PSWS. The method of recovering of costs, through overhead or on a project basis, should be clear in the contract. In addition, a damage recovery clause that establishes an escrow fund to recoup data in the event of a catastrophe or insolvency event is a contract consideration. Establishing policies and procedures for PSWS use in the contract forces parties to utilize the system for the purposes intended.

6.2.6.3 Permissions and Access Control

Establishment of access control to the PSWS is critical to maintaining contractual boundary lines. For example, the subcontractor is not able to communicate directly with the architect's consultant. In determining

access, there should be a clear map of information flow. The map of information flow ensures that party lines are clearly drawn and that parties have access to the documents and features essential to their role in the project. The information map also establishes notification groups for various changes or issues to ensure parties are aware of information crucial to their role. Each user has an individual password that provides access to only those features and information related to their work. The password also establishes permission to access, modify, change, or delete information or files as determined by administrators.

6.2.6.4 Instructions for Use

Clear instructions for use should be determined and made available to all users. There should be documentation of the required features and uses of the PSWS. It may be advantageous to make step-by-step instructions for the required modules available to users. Furthermore, the appropriate use of the PSWS in terms of how to upload/download information and file organization should be clear and made standard. In addition, a determination needs to be made in regards to whether communication on the site should be formal, like written correspondence is, or informal like e-mail. Website etiquette is an important issue that to address early in the implementation process.

6.2.6.5 Mandatory/Optional

In order to reap the benefits of a PSWS project management system, all project parties must utilize the site. The most important features of the PSWS, like document management, RFI/Submittal tracking, daily message checking, and other features as determined by the company, should be mandatory for users. Specialized functions such as online meetings can be optional until users are more comfortable with the system. To encourage use of the site, PSWS usage should be part of employee evaluations.

6.2.6.6 Computing Changes

Procedures should be in place to perform any necessary computing changes quickly so that immediate use of the PSWS is possible. The computing requirements of the PSWS should be identified and compared to the current computing resources to determine what improvements, if any, need to be made. Generally, Microsoft Internet Explorer should become the standard web browser and a minimum of a DSL/Cable Internet connection should be made.

6.2.6.7 Security Issues

Security is an important concern when using PSWS to ensure that information does not fall into the wrong hands. The establishment of access control and passwords is the primary means of maintaining information integrity. Most PSWS systems provide information as to who creates, uploads, views and edits documents, improving accountability and security of the information. In addition, the handling of signatures should be through paper-based copies and possibly scanning until a company can fully investigate the availability of digitized signature software. The PMASP is responsible for virus control and security of the data on its servers.

6.2.6.8 Liability

Liability for the information on the PMASP should be clear before use of the site begins. The PMASP should be responsible for the security and available of data on its site. However, the parties utilizing the PSWS should map chain of events for data recovery and reinstating service in the event of a problem. Furthermore, it is advisable to write a warranty clause requiring the provider's data center to perform repairs w/in specified time; twelve hours is typical.

6.2.6.9 Notification

Notification is an important feature of the PSWS that should be mandatory. The notification features informs specified parties, via e-mail, of new, changed, or pressing information that requires that user's attention. Establishment of protocols stating, "If __(type of document)__ is submitted, one must notify __(names of users)__," simplifies use of this feature.

6.2.6.10 Site Responsibility

It is important to establish responsibility for the site early in the process. Generally, the lead party on a project determines the need for PSWS use and sets the policies and procedures. Items such as responsibility for training, costs, and access control fall to the lead party. The lead party should have a site administrator to handle those issues and the organization of the site. The lead party is best able to communicate the needs of the owner and therefore control the project. In terms of responsibility for information on the site, the creator of the document is responsible for its validity. As for keeping the site running at all times, virus control, and data back-up, this responsibility falls to the PMASP provider. These responsibilities should be clearly established and documented before use of the site for a project begins.

6.2.6.11 Project Closeout

Procedures should be in place for the closing out of a project. Presently all project documentation is compiled and stored by each individual party. The PSWS places all project documents in one location, so that there is a complete archive of project information. The lead party should then transfer data to a CD for storage and future reference. Potentially copies of the CD provide project information for the other project participants.

6.2.7 Training

Training is a critical component of the implementation process that has the potential to greatly impact the success of the PSWS. It is essential to spend the time and money on training to make users more comfortable with the system. The key is to train users before use of the PSWS, not after. It is important to access the technological capabilities of all users to determine training needs and create education plans for all users. Training will differ based upon the role and skill level of the user.

Various parties can handle training in many ways. It is important to conduct professional training, generally by the PMASP, at the start of each project. Initial training, at a minimum, should be done in the classroom. Researchers conclude that human interaction in the classroom is a more effective training method than electronic training. Classroom education encourages input from all trainees as well as the ability to present, demonstrate and try out the features and then ask questions. It is a more hands-on personal experience. As users become more experienced with the PSWS, training can shift to include only new users to a project. Once fundamental training has occurred, an in-house expert can conduct training sessions on updates and changes to the required features and introductions to the more specialized features the PSWS offers. Furthermore, the in-house expert, generally the site administrator or PSWS champion, should assemble training manuals and/or step-by-step instruction guides to help with the learning process.

6.2.8 Setting up the PSWS for a Project

The above steps focus on company-wide implementation steps. Once these steps are taken, projects can begin using PSWS. Setting up the PSWS for a project involves several steps.

6.2.8.1 System Administrator

The designation of a system administrator for each project or multiple projects is an important step in the process. Larger companies may have several administrators, one for each geographic region or office location. The system administrator has a role similar to the PSWS champion, so the champion, in some cases, may become the administrator. The administrator works with the owner in terms of meeting the owner's needs, requests, and contract requirements in terms of project management. The administrator also works with the project manager to determine the project needs and what PSWS features to use. The administrator then sets up and organizes the PSWS, and loads the initial project information. The system administrator controls training for the project parties and provides support for any issues, problems, or questions about the PSWS that may arise on the project.

6.2.8.2 When to Start

The use of the PSWS on a project should start at the beginning of the project, whether this is pre-design or the first day of construction. The lead party on the project should clearly define PSWS use and expectations during partnering and project meetings. A PSWS should only be imposed on projects in progress if there are serious problems with the current project management system on the project.

6.2.8.3 Initial Information

The system administrator should place important project information on the PSWS before opening to entire project team. This includes project contacts, contract information, and any other available project documents, depending on what stage PSWS use begins. The PSWS must give a good first impression to promote use. A first-time user should be able to use site to do work, not find it empty.

6.2.8.4 Applicability of Policies and Procedures

The applicability of the established PSWS policies and procedures to a given project should be clear to all involved parties. There needs to be clear documentation of any additions to the policies and procedures for the project. The following three policies and procedures often require project-specific changes.

6.2.8.4.1 Contract Conditions

Contracts vary from project to project. The examination of the contract in terms of project management requirements ensures that the PSWS meets these qualifications. Furthermore, the contract establishes which system to use as well as responsibility for costs, support, and training.

6.2.8.4.2 Access Control

The site administrator must establish access control for the PSWS according to the established procedure. In determining site access, attention should be given to contract boundary issues as well as the map of information flow. A user's role in the project is the basis for user profiles and access rights. Parties should be clear as to who has access to what aspects of the PSWS as to not create confusion or misunderstandings as to who has what information available to them.

6.2.8.4.3 Notification Procedures

For each project, there is a different lead party and various other project parties involved. Therefore, continual updating of the map of project information ensures proper access to users. Furthermore, new notification protocols are written for each project depending upon the needs, issues, and parties of the project.

6.2.9 Support Network

Having a support network in place gives users more confidence in using the PSWS. Through the support network, problems and issues are quickly resolved to not lose critical project time. The support network has several levels. On the project level is the site administrator who controls specific issues with the PSWS for a given project. Next is the PSWS champion who deals with PSWS implementation on a company level. The top of the support network is the staff of the PMASP. The support network solves problems and work to improve the PSWS based upon user recommendations.

6.2.10 Lessons Learned

The implementation process never truly ends. A continuous learning process occurs as additional features are added and updates are made to the PSWS. As users become more experienced with the PSWS, they are able to utilize the more advanced features that the PMASPs offer. Users also discovery what works and what does not in terms of the PSWS as a replacement of the paper-based project management system.

Project parties should hold regular meetings to discuss the use of the PSWS. The meetings should be a forum to discuss the benefits seen, the problems encountered, and other areas of concern. The meetings can also identify those areas that need improvement and provide input to the development staffs of the PMASPs.

6.3 Sustainability Challenges of Using PMASP-based PSWS

As discussed earlier in this paper, there are barriers to the implementation of project-specific websites for project management (PSWS) available through construction-based project management application service providers (PMASPs). Before and during implementation, some of these barriers are easily overcome. However, problems remain, even after

implementation, which need to be resolved. In general, there is no problem with controlling access to the site or problems with IT investment. The primary challenges that remain are:

- User resistance to change
- Support of all project parties
- Integration of existing business processes
- PSWS is not a "single point of access"

6.3.1   <u>User Resistance to Change</u>

Through the implementation case study, the companies identified user resistance to change as a challenge even after implementation. Users still feel that they are shifting from a functional system and way of doing business. They see no problems with the current system and feel the PSWS is just another burden. Overcoming this challenge involves continual education as to the benefits of PSWS, though documented examples of projects completed using a PSWS. Clear identification of the problems with the existing project management system may make the need for an improved system clear to users.

6.3.2   <u>Support of all Project Parties</u>

Given the fragmentation of the industry, it is difficult to gain support from all project parties. There is a need to get as many parties on board as possible to reap a majority of the PSWS benefits, and work towards a single project-based project management system. Parties must agree on the responsibilities and expectations for every user. Writing a requirement to use the PSWS into the contract, informs parties in advance that the system will be used and give the party the option to accept the project or not. Therefore, only interested parties will sign onto the project.

The range of technological skill levels in the industry partially limits the support of project parties. Users must acclimate to the web environment, and there is a longer learning curve for those with limited computer skills. By providing more

extensive computer training for the unskilled parties, in terms of general computing and PSWS use, the parties may be more receptive to learning.

6.3.3 Integration

Project management is a complex process that involves many project aspects. Determination of which project aspects can be transferred online and managed through the PSWS features is important. The inability of the PSWS to integrate with all existing project management tools limits the full transfer of project management to an online setting. Presently, there are integration issues with scheduling and budgeting programs, which are two crucial aspects of a project. However, all of the PSWS providers are working on this issue and integration of these features is in the near future. Furthermore, the PMASPs are very receptive to user input and recommendations for additional integration.

6.3.4 Not a "Single Point of Access"

The PMASPs advertise PSWS as being a "single point of access" for project information with all project information available in one place for quick access. However, many users feel differently. Companies report that PSWS are not truly "a single point of access". While much information is available online, there are still issues that prevent a complete shift to online project management. Companies report that scheduling and budgeting functions are difficult to move online due to integration issues with the software. In addition, concerns remain over the authenticity and security of signatures, which require official copies to remain paper-based. Furthermore, security, integration, and trust issues generally keep all financial documents, including invoices, payments and accounting offline. Therefore, while the PSWS is a great source of basic project information, it will take time before it truly is a "single point of access". It takes time and resources to fully transfer all aspects of a project to a single application. Advances in the capabilities of the PSWS are continuous. In time, the issues with integration and security will be resolved and the PSWS can truly become a "single point of access".

Chapter 7: Conclusions and Recommendations

There is a need in the A/E/C industry to move away from the present paper-based project management philosophy. While the fragmented nature of the industry lends itself to this sort of system, there are many problems associated with it. The individual project management systems require each party to communicate information to the other parties, an information-push system. This project management philosophy causes schedule delays, budget overruns, and costly appeals.

Integrated, real-time project management systems, particularly project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs), serve to improve project management. Moving to online project management is a fundamental change in the project management philosophy of the industry. Using a PSWS on a project means that instead of each party running its own project management system, there will be one project-based system. Earlier research has shown that there are many benefits to using an online project management system but there are numerous barriers limiting the use of PSWS. Furthermore, how to implement PSWS into a company or on a project remained unclear.

Through research, this paper identifies implementation considerations and lessons for the use of project-specific websites for project management (PSWS) available from construction-based project management application service providers (PMASPs). The Implementation Considerations and Lessons chapter consists of three parts. The first part, background, looks at the benefits and barriers of PMASP-Based PSWS and a needs-capability analysis between the project management needs of the project parties versus the project management capabilities of five leading PMASPs. The second part of the chapter identifies key steps for implementing PMASP-based PSWS. Finally, the chapter examines the sustainability challenges of using PMASP-based PSWS after implementation.

In general, PSWS improves communication between parties, productivity, knowledge of project status, and risk management. Furthermore, PSWS result in time and cost savings and a greater competitive advantage. The barriers to PSWS are grouped into technological and people/cultural issues. While many of the technological barriers, except integration, are easily overcome, the people/cultural issues hold the greatest challenge. The needs-capability analysis shows that the basic project management needs of document management, design collaboration, and field operations are met, but the PMASPs lack in the extended needs of bidding, estimating, scheduling, budgeting, and accounting. In terms of implementation, the paper identifies ten key steps for companies to take in implementing PSWS. Companies must create a plan, select a PSWS champion, choose their PSWS system, develop policies and procedures, provide training, and continue support through PSWS use. Challenges do remain, however, after implementation. The greatest challenges after implementation are user resistance to change, user support, and integration with existing business processes.

In general, the trend in the industry is towards the use of project-specific websites for project management (PSWS) available through construction-based project management application service providers (PMASPs). However, the PMASPs must continue to listen to the clients and work to provide the features clients demand. Through carefully planning and a dedicated implementation team, PSWS can successfully be used in the industry and provide numerous benefits to both companies and clients.

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Chapter 9: Appendix A

VIRGINIA POLYTECHNIC INSTITUTE
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Case Study: Implementation of Project Specific Web Sites

As per our previous e-mail communications, I am exploring the use of project specific web sites as an online project management tool in the A/E/C industry. The purpose of the questionnaire that follows is to gain an understanding of how project specific web sites are chosen, implemented, utilized, and problems resolved.

In answering the questions, please base your answers on your firm's procedures and policies for project-specific web sites, along with your and your co-workers personal experiences. Throughout the questionnaire the acronym, PSWS, is used to mean Project Specific Web Sites.

Please return this questionnaire either via email to jfirman@vt.edu or by mail to the above address, Attention: Jennifer Firman. I would like to have the questionnaire returned no later than (date).

If you have any questions, please feel free to contact me either via e-mail jfirman@vt.edu or by telephone at 540-552-7095.

Also, if you know of any other companies that may be interested and willing to help me with my research, please provide me with their contact information.

Thank you very much for your time and willingness to participate in my research.

Sincerely,

Jennifer L. Firman, EIT

Barriers

1. Before implementing and using Project-Specific Web Sites (PSWS), what barriers and/or problems did you or other members of your firm perceive?

2. During the implementation process and when beginning to use PSWS, what barriers were encountered?

    a. Were these barriers expected or unforeseen?

    b. How were each of these barriers overcome?

    c. What do you consider the biggest barrier your firm had to overcome in implementing PSWS as a means of online project management?

Site Development and Costs

1. What factors influenced your firm's decision to use Online Project Management and Project Specific Web-Sites (PSWS), in particular?

2. Who and/or what factors influenced the decision of what type of site/program to use?

   a. What factors made your firm select Constructware as your PSWS tool?

   b. Do you use any other means of online project management (i.e. company-developed PSWS or other providers such as Buzzsaw)?

3. What were/are your firm's goals and purpose in using PSWS?

4. Does your site allow for company and/or individual customization of the screens and information?

5. What areas/departments of the company utilize the PSWS?

6. Approximately how many projects, in total, has your firm managed using PSWS?

7. Currently, how many projects are being managed through PSWS?

8. Do you have senior management support, "buy-in"?

9. How much does it cost to run the PSWS?

   a. Who (which party) is responsible for the costs?
   b. Is it cost-effective?
   c. Do the costs decrease as the number of projects managed online increases?

Implementation of Project Specific Web Sites

1. Please detail the steps taken in implementing Project Specific Web Sites in your firm.

2. What policies and procedures were established?

3. What changes to the current computer hardware/software needed to be made?

4. What costs were associated with setting up the PSWS?

5. How is the PSWS organized and set-up? Who is responsible for this?

6. Who starts up the site and uploads the initial project information?

7. How was access control determined and established?

8. What procedures for uploading/downloading files, editing files, revising drawings, submittal procedures, etc. were established?

9. Who is responsible for the site?

10. Is there any time of notification system established to inform users of when new information or revised information has been posted?

11. What were/are the security issues? How are security issues handled?

12. Did you have a PSWS "champion" or one person/group of people who were the innovators and leaders of the implementation?

13. At what point during the project does your firm begin using the PSWS?

Implementation of Project Specific Web Sites (cont.)

14. Can and how is the PSWS customized for your firm or for individual users?

15. Are subsequent projects easier to set-up on a PSWS?

16. Is there a learning curve associated with the PSWS?

Site Access and Security

1. What aspects of the project are managed/accessed online?

   a. What aspects of the project are still solely paper-based?

   b. Are paper copies still made of the online material?

   c. Are there means established for notification of new information – drawings, reports, RFIS, specs, photos, etc.?

   d. Approximately what percentage of the project is managed online?

2. What parties have access to the project web site?

   a. Do all of the parties regularly access the site?

   b. Are all parties supportive of the site (i.e. use the site for a majority of its capabilities)? If not, which ones do not support this and for what reasons?

3. How is site access limited/controlled?

   a. In what ways are passwords used?

   b. How are reading/writing privileges determined and controlled?

   c. Who has the ability to add and/or delete files?

   d. Who controls the organization of the site?

Site Access and Security (cont.)

4. What types of site security are utilized?

    a. Who is responsible for the validity of information posted?

    b. Who manages the site?

    c. How are signatures for drawings, documents, RFIs, submittals, etc., handled?

    d. How is confidentiality/authentication addressed?

    e. Are there any means of virus control in place?

Benefits of Using Project Specific Web Sites

1. What benefits are there to using Project Specific Web Sites (PSWS)?

2. Has your firm seen improvement in the flow and accessibility of information?

   a. Are project participants better able to determine what information they need and do not need?

   b. Is the PSWS truly a "single point of access" for information?

   c. Approximately, what percentage of the information needed by a project participant can be readily found online?

   d. Does it take less time to retrieve needed information?

   e. Is the submittal and approval process for RFIs and Specifications changed by the use of PSWS? If so, how?

3. Has the use of PSWS made your firm more competitive? If so, how?

4. Does the PSWS generate any tangible savings in costs and/or time? If so, please estimate the savings and detail what areas these savings occur.

5. Has the use of PSWS affected your firm's "partnering" or collaboration with other firms?

   a. Have the relationships with the other project participants changed as a result of using PSWS?

   b. Has communication between the project participants improved as a result of using the PSWS?

Benefits of Using Project Specific Web Sites (cont.)

6. Does the PSWS provide a better knowledge of project status for project participants (i.e. what is done, what is pending, what is overdue, what their responsibilities are?)?

7. Does the use of PSWS reduce the number of claims/litigation?

    a. Does the use of PSWS create an adequate paper trail for claims/litigation?

    b. Is the claims/litigation process made easier by the use of PSWS?

Challenges of Project Specific Web Sites

1. What challenges in setting up the Project Specific Web Site (PSWS) did your firm and/or individual users encounter?

2. What challenges in using the PSWS did your firm and/or individual users encounter?

3. Are the challenges your firm has faced technological issues or people (sociological) issues?

4. Have there been challenges due to project participants unwillingness to accept the change (new technology/new way of doing tasks)?

5. Has party coordination been a challenge to using PSWS?

6. Is generating/maintaining support for the PSWS a challenge?

7. Has site access and/or controlling access been a challenge?

8. Is a lack of computer skills by project participants a challenge?

9. Do you find that project participants post information more because it is needed and vital to the project or "just-in-case" someone needs it?

Chapter 10: Appendix B

Project Management Questionnaire

1. For classification purposes, please provide the following company information:

   a) Name of Firm:
   b) Type of Firm:
   c) Company Size:
   d) Annual Revenue:
   e) Areas of Specialty:
   f) Your position:

2. What do you feel are the project management needs of the various project parties involved in a given project? Please consider all of the components that go into a project from project inception through design, construction, and project closeout.

To the best of your ability, list the project management needs in each category, as applicable, for the following parties. Delete or clarify any need listed that does not pertain to a party. List any additional needs you see.

   a) Owner
      - Contract Administration
         i. Schedule
         ii. Estimating/Budget
         iii. Invoicing/Payment
         iv. Project Status
      - Document Management
         i. RFIs
         ii. Daily Reports
         iii. Correspondence
         iv. Report Creation
         v. Project Progress Photos
         vi. Submittals
         vii. Drawings
         viii. Other (please list)
      - Meetings/Communication
      - Claims/Litigation
      - Inspections
      - Other (please list)

   b) Construction Manager
      - Contract Administration
         i. Schedule
         ii. Estimating/Budget
         iii. Invoicing/Payment
         iv. Project Status

- Document Management
    i. RFIs
    ii. Daily Reports
    iii. Correspondence
    iv. Report Creation
    v. Project Progress Photos
    vi. Submittals
    vii. Drawings
    viii. Other (please list)
- Meetings/Communication
- Claims/Litigation
- Inspections
- Other (please list)

c) Architect/Engineer
    - Contract Administration
        i. Schedule
        ii. Estimating/Budget
        iii. Invoicing/Payment
        iv. Project Status
    - Document Management
        i. RFIs
        ii. Daily Reports
        iii. Correspondence
        iv. Report Creation
        v. Project Progress Photos
        vi. Submittals
        vii. Drawings
        viii. Other (please list)
    - Meetings/Communication
    - Claims/Litigation
    - Inspections
    - Other (please list)

d) Contractor
    - Contract Administration
        i. Schedule
        ii. Estimating/Budget
        iii. Invoicing/Payment
        iv. Project Status
    - Document Management
        i. RFIs
        ii. Daily Reports

        iii. Correspondence
        iv. Report Creation
         v. Project Progress Photos
        vi. Submittals
       vii. Drawings
      viii. Other (please list)
- Meetings/Communication
- Claims/Litigation
- Inspections
- Other (please list)

e) Subcontractors
- Contract Administration
         i. Schedule
        ii. Estimating/Budget
       iii. Invoicing/Payment
       iv. Project Status
- Document Management
         i. RFIs
        ii. Daily Reports
       iii. Correspondence
       iv. Report Creation
        v. Project Progress Photos
       vi. Submittals
      vii. Drawings
     viii. Other (please list)
- Meetings/Communication
- Claims/Litigation
- Inspections
- Other (please list)

3. Current Usage of Project Management Tools
    a) Does your firm currently use any project management software? Please list and give a brief opinion of the software in terms of meeting your needs.

    b) Does your firm currently use any forms of online project management, including intranets or extranets? Intranets are systems in-house, and extranets are hosted by an external provider (Buzzsaw, Constructware, Meridian Project Talk, E-Builder, etc). Please list and give a brief opinion of the systems in terms of meeting your needs.

    c) To what extent do these tools add value to projects? In other words, what benefits do these tools provide?

4. Improvements needed to Project Management Systems
   a) Please list areas of the existing project management tools available that need improvement

   b) What additional project management tools do you feel are needed?

   c) Is complete online project management realistic?

Vita

Jennifer Lynn Firman received a Bachelor of Science degree in Civil Engineering from Rutgers, the State University of New Jersey in May 2001. She then moved to Virginia, and completed her Master of Science degree in Civil Engineering, focusing on Construction Engineering and Management, from Virginia Polytechnic Institute and State University in December 2002. In the past, she has held internships with Vargo Land Surveying, Engineering Design Associates, Pennoni Associates, and Gannett-Fleming, all in New Jersey. She plans to pursue a job with the United States Army Corp of Engineers upon graduation from Virginia Tech. Her goals include earning her Professional Engineer (P.E.) license and continuing to excel in the fields of construction and civil engineering design.