PUMP LIFE-CYCLES AND THE INTERNET
UTILIZING TECHNOLOGY TO IMPROVE PUMP RELIABILITY

by
Paul Shank
Oliver & Laughter Co.
Houston, Texas

Paul Shank is with Oliver & Laughter Equipment Company in Houston, Texas. He has 18 years sales and engineering experience in the specialty process equipment field. He has published articles on technology in various professional publications and directly on the Internet. He has also authored and coauthored several software programs for the selection and pricing of pumps, compressors, and steam turbines.

Mr. Shank received a B.S. degree from the University of Houston.

ABSTRACT

Information technology, specifically computer mediated communication (CMC), will revolutionize the pump industry, from selection through installation, operation, and maintenance. There will be winners and losers. It will change not only the way business is done, but with whom business is done. It will also dramatically change the way that jobs are done, the tools that are used, and the support that is expected from vendors. Other changes will involve the information manufacturers will expect from users–some of which is now considered proprietary. In fact, the very concepts of "proprietary information" and "intellectual property" will undergo profound changes as information is made available and shared over the internet.

Computer mediated communication is simply the exchange of information using computers. This can be done over the internet, or, using the same programs and protocols, it can be done over intranets within companies. As the exchange of information between trading partners increases, it will become increasingly difficult to know where internal communication ends and external communication begins. And as alliances and partnering agreements expand, it will become difficult to know where organizations end and suppliers' and customers' organizations begin.

Note: The intranet is simply an internal network, like a local area network (LAN) or wide area network (WAN). It uses different network software, usually Netscape Navigator or Microsoft Explorer to perform the activities previously done by menu pages. The intranet functions just like the larger internet. Information is accessed using search engines, and presented to the user in a format that can be read online or printed for further study. The advantage over more conventional LANs or WANs is the ability to search for information system wide, quickly and easily, and to provide access to the same data by computers using different operating systems.

The companies who embrace this technology will lead the industry. Those who do not will find productivity and profitability lagging, and their very existence threatened. The cost for these

improvements is not new equipment–most users now have the necessary hardware. The changes will be in operating philosophy, how will business be done in the twenty-first century.

Change is always a little unsettling, and the technology of CMC promises to dramatically change the way all jobs are done. The pump industry can wait for change and try to adapt, or become the agents of change.

A look at the life-cycle of a typical API pump will be instrumental in examining the opportunities that are available to users and specifiers who choose to command technology and let it work for them.

INTRODUCTION AND DEFINITIONS

Technology failed to deliver the "paperless office" of the 1980s, because it was expected to eliminate the printed word. It should have been asked to get rid of books. A subtle difference, perhaps, but the key is information, not paper. When information is turned into electronic media, the paper problem goes away.

The pump industry is awash in paper–industry specifications, company specifications, project specifications, site specifications, professional associations specifications–the list is as endless as it is incompatible. The cost imposed at every level for reconciling this information is enormous.

It is important to note that while the technology discussed herein is certainly undergoing rapid expansion, it is not new or untested. While not widely used in the pump industry, it has been well defined and proven in many other business sectors such as law, medicine, and research. All the ideas and systems herein are currently being used successfully in many areas of business and research.

Computer mediated communication (CMC) now offers solutions to a great many problems that plague pump users. It will change the way business is done, it will change the relationships between users and suppliers, and it may well change business partners. Electronic mail (e-mail) will change communications, the World Wide Web (WWW) will offer on-demand information never before available, and linked file transfer protocol (FTP) will provide access to databases with technical information that was previously unavailable, at least in a timely manner.

HyperText Markup Language (HTML) is the language of the Internet and most intranets. It is a "cross-platform" universal language; which means it can be read, complete with all formatting and embedded graphics, equally well by a Windows based PC, OS/2, Mac, or Unix based system–virtually any operating system likely to be encountered on the internet. The advantage to a language like this is that it allows data and information to be accessible, with all their nuances, by any user on any platform (Figures 1, 2, and 3).

Is there a price to pay? Yes. There are the inevitable security issues. Ownership of intellectual property and the rights of those owners must be defined. There will be financial costs, and questions of who is going to bear them. And then there is the personnel issue. Is there room for all? And if so, at what skill level?

The genie is out of the bottle. The question is whether it is asked for three wishes or everyone runs and hides.
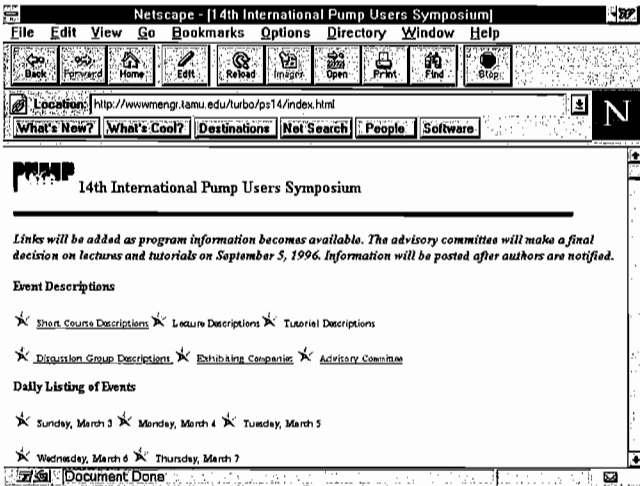
Figure 1. Hypertext Links "Jump" from Document to Document, within the Same Computer, across the Continent or around the World. The International Pump Users Symposium offers information from schedules to speakers to hotel accommodations via World Wide Web pages.
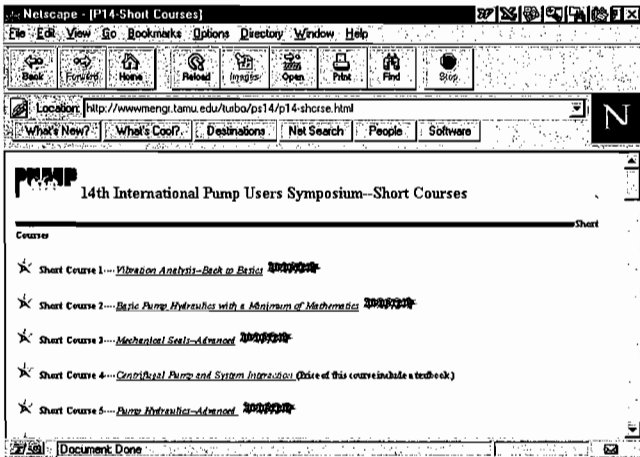

Figure 2. From HyperText Links on the "Index" Page, One Click Takes the User to the Short Course Title Page. More Information on Each Course Is Linked to the HyperText Titles above.
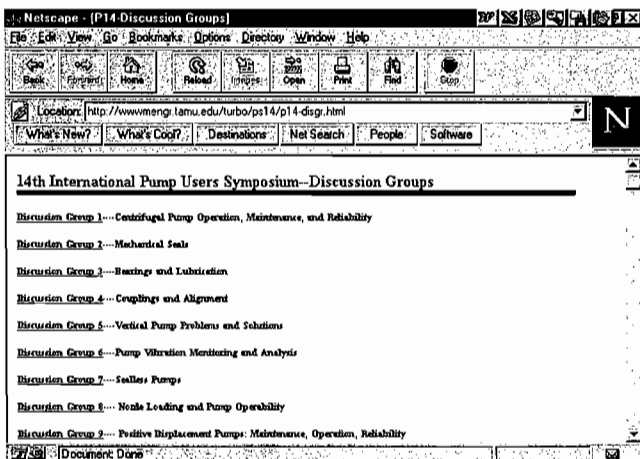

Figure 3. This Discussion Group Page Is Another Link from the "Index" Page. Again, Complete Descriptions for Each Discussion Group Is Found by Following Individual HyperText Links above.

SUPPLIER QUALIFICATION– PRELIMINARY SELECTIONS

The next generation of selection programs will solve existing problems by being dynamic rather than distributed, by allowing the flow of information to travel both directions, and making suppliers and users equal partners in process of equipment specification.

The selection disks arriving by mail every month are passé. So are the downloads from the mainframe. The coming wave of selection programs will be internet based through Web pages that will allow not only selections with the most current data, but the option to query applications engineers directly via e-mail. Like any other distributed information system, supplying disks or offering program downloads has the twin disadvantages of loss of control and loss of feedback.

Control is important for the supplier, because only through control of information resources can anyone be sure the most current information is in the hands of the users and specifiers. As program life-cycles decrease, and as dissemination of that information expands, control becomes more difficult. Outdated selection procedures do not offer the best information or portray the best image of the supplier. Time sensitive self-canceling programs (programs that use the computer's internal clock/calendar to delete themselves after a given period of time–30 days, for example) are not the answer, because these simply move the responsibility for information management from the supplier to the user.

Distributed selection procedures limit the ability of suppliers to automatically incorporate the information into order entry procedures, marketing and manufacturing projections, and product upgrades. It also prevents suppliers from determining the effectiveness of their programs. In this market, software evaluation is possible only by knowing how often it is used, by whom, and for what purposes.

Dynamic selection programs, available via the World Wide Web, allow suppliers to monitor who is using the program, and the success of those individuals with the program. It also lets a supplier know which products are of most interest, where products are not meeting customer needs, such as flow or pressure requirements, and what is the optimal scope of supply for the user.

Note: Process Associates (http://www.processassociates.com) currently provides a dynamic selection procedure for compressors, and automobiles and tires can be sized, specified, selected, and even purchased in this manner.

DRAWINGS AND DATA

"Drawings will be made available for download after receipt of order." That is the response to "How soon can I get drawings?" As companies complete their computer aided design (CAD) libraries, most of which will be three dimensional subassembly drawings that can be merged into complete drawings, they will simply enter the scope of supply and request the assembled drawing. CAD program protocols are more standardized than virtually any other program group, so this capability already exists for many companies and users.

Note: Netscape Navigator has a helper application that allows users to view AutoCAD drawings without opening (or even installing) AutoCAD.

The purchase order number and equipment item number may form the basis for information exchange as the project moves from design through specification to hardware in the field. A complete record is thus retained by both parties, and more importantly, it is easily and immediately accessible to all parties. Alliance partners, having developed the nonmaterial requirements well in advance of any project, will offer each other a distinct cost advantage by ensuring that all the information necessary to a project, and only

that information, is transferred in a timely manner. Processing unnecessary information is a significant hazard of CMC and information technology in general. Not all information is created equal, and it is imperative that the essential information be separated from the nonessential, lest one drowns in a sea of bits and bytes instead of paper.

INSTRUCTION AND OPERATION MANUALS

Many trees give their lives to produce instruction manuals of questionable value and even more questionable destination. Where do 17 copies of an instruction manual go? Not into the hands of the machinery engineer tagged with the responsibility of starting up the equipment. But even more importantly, how do they get one in the middle of the startup? But first things first.

Most suppliers currently print mass quantities of generalized instruction manuals to reduce cost and enhance standardization. But by definition, a specific pump is not well represented by a generalized manual. Some suppliers add in sections to address a pump's specific options, and sometimes the instruction manual even includes the data sheets. But over the life of the pump, that instruction manual will be consulted more times than any other piece of information generated in the purchase process, and yet it will receive less attention in the specification and review process than the title block on the drawings.

The instruction manuals can easily be converted into HyperText Markup Language (HTML), which allows inclusion of "inline" drawings, graphics, annotations, and hot-links to other documents detailing subsystems. This information can be installed on the user's intranet and immediately available to anyone needing the information. Unlike hardcopy manuals, once an electronic version is installed on the network, it is immediately available to everyone, and it is protected from loss by the webmaster.

The electronic residence for the original instruction manual should be the responsibility of the user. However, an important hot-link in the instruction manual should be directed to the supplier's server where current technical notes, troubleshooting guides, and upgrades are available. The user, viewing the instruction manual on the intranet, can simply click on a hot-link button marked "Service Reports." This information, seamlessly to the engineer, is now coming to them from the supplier's server in another city, another continent. A keyword search-engine is available to examine the supplier's database of service reports on similar installations. A wealth of currently unavailable information can be immediately in the hands of the user, regardless of time of day, in moments (Figures 4 and 5).

OPERATION AND SYSTEM MONITORING

"The latest monitoring system has an RS-232 port." That means equipment can be connected directly to a computer. And *that* means real-time operating information can be telneted to the manufacturer to help resolve operational problems. With the trend toward purchasing equipment systems instead of component purchasing, suppliers' responsibilities will increase dramatically and their ability to quickly sort out system difficulties will have to expand. This will present difficulties as the number of engineers qualified to troubleshoot complex systems decreases. One very simple method is to build interconnectivity into the system.

No matter how well designed the system, there will always be some questions unanswered or some operating parameters not fully documented. Currently, users troubleshoot to the best of their abilities with existing software and local knowledge. Not until those resources are completely exhausted do they typically call the manufacturer. In part, this is due to habit, but the habit is grounded in experience.

Consider the following scenario: To save time and cost, a large boiler feedwater pump has been purchased as a system, including lube oil system for pump and gear, seal systems, RTD and
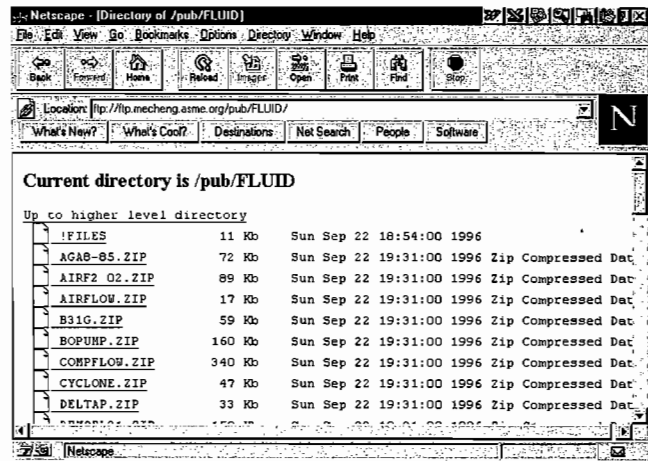

Figure 4. File Transfer Protocol Sites Are Efficient Methods to Store and Retrieve Large Documents Such as Instruction Manuals and Repair Procedures. Documents can be stored in any format–HTML, ASCII, or as .ZIP (compressed) documents, but cannot be viewed online. They must be downloaded for viewing. Most sites have an index describing the files in the directory. This is usually the first file shown on the page, as shown here.
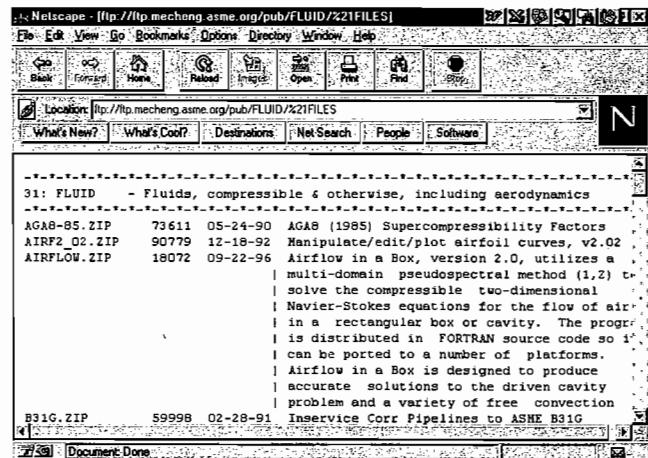

Figure 5. Following the "!FILES" Link Leads to More Description of Individual Files. This Helps Ensure That the File Downloaded Will Provide the Required Information. Even with Fast Modems, Large Files Can Take over an Hour to Download.

vibration monitoring systems, minimum flow recirculation valve, complete instrumentation, and its own onboard controller with logic and permissives linked to the control room. Unfortunately, the permissive starts cannot be overcome to energize the pump.

The supplier's field service engineer, well versed in the ways of boiler feedwater pumps, is no match for the complexity of this system. In fact, perhaps no single individual can fully troubleshoot a system of this complexity designed by several subvendors. But if the primary vendors can log on to the system from their respective offices, in turn troubleshoot their own system, and compare notes with the local engineers, it is quite likely a solution will be quick and easy.

Compare this with the current model. Each system and subsystem must be inspected, one at a time, probably involving a number of phone calls, until the problem is discovered and resolved.

A large compressor packager installs a modem in the control panel with links to all the onboard controls and monitors such as inlet guide vanes, variable diffusers, pressure and temperature

transmitters and the vibration monitoring instruments. In the event of compressor malfunction or problems at startup, a service engineer can log on to the compressor from his location–home, office, or hotel room–and have all the information and controls available to the local operator. Operating conditions can be monitored indefinitely to detect transient events, or troublesome operating points can be duplicated while the engineer is online so that diagnosis can take place. More importantly, corrective action can be made or operating protocols revised.

This company also uses digitized pictures of the compressor and compressor components as part of their computerized control system. This allows the operator to "see" what area of the compressor is in question. If alarms occur at startup, for instance, the control panel offers a context sensitive help menu. So while the user always has the option of immediate factory assistance via the modem, the system is designed to help the customer solve problems on the spot. This saves time, aggravation, and makes the controls complement the machine (Figures 6, 7, and 8).
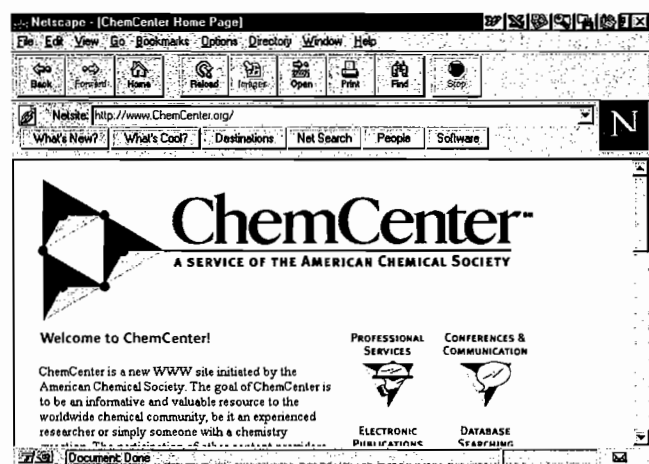

Figure 6. Web Pages of Professional Organizations Can Provide Valuable Links to Information Ranging from Technical Information on Products to Conferences or Expert Technical Advice.
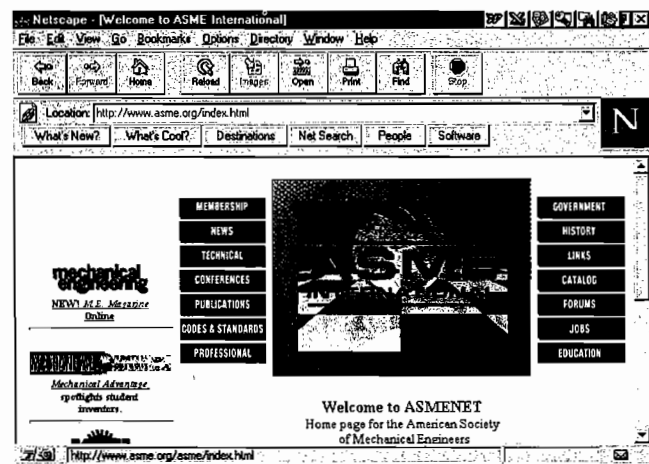

Figure 7. The ASME Homepage Offers Links to Technical Information, Conferences, and Other Topics of Interest to the Engineering Community.

MAINTENANCE AND RELIABILITY

Reliability can be built into a pump, but it must also be built into the pumping system, and then the two must be merged. A certain
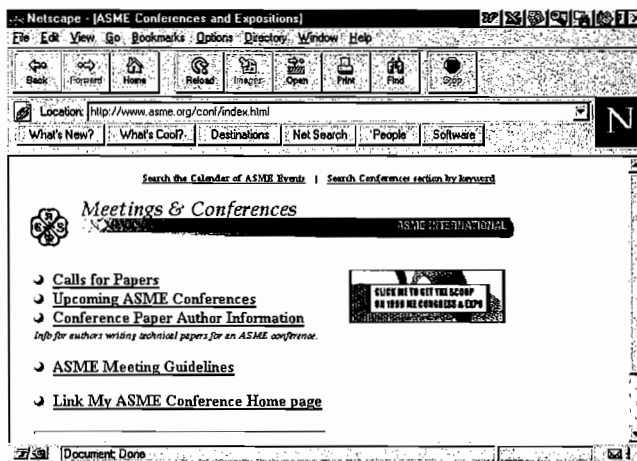

Figure 8. Following a HyperText Link from the ASME Homepage Is the "Index" Page for Meetings and Conferences. A Link on this Page Also Gives Instructions on How to Create a Link from the User's Homepage to These ASME Pages. This Is a Helpful Time-Saver for Frequent Users.

amount of reliability can come into being only after the fact. It is at this point that both user and manufacturer must have free and open communication. This applies not only to phone calls and site visits, but maintenance databases on both sides.

Reliability should be defined as the user's ability to operate a piece of equipment in such a fashion that loss of production does not occur. This does not mean that it does not fail. It means that the user has the time, spare parts, and expertise to repair the equipment on a schedule that does not adversely affect production. The cost of reliability, then, is the sum of maintenance time, labor, inventoried parts, and third party expenses such as field service engineers and consultants. This definition is substantially different from MTBF, but perhaps it is a more realistic measure of reliability. A pump's MTBF of eight years is nothing if it consistently fails unpredictably and brings the entire operating unit crashing down! For the purposes here, the ability to manage information so that failures do not result in loss of production is of interest.

Reliability is primarily a function of maintenance practices, and these rely heavily on record keeping. For convenience, record keeping can be broken down into three general activities: creation, organization, archiving. These are listed in order of occurrence, and more significantly, in order of the importance assigned to each activity.

• *Record creation*–has never been a problem in the pump industry. Lots of records are created. Not always the right ones, and not always very accurately, but lots of paper is generated.

The current systems for information management have not benefitted from the efforts at computerization. If experience with computerization has taught anything, it is how to generate more information, but not really how to manage that information. In fact, maintenance and repair efforts may actually be suffering due to an information glut. A review of these three facets of information technology may be instructive.

Efforts in the creation of information need no improvement. A little more thought could perhaps go into the quality of information that is created, but overall, the pump industry is well documented.

• *Organization*–is a little more complex. Sometimes information is organized by job, sometimes by item number, sometimes by system, and sometimes by little secret files. How many times do requests for information go unfulfilled, because information cannot be found that is known to exist?

Organization is a very different situation. Information is scattered in hardcopy files, multiple databases, and documents,

both paper-based and electronic. The physical location of this information is so widely spread that most users cannot access all the data on a single pump in anything like a reasonable amount of time. As a result, the meaning of the phrase "satisfactory operation" or "acceptable failure rate" has no consistent meaning from plant to plant, even unit to unit.

Consider the dilemma of two machinery engineers operating comparable units in different plants. The first engineer's Item No. P-3202 has a MTBF of six months. In the first engineer's opinion, a very satisfactory record for this service. The second engineer's Item No. P-3202 has a MTBF of six months and the second engineer is considering scrapping the pumps, based on reliability issues.

The differences in attitude may be traced to a variety of sources, but the major problem is a lack of shared information. If this service is so rigorous that a six month MTBF is actually good, the second engineer should increase parts stocking and revise anticipated repair schedules. But if six months is not an acceptable MTBF, perhaps the first engineer should follow the lead of the second engineer.

The tie breaker in this controversy should be the supplier. By logging on to the supplier's database, these engineers could determine whether this pump's MTBF is satisfactory or not. And if not, they can use this database to contact other users with better MTBF rates. They can also compare their operating conditions and histories to the database mean. Of course, they should have been reporting their maintenance and repair history to the supplier, so the database could be complete and useful, to themselves, other engineers, and the supplier.

But this brings them to the edge of the information quagmire. Are they colleagues or competitors? How much do they really want the supplier to know about actual operating conditions? While they would all like to have access to this type of information, are they willing to turn over the data necessary to make it useful? And do they even have access within their own organizations to this information so it can be contributed?

The need is to examine the definitions of proprietary information, the motives, and the tradeoffs that are available based on decisions made. If a supplier can log on to a boiler system and determine steam production, or look at an extruder and know production rates, how much of that information should be made available to colleagues/competitors? Who will maintain and control these data? And who will have access? In many cases, companies may turn data access and information availability into a competitive advantage.

Note: Security of information is actually a lesser problem than the idea of proprietary information. While the company reports production capacity and utilization to the Chemical Manufacturer's Association, operating units have consistently been reluctant to compare data with outside colleagues.

• *Archiving*, the physical storage of information, is generally accorded the least attention.

Data archiving for most organizations is easy. The older it is, the less accessible it becomes. The file cabinets move from the machinery offices to the main file room. Convenience is lost because with paper-based systems, there is only one copy, and if it is lost, it is gone. So a form must be completed so the information can be traced. But what if new information needs to be added? How will other users be notified?

From the main file room, the individual file is purged, losing untold information, and then, if they are lucky, it is turned into a microfiche. The only advantage to microfiche is that they are easier to store. They also make information much harder to access, they are infinitely easier to lose, and there is still only a single copy. Otherwise, the file goes to the shredder and the recycle box.

Information maintained on a plant-wide or company-wide intranet solves most, if not all, of these problems.

Storage volume is greatly reduced. Yes, there are limits to the size of electronic storage devices so some selectivity must be used. But by properly configuring the information inputs, this problem takes care of itself and renders the data more useable for a wide variety of purposes.

Note: For information safety and security, all intranets are designed to limit changes to the original document. Only the webmaster or the designated system administrators have system authorization to access and modify a document.

There remains only one copy of the information, technically, but it is concurrently accessible by multiple users, any of whom can print a hard copy. Additional information can be simply added, either as a hot-link addendum or changed within the actual data file itself through the webmaster. An intranet can easily be designed to automatically notify a predetermined e-mail list of any changes in the database, thus ensuring that all interested parties know of the change.

Finally, the information is accessible and usable. The engineers mentioned previously can compare, or perhaps the reliability program would do it for them, their pumps' operating history and reliability. Additional data from suppliers and other users could readily confirm their hypothesis.

REPAIRS

The ability to repair equipment can benefit greatly from computer mediated communication. First of all, updated maintenance manuals should be available, via the internet, from the manufacturer. This type of information is currently available from most computer and computer peripherals manufacturers. This is also done, in a slightly different manner, by Lexis, the information provider for attorneys (Figure 9).
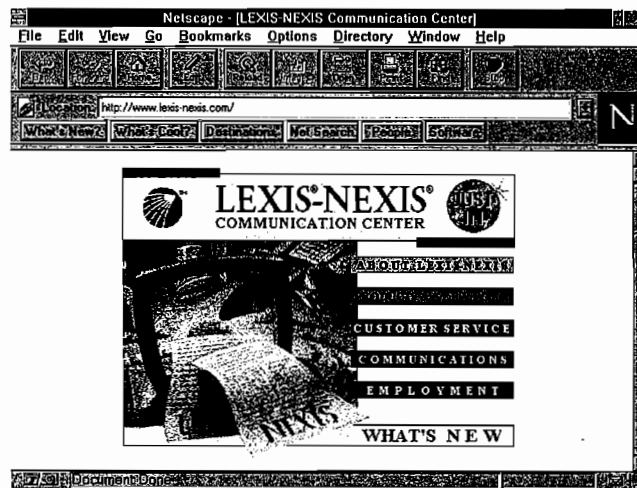

Figure 9. Lexis Provides Legal Services and Information for Attorneys and Professionals Using a Proprietary Telnet Communication Link.

This manual would include not only the original instructions, but additional information gathered over the years since the equipment was manufactured. In some cases, this could be critical information that could reduce repair time and/or costs. Any design upgrades would also be noted here.

During equipment inspection, especially when there are questions regarding the mode of failure, factory service engineers frequently receive faxes of snapshots. If the repair facility instead had a digital camera, currently costing about the same as a single wear ring, the digital image could be instantaneously e-mailed to the service engineer and actual usable information would then be

available. Likewise, if the repair facility needed a part not immediately available, the machine drawing could be e-mailed or the digital instructions for the CNC machine tool could be sent.

Again, the wide gray line of proprietary information is being approached. And again, it must be determined what partnering agreements and vendor alliances are really intended to do for both parties.

Note: One major chemical company has developed a "helmut camera" system that attaches to an inspector's hard hat and includes a cellular phone headset. A company engineer can then monitor disassembly, inspection, or testing from his location, whether that be office, home, or elsewhere, and at the same time, question the inspector further about the operation. This allows the most qualified individual to be part of the repair or inspection without the expense in time and money of being physically present.

SECURITY

The security of information will always be an important issue. Is it all that it is made out to be by computer security experts hawking their services? Probably not. But it is an area that must be considered. To review security, it must be determined what information will be available and who will have access. Companies must also realistically appraise the value of their data to know how hard someone may work to get it. The following breakdown outlines the way many companies structure online information, and what security, if any, is appropriate for that information.

Users and developers of online information technology must remember that security cannot be the only purpose of a network. The network exists to enhance the ability of employees to do their jobs and to allow the company to conduct its business with customers in an efficient manner. If security intrudes on this charter, system users will find ways to circumvent the system.

Levels of Access

• *Public Space*–Designed for the casual visitor. This area typically has conventional advertising, corporate mission statement, markets served, perhaps even excerpts from the latest annual report. Other information could include technical papers designed for public viewing.

• *Office Space*–The area of the company that would be seen if walking around the company's office building. This level would allow the customer and manufacturer to conduct business, but would be restricted to authorized persons. Security would be limited by requiring a user name and password. Although not every transaction and communication in this level would be considered public, this level is not considered secure and sensitive business and documents would not be available at this level.

• *Work Space*–Restricted access area where the company conducts its own business. This is the closed door area of the company. This level of security would be for internal communication regarding contract negotiations with suppliers and customers, proprietary specifications, etc. This area would be limited to individuals involved in these business activities only.

• *Secure Space*–This level would require very strict user authentication, and access would be limited to specific individuals, as opposed to specific levels or grades of employees in the higher levels. This area would hold sensitive corporate data, personnel and financial records, strategic planning, etc. Security measures at this level vary from company to company, but can include frequently changed passwords, codes that allow access only from certain workstations, synchronized random number generators for passwords, and a plethora of high tech options for information protection. This level is frequently on a separate server from other LANs and intranets.

Firewalls are always used, and are generally quite effective. As mentioned before, firewalls, offsite or outsourced servers, and virtual servers are all methods used both for security and for company convenience. From a security standpoint, small to medium firms and even many large companies are best served by offsite or outsourced servers with full-time professional webmasters and systems administrators whose job is to stay on top of the latest developments on both sides of accepted behavioral norms. When properly administered, firewalls are secure.

Note: Security is possible. One computing group has developed a combined hardware/software firewall system that is so secure that it has offered its system on the Internet and challenged hackers to defeat it. After more than 2000 attempts, the wall remains unbreached. But, if a password printed on a piece of tape is left inside a laptop, well, there it is.

Security failures are more often the result of lax enforcement of security measures within the company than hackers on the outside. Like any other job related training, security of the computer system must be included. Employees must understand the importance of system security.

Data backup is still the most effective method for guarding against catastrophic loss of information. Like other security measures, this must be done regularly, with frequency based on the rate of information change in the database. The change in networking philosophy from workstations to fully functional PCs has left much more data on individual hard drives. While this information may be critical to the enterprise, there is frequently no enforced program for backing up data on individual computers.

Viruses remain one of the most likely causes of information loss. Unfortunately, this type of loss is almost totally preventable, but like most security measures, it is paid scant attention until the damage is done. The virus infects the computer by hiding in an executable file. These are files that end with .exe, .bat, .com, and the like. These are files that actually operate the program. With rare exceptions, viruses cannot infect a computer from a data file. A number of good programs are available commercially and through shareware sources.

The best programs install themselves into the autoexec.bat program and then remain active as long as the computer is on. They scan all executable files for viruses on startup and then remain on duty as terminate and stay resident (TSRs). From this state, they scan any files imported into the computer, whether through disks, network connections, or the internet. This type of program greatly reduces the risk of virus infection by automatically scanning the computer's memory and any incoming files.

Note: A popular word processing program became susceptible to infection with a new virus strain. While still technically introduced into the system by an executable file, the file in this case was a macro within a document. This is an area of programs that most virus detection programs do not check. The program has been modified to prevent this type of virus in the future, but it shows the creativity of virus creators.

Hackers generally fall into two classes–vandals and spies. Vandals view breaching security as a game and will destroy your data, taunt your information services personnel, and generally make life miserable. Some are very good, most are not, and they are almost always outside your company. They can be stopped. But if your firm is attacked, bring it to the attention of the authorities and consult your IS professionals or a competent consultant for advice to prevent future attacks and security breaches. Spies are more difficult to detect and more frequently will be your own employees. Spies do not destroy data and if they are good, they will leave no trace of their activities. Easily administered programs are available to monitor internal and external access to data. Do not get caught guarding the back door while the horse is being led out the front.

PERSONNEL ISSUES

The trend in business is to do more work with fewer people. The idea is to have technology take up the slack. This is certainly possible and a number of ways have been discussed in which technology can help increase the reliability of a typical centrifugal pump. Many of the concepts provide leaps over current levels of people and companies. What will the changes in communication and information management bring to the pump industry and the people in it?

First of all, vendor alliances, a term used generically here, will begin to focus less on first cost for hardware and more on the information necessary to decrease life-cycle costs. Persons and organizations that do not contribute to this exchange of information will be eliminated from the system. Alliances will also force suppliers to increase their scope of supply to include many accessories and ancillary equipment currently under separate contract from other vendors.

For example, an internal expediter whose only function is to relay information from the shop floor to the customer, will soon be replaced by an information link that allows the customer to access the project scheduling database. This will provide detailed information not only on manufacturing itself, but subvendor work and the status of supplies ordered to complete the job.

Sales organizations will be reevaluated in terms of the information they supply and the systems they can produce. Manufacturers may become more involved in the maintenance of information, while actual production is outsourced to smaller and more specialized organizations. And users themselves will take advantage of cooperative databases with manufacturers and competitors to reduce reliability costs, eliminating their own database management duties.

For all this to work, of course, employees will require training. Most companies, large and small, provide little, if any, training in technology. Many companies are gratified when they can enforce software standards, and training is left to employees, teaching themselves and each other. To be effective and allow the company to receive the proper return on its investment, the tools must be appropriate and the people using them must be trained.

Tools are easy. Commercially available software can usually be configured to meet the needs of almost any company in the pump industry. Training is more difficult because, to be useful, it must be tailored to the specific systems the employees will be using. Most trainers are very good at their software programs, but lack full understanding of the business processes in which they will be used. Competent trainers for software, with expertise in the pump industry can be found. Alternatively, trainers willing to make the investment to learn business processes can also provide excellent service. As with all consultants, a good relationship will come from a complete understanding of the training to be furnished and confirmation, after the fact, that the employees are now competent in the program.

CONCLUSION

Information technology will change the way work is done. Business partners may well change, not just from manufacturer to manufacturer, but possibly from pump manufacturers to systems manufacturers. And, interaction with business partners will be in a much more open manner.

Computer mediated communication will improve reliability, possibly extend MTBF, and reduce maintenance expenses. Common databases with manufacturers will allow analyses of equipment performance and compare to industry norms.

There are costs; there are tradeoffs. The changes will not happen overnight. First, users and suppliers will need to come to grips with the new meanings of proprietary information and intellectual property that this technology will demand. Without a conscious decision to move alliances forward to the new level available through existing information technology, the opportunity to truly change the pump industry will be lost. Finally, the users must work with suppliers to ensure that any new communication technology must adhere to the open standards being developed with the rest of the world. If proprietary standards are allowed to become the norm, instead of developing the pump industry through cooperation and an open exchange of information, costs will increase, isolation from each other and the rest of the information culture will be encouraged, and the technology now revolutionizing much of the rest of the business world will be lost.

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