INTERNET TECHNOLOGIE
IN PROJECT MANAGEMENT

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Abstract

Many firms currently use the Internet as an advertising vehicle. The greatest potential of the Internet and the World Wide Web, however, lies not in advertising, but in project management. This paper discusses the special challenges of modern project management, and how the use of e-mail, electronic technologies, and the web can help meet them.

INTRODUCTION

Modern roofing and other construction projects present unique challenges to the consultants, architects, engineers, and contractors who administer them. The professionals involved in the project may be from separate cities with the project taking place in yet another location. Materials, approvals, crucial test data, and other information may arrive from offices, distributors, and laboratories dispersed around the country. At the same time, issues and questions that arise during planning, construction, and close-out need daily attention. Finally, how do you ensure that managers, owners, and other parties involved with the project who are off-site but still need regular status updates can get the information they need, when they need it?

All phases of construction project management have, at their heart, three central problems: recordkeeping, distance, and access. You have to ensure that records are retrievable, and with even small firms doing business coast-to-coast, you have to have some way to make sure that all staff have access to information, as needed.

The Internet offers a resource that can address many of these problems. By providing a worldwide conduit for electronic information of all types, it allows the smallest company to connect to field staff, clients, and resources, regardless of location. By using e-mail or a project web site, even the smallest firm can provide global, secure, 24-hour access to critical project information. This article will discuss the record keeping/distance/access problem, and illustrate how a fictional roof consulting firm uses the Internet to address these issues.

MAIN CHALLENGES

Record Keeping

One of life's elemental truths is that paper gets shuffled. The corollary is that paper that gets shuffled gets lost. Construction projects generate paper faster than a full-circulation newspaper: bid requests, bids, change orders, inspection reports, and a host of notes, letters, details and sketches often fill filing cabinets to overflowing.

Even assuming that your office never loses a single piece of paper, actually finding the piece of paper you need can make the most cheerful consultant into a snarling maniac. Four-thousand sheets of paper, however organized, are still 4,000 sheets of paper.

This is the first challenge of modern project management: record keeping. How do you keep all of the information relating to a project? And once you keep it, how do you find what you need? Finally, how do you find what you need quickly?

Distance

Most projects do not take place near your office. Many offices now have field staff on site in different cities, states, and countries. For the most part, they communicate with their offices via fax, phone, and overnight services.

This gets expensive. Some documents simply have to be reviewed by the main office right away. This means a long distance phone call to send a fax and possibly the additional charge of the copy store or hotel for the transmission. Even so, the received fax may not be of sufficient quality to serve as a permanent record—the originals still have to be sent. Less time-critical documents can be sent overnight, but this is even more pricey.

Even worse, what if the recipient of the fax is on a different project? Then the main office has to retransmit the documents at further expense. Combine this with a time zone difference of two hours or more, and even critical documents transmitted by fax may not show up on the recipient's desk for a day. If applicators are waiting for an answer to a question, this delay can spell trouble.

Distance, then, is another serious problem when managing a project. You have to get accurate, timely information to field staff and other interested parties, regardless of their location.

Access

Finally, once the information is collected, and even assuming you can transmit it when you need to, to whomever needs it, at a reasonable cost, how do you make sure that the correct information can be retrieved?

Paper can only be in one place. You can put information on

paper, but only in a single location. This guarantees that if someone in the field needs to see a piece of information, then someone at the main office has to find the right piece of paper and send it. And that guarantees a delay. The person at the main office has to know where to find the necessary information, which has to have been filed in the right place.

If a three-hour time difference is added in, you can see where access to paper documents stored in even the best system can create a problem. If the field staff are in California, and the office is in New Jersey, there is a window each day when the people in the field may not be able to retrieve paper documents.

Both distance and record keeping affect access. Even if records are carefully stored and there is an effective way to deliver them, someone who needs information must be able to find it when they need it.

COMPUTERS: A PARTIAL "FIX"

Computers now address some of the problems described above. Many documents once stored only as paper are now stored on hard drives and CD-ROMs. Electronic documents have several advantages as far as record keeping and access, but they do not, on their own, address problems caused by distance.

Computers Make Record Keeping Easier

Files stored on computer hard drives or other recordable media (CD-ROMS, floppy disks, etc.) are more difficult to misplace. With a little planning, client records, project information, and even faxes and scanned documents can be placed in a hierarchical "tree." If you can access the computer on which the information is stored, that information is easy to locate and, if

necessary, print.

It is also easier to protect information stored on a computer from damage. While hard disk drives do not last as long as paper—the average computer hard disk has an 18-month error-free life—data stored on a hard disk can be copied to longer-lived CD-ROMS, backup tapes, or, as a last resort, paper.

So, computers do an excellent job of streamlining and improving record keeping. They also make it easier to access large quantities of material. However, computers alone do not address some access issues, and they are completely unable to close the distance between field staff and the data they need.

Computers' Shortcomings: Compatibility and Connectivity

Computers actually create one serious problem. Computers use operating systems to "talk" to the user: Windows 95, Mac OS and UNIX are all operating systems. In some cases, information stored in one operating system cannot automatically be read by another. While there are numerous tools that can translate data from one system to another, these add a level of complexity that the average computer user does not need in his or her day-to-day business. A consultant can, of course, ensure that all of his staff use the same type of computer and operating system. However, he cannot require his clients to do the same. If it is necessary to send documents or other electronic information to a client who does not use a compatible computer, the consultant is back to the least efficient, most expensive methods: fax and overnight shipping.

Even if everyone a company works with uses the same type of computer and operating system, problems of compatibility
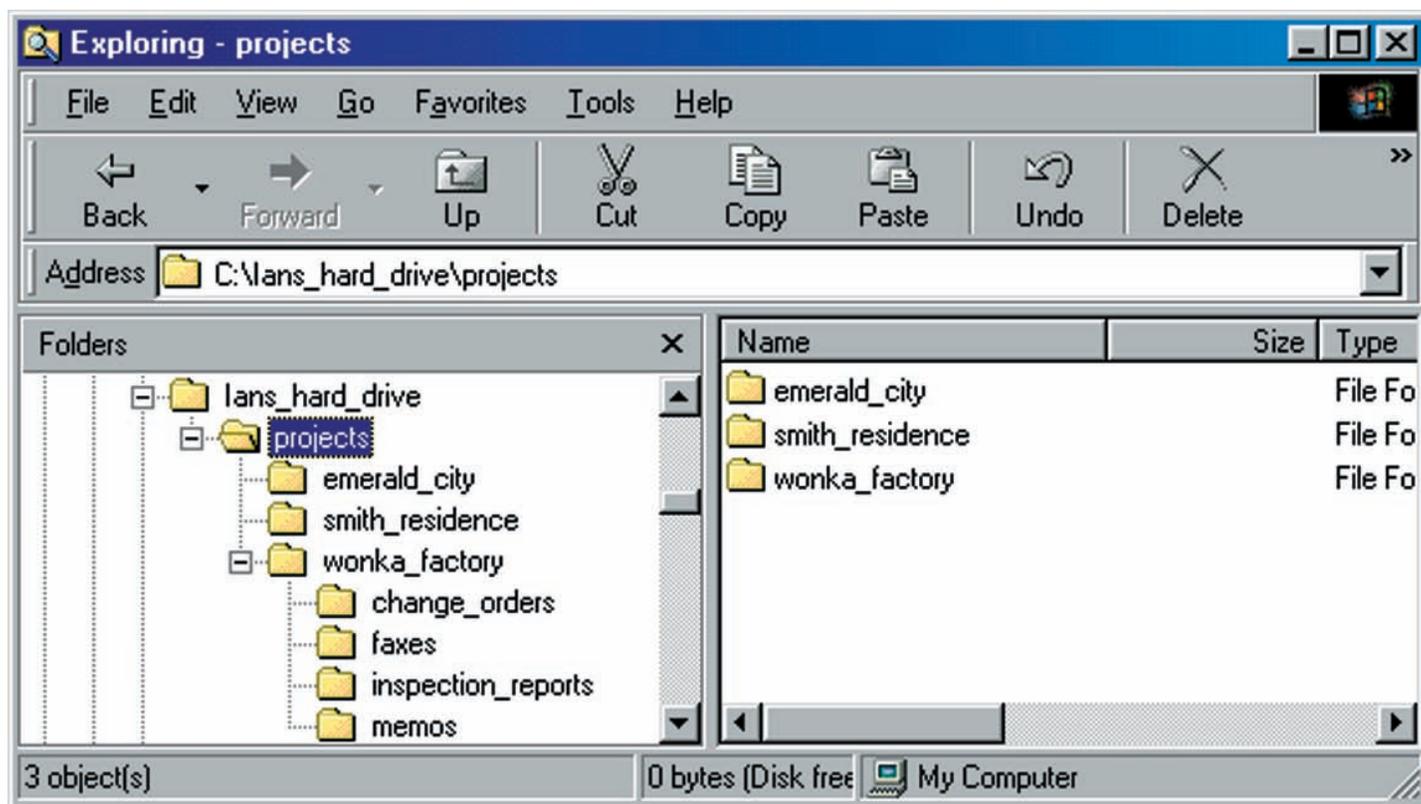

Figure 1: A project's directory on a computer hard drive. Note subfolders for specific document types.

may still be faced due to different applications. Everyone who uses a computer uses some type of computer software to create schedules, documents, details, and spreadsheets. Most of these applications are less than perfect at exchanging data—if a Microsoft Word document is sent to an office using Lotus WordPro, the recipient will be able to open the document, but formatting will probably change. There are times when it is necessary to guarantee that documents look the same, regardless of who opens that document, and most typical word processors, spreadsheets, and other applications ensure the opposite. Scheduling packages may be completely incompatible.

In addition, data stored on a computer can only be accessed by someone who is directly connected to that computer. While Local Area Networks (LANs) connect computers in one office to each other, and allow access on a small scale, connecting computers in different offices using conventional technology remains expensive.

ENTER THE INTERNET AND THE WORLD WIDE WEB

Computers alone present a perfect answer to the challenge of record keeping but do little to address problems of distance and access. Something is still missing to tie diverse groups of computers together cheaply and quickly and to provide a common set of formats for exchanging information.

The Internet and the technologies built upon its infrastructure provide the answer. The Internet itself can be compared to a modern freeway system for information. There is a single, main highway called the Internet backbone. Many arteries connect to that backbone, and many smaller streets or driveways carry information directly from businesses and homes to those smaller streets. The end result is a worldwide computer network to which you can connect with a local phone call from almost anywhere.

The Internet is the foundation for many other technologies, of which two are commonly known: e-mail and the World Wide Web.

How E-Mail Works

E-mail is the most common form of communication on the Internet. It is also fast becoming the most common form of communication, period. Using any one of many free or inexpensive programs, you can send a message from your computer to someone anywhere else on the globe. The recipient may receive a message as quickly as a few seconds later.

Improvements to e-mail in the last few years make it easy to attach other files, such as word processing documents, spreadsheets, and pictures to e-mail messages. As long as the recipient has a compatible program, he or she can open the attachment.

And, since you can typically connect to the Internet and send e-mail using a local phone call to your Internet Service Provider, it is an extremely inexpensive way to communicate.

The Last Piece in the Puzzle: The World Wide Web

The next "layer" built upon the Internet is the World Wide Web. The WWW uses a common language called HyperText Markup Language (HTML) to display documents that look and act the same, regardless of the computer, operating system, or applications on each viewer's computer.[1]

More important, the World Wide Web provides a way to build access points to document libraries, databases, spreadsheets, and project management information. Anyone with a computer and an Internet connection (and a password, if desired) can retrieve, review, update, and discuss project information via the World Wide Web.

And information stored on the WWW is always there. Whether in the office, at home sleeping, or on a sailboat in Aruba, clients, staff, and other parties can use the WWW and e-mail to retrieve documents, discuss project issues, make status reports, and effectively collaborate.

EXAMPLES OF INTERNET-ENHANCED PROJECT MANAGEMENT

These examples will use a fictional consulting firm, FRC, Ltd. Mary Roofer owns FRC, and she employs an engineer, a technician/field staffer, and an office manager. She has one office, located in Los Angeles, CA. Recently, she signed a contract with General Contractors, Inc., in San Francisco. FRC is going to specify a roof system for a large commercial job and, if all goes well in the specification phase, administer application of the system.

Her client does not have an office in Los Angeles and wants her to send all work through the San Francisco office for approval. The client also wants her to coordinate sending the draft specification to the architect and building owners, who are also in San Francisco.

The First Step: E-mail

Writing the specification is not a problem. Mary knows her problems will begin when she starts sending the draft specification to the concerned parties. If she sends it by fax, they will have to edit the copy and fax it back to her, which will mean receiving handwritten edits on a copy of a copy and probably spell several more visits to the optometrist. If she sends the material by overnight mail, the project may be delayed. And, if one person whose sign-off is required is traveling at the wrong time, she will have a hard time ensuring that the fax or overnight package gets to him.

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Mary decides instead to distribute the draft specification by e-mail. She already has an e-mail account and knows that all of the document recipients do, too. After contacting each recipient, she knows that they all have word processors that can open her document, as well. Each reviewer can check their e-mail, wherever they are, and can review the specification and respond quickly.

She decides to further streamline the process by asking each reviewer to make comments and changes right in their electronic copy of the document, in boldface type. This will make their comments easy to find and save her the trouble of trying to read scrawled notes.[2] Her reviewers agree to do this and wait for her e-mail.

When the first draft specification is complete, Mary tansmits it to the architect, the contact at her client, and the owner's representative. Even though the architect is at a convention in Reno, he receives the document that afternoon when he uses his laptop to check his e-mail. All of the recipients have nearly immediate access to Mary's draft as an online document and make their edits. When the edits are complete, they e-mail their drafts back to her.

Mary reviews each draft for comments and changes and makes revisions to her original document as necessary. If she has questions, she either calls or e-mails the reviewer. Once the revisions are complete, she circulates the second draft in the same manner. Eventually, the reviewers agree that the specification is ready for use and add it to the project bid package.

How E-mail Worked

E-mailing the specification and receiving revisions by e-mail helped Mary in several ways:

- First, all of the revisions she received from reviewers can be saved as named, dated files that specify who made those revisions. She now has a permanent, non-paper record of who requested which changes and when. When the project is complete, she can transfer these changes (and all other project documents), to a CD-ROM "Project Binder" for safekeeping.[3]
- Secondly, she was able to deliver her drafts directly to the recipient, regardless of his or her location, without having to involve other staff.
- Finally, Mary saved the expense and delay of faxing, mailing, or overnighting three copies of the specifications to San Francisco. She also saved the reviewers the same expense. While a single, long distance call or overnight package may seem inexpensive, it adds up quickly.

Mary followed two rules that guaranteed success:
- Ensure Compatibility: She checked with each reviewer that he or she had e-mail, and would be able to open the file she sent. If any reviewer was unable to open the document, she could have arranged to fax or overnight the document to that specific person, while still e-mailing the others.
- Have a Plan: Mary also made sure that all reviewers were in agreement as to how to make their comments in revisions. By doing so, she avoided having to hunt for their input.

Her client was happy with the result, and FRC will now be administering the bid and application processes.

Moving to the Web

Mary is feeling pretty good at this point and decides to take another step. She has to assemble the bidding documents and send the package to 10 or 20 recipients. The package itself is roughly three inches thick, and her client wants to handle distribution on her own.

Mary decides to make the bid documents available via a World Wide Web site. She knows that her ISP provides her with a free web site, which she has never used.[4] Her office manager has played with some of the simpler web design tools and thinks she can put something together. And her client agrees that the WWW is worth a try. After a few hours, she builds a very simple page that explains the purpose of the site and allows visitors to download the bid documents in two possible formats by clicking on a link. The ISP walks her office manager through the process of transferring their material to the web server, and they are up and running.

Mary contacts each bidder to provide the address of the web site. If a bidder says he cannot connect to the WWW, then she prints one copy of the bid documents and ships the bid package to him. Since the documents must be signed, she instructs the bidders to print the documents, complete them, and send them back by the established project deadline.

During this process, several bidders call her to ask for other information. After she answers the same question several times, she asks her office manager to add that information to the bidders' web page. Many of the bidders said they looked there first, and this seems like a good way to reduce phone calls. She also sends an e-mail to each bidder letting them know that the information has been added to the web site.

Several other roofing companies contact her client to request an opportunity to bid. The client agrees and sends them to the project bid web site. They download the bid package without adding to Mary's workload.

How the Web Worked for the Bid Process

After several weeks, she receives the bid packages. Of ten bidders, she only had to print and send two packets. The others received the information from the web page as soon as it was available. Each bidder was able to get answers to typical questions directly from the web site. Like e-mail, the web site allowed her to reduce faxing and mailing of large documents and it allowed recipients to download and use the documents regardless of their location. The web site offered several additional benefits:

First, if a bidder wanted an additional copy, Mary did not have to re-e-mail the document to them. They could download the document from the web site when they needed it.

Secondly, as she found questions that were asked again and again, she could post the answers on the project bid web site. Once bidders learned that they could get answers to their questions from the site, they went there rather than calling Mary. This saved everyone time.

There are four basic principles that Mary followed to make the bidding site work:

- **Notify, notify, notify.** Once Mary set up the project bid web site, she notified all prospective bidders. Then, if the content on the site changed significantly (as when she started offering answers to frequently-asked questions), she notified them again. This ensured that those who might find such a site useful knew it was there.
- **Have options.** Mary also placed the bid documents on the web site in two formats: Rich Text Format (RTF) and Portable Document Format (PDF). RTF can be opened by at least 80% of existing word processors. PDF can be opened by anyone who has a free reader on their computer—the reader is available for Macintosh, Windows PCs, and most UNIX computers. Finally, if bidders could not connect to the web at all, Mary was willing to send them a printed copy of the bid documents.
- **Be aware of context.** Documents requiring legal context—signed documents—are not a sure thing when delivered digitally. The American court system has yet to render a clear opinion. The jury literally is still out. So, if you have documents that need to be signed, do not take chances. Let your users download the material, print it, sign it, and send it back. You've still saved time and money, without making any lawyers queasy.
- **Take small steps.** In this scenario, Mary only used what she had—e-mail and a word processor—and used it to

her advantage. She did not reinvent the wheel. One of the best features of doing business on the Internet is that you can always enhance what you're doing later.

The result? Far lower expenses, faster delivery of information, and no negative impact on the bidding process. Once again, Mary made life easier for her client without making things complicated.

Taking the Plunge

Mary's client has given her more work and some good reviews with other companies. Her company has grown over the last few months, and now, as the actual work is about to start on the original project, she has 10 employees. One of them—a Registered Roof Observer—is going to be in San Francisco at least half time for the next six months, supervising the application. His job it to report application issues and contractor or owner questions and get answers to them as quickly as possible. In addition, he is going to compile the project record: daily reports regarding weather, inspections, and photographs.

Mary wants to have access to this information each day. So does her client. In addition, if issues arise, she'd like to be able to handle them without traveling. She's got a business to run. Finally, she wants the client to be able to see the same informa-
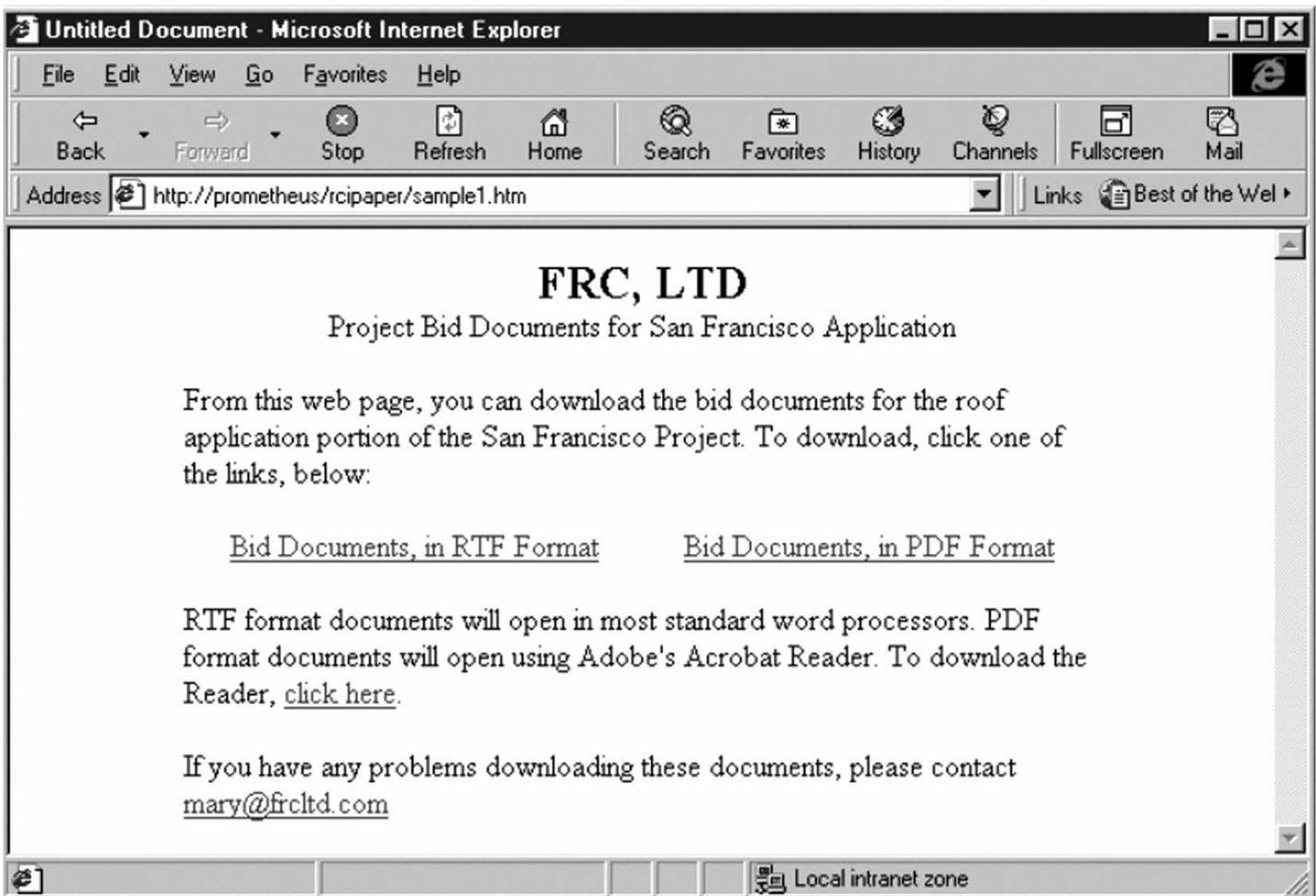

Figure 2: A simple document download web page.

tion she does without calling her office every time they need a photograph.

She goes to her office manager with all of these questions. The office manager, while comfortable with simple web design, feels that what Mary is asking for is out of her league. She calls a web consultant, who designs a simple but complete project management site for FRC. The site includes several important tools:

- **Security.** Only the client and FRC have passwords to enter the project site. And, when Mary's field person adds data to the site, Mary has to click an "approve" button; if she does not, then the client cannot see the data. No sense in showing lack of spelling ability to the world.
- **Easy File Transfer.** It is normally a complex process to transfer files to a web site. The consultant creates a simple web page that allows transfer of photographs and documents using the familiar "browse" button.
- **Forms.** The daily job log and inspection reports are entered into the web site using a set of simple web page forms. The information is stored on the web server in a file which can be saved on a CD-ROM for storage purposes.
- **Retrieval.** The site includes search tools so that visitors can locate the information they need quickly and easily.
- **Discussions.** The consultant also includes a tree-style, threaded discussion system. This lets the client, FRC staff, and other parties with access permission discuss ongoing issues and create a library of answers to questions at the same time. Later, if the same questions arise, visitors can search the discussion system and get the answer without waiting for an answer from FRC.

Mary's field staffer takes a good digital camera and a palmtop computer to the job site. During the day, he snaps digital photos or even records digital video of the work in progress and writes notes into his palmtop computer. At the end of each day,

he takes his notes and photos to his hotel, transfers his notes from his palmtop to his laptop, connects his laptop to the Internet, and completes the inspection report and daily log entry. He also transfers any photos he has taken. If an urgent issue arises, he connects his laptop to the Internet in the job trailer during the day, e-mails Mary the relevant photos, and waits for her call. Mary can see rooftop conditions within a few minutes of his e-mail without traveling to San Francisco.

Each day, Mary reviews the field staffer's entries, makes any edits or additions she feels are necessary, and approves the entry. The client can immediately review the results of the day's work, including photographs.

At one point, the applicator does not understand the details provided by the architect. Mary's client decides that her firm should redraw the detail with a roofer's eye. Mary creates one new "branch" on the discussion system and adds the first draft of the detail to the first message, which basically asks, "How is this?" Her field staffer connects to the Internet, downloads the detail, and shows it to the applicator. The applicator requests a few changes, which the staffer enters into a reply on the discussion system. The CAD specialist at FRC's main office can see the new message, make the necessary changes, and post the edited detail to the discussion list. The applicator sees the new drawing and approves it. The entire process takes less than one work day.

How the Web Worked During the Application Process

Throughout the roofing application, the web site works as an electronic project binder, collecting daily information and photographs and even scanned documents that Mary feels need to be included. The client is able to keep track of progress, without creating administrative overhead for FRC or their own office.

The web site helped FRC on many levels:

First, it reduced administrative costs. Mary's staff in the field did not have to fax material to her office to be copied and stored in a file folder. And, her field staff could interact directly with staff at the main office, such as the CAD specialist, without involving anyone else.

Secondly, the site produced a near-continuous flow of information to the client and anyone else who they agreed to include. The client could go to the web site each day and see the project unfolding. If he spotted issues not apparent to Mary, he could contact her.

Thirdly, the web site created a permanent store of project information. When the project is over, Mary can copy all of the information to a CD-ROM and store it for later retrieval if necessary.
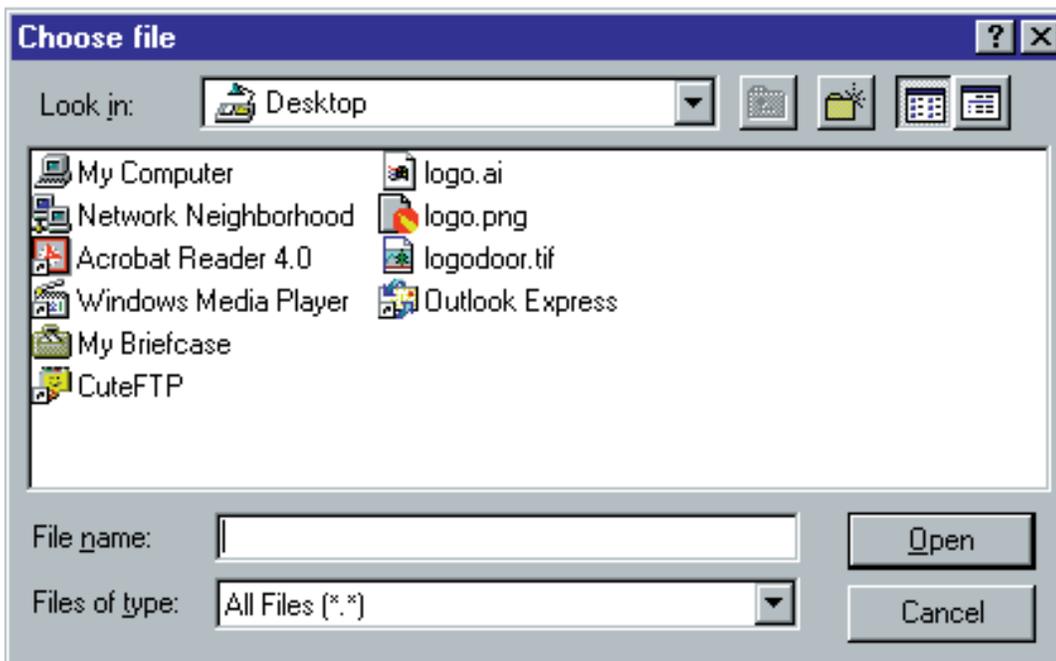
Figure 3: Saving files to the web server using a simple outline form.

Finally, and most important, the web site simplified communication between Mary and her field staff. Regular communication could be handled via the web site. Emergencies could still require a phone call. But wherever Mary was, she could still connect to the Internet on any computer and retrieve information about the project.

The rules, in this case, cover a range of concerns:

- **Plan for Security.** As above, Mary had the site designed to keep unwanted intruders out. This bears repeating. Internet security is extremely robust, but it only works if you use it.
- **Plan for Review.** Always include a way to review material before everyone else can see it. Just as with printed material, you want to look your best. In this case, review and approval is much easier, but you have to plan ahead.
- **Make it Simple.** Do not assume that anyone is willing to do something that is more complicated. In this case, the web site reduced the need for trips to the one-hour photo shop, faxing, shipping documents, conference calls, and possibly trips to San Francisco by Mary. All it required was a user who understood web browsers.
- **Respond.** If you create a site where other parties on a project can interact, then interact with them. If you do not respond to one of their questions, they may stop using the site and revert to the telephone.
- **Don't Do It Yourself.** When you start implementing more complex solutions, such as in this example, talk to an expert. I will announce my bias on this count right now—I am one of those experts. But there are complexities involved that you should not have to take the time to learn. Put another way, would you want me to specify and apply a new roof over my office? 'Nuff said....

The project web site allowed FRC to keep everyone in the loop, without requiring Mary's constant attention. It also allowed them to resolve questions quickly and create a permanent project record with minimum administrative overhead.

CONCLUSION

For a roof consultant, modern roof system specification and project management pose a serious challenge: How do you store, organize, and distribute critical information at all phases of a roofing project when your office, the project, and the interested parties may all be in different locations? Further, how do you make sure that these parties can get the information they need, whether you are in your office or not? Conventional means— files, fax, mail, and overnight packages—may address some of these concerns. But the long distance phone calls, shipping charges, and staff time required to use these methods cost both hard and soft dollars.

The Internet provides a number of possibilities for small and large firms to reduce the costs of project management while increasing their ability to provide timely, useful information to those who need it. By using first e-mail, then simple and finally more complex web sites, consultants can automate record keeping, bridge distances, and improve access to project information.

The Internet and World Wide Web will not ultimately replace mail, faxes, files, and on-site visits. But it is a new, powerful tool that can enhance a team's ability to collaborate at all phases of a project. ■

(Editor's note: This paper is reprinted from the Proceedings of the 14th Annual RCI Convention in Charlotte, NC, 1999.)

FOOTNOTES

1. There are some exceptions to this that could occupy another article. For more information, skim any of the many HTML guides currently available or talk to a web designer.
2. If all of the reviewers were using the exact same word processor, they could probably use that program's revision marking tool to make comments. But Mary is unsure of her reviewers' expertise with their software and decided to use boldface type as a simpler approach.
3. There are many companies who offer this inexpensive service.
4. The majority of Internet Service Providers now give their clients free sites with more than enough storage space for a small-to-medium-sized company's purposes.

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Ian Lurie is an award-winning website and information designer with nine years' experience in online and website design, as well as technical workflow consulting. As co-author of *The Roof Construction Guide for General Contractors*, marketed by RCI, his familiarity with the roofing and waterproofing industry allows him to apply his skills to the special needs of the industry. He is the president of Portent Interactive, formerly The Written Word, Inc. You may visit his website at www.portentinteractive.com.