Changes in Technology

CADD

CEFMS

GIS

ISO 9000

VE

WWW

NRRS

Customer Care

Integrity

Professionalism

Purpose

Quality

Esprit de Corps

Caring Leadership

Value Engineering
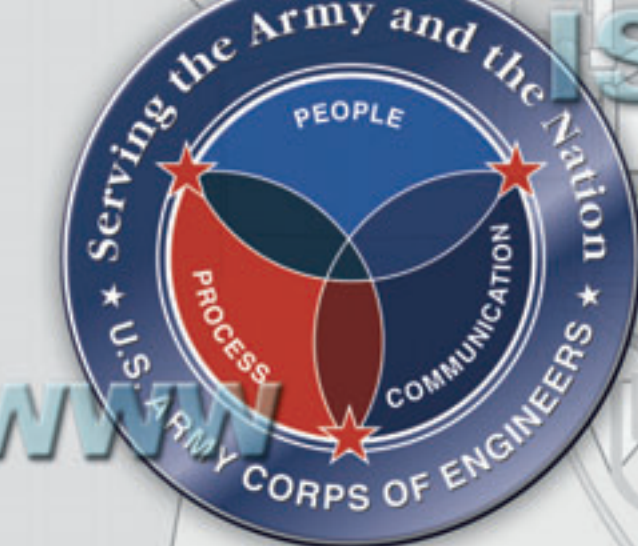
Serving the Army and the Nation

PEOPLE

PROCESS

COMMUNICATION

U.S. ARMY CORPS OF ENGINEERS

Pillars of TQM

Customer
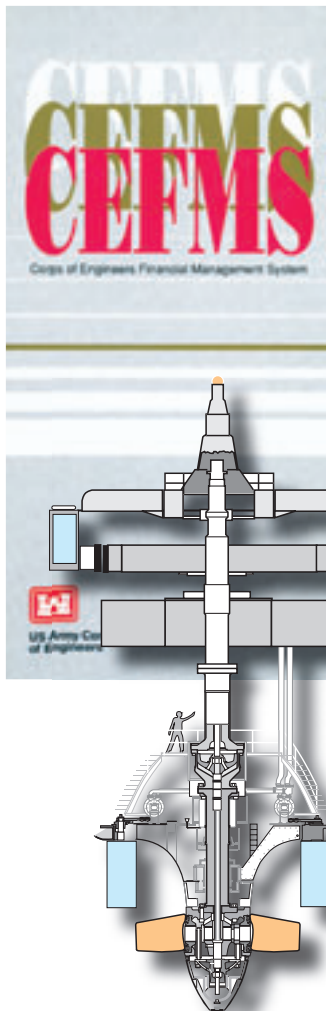
Quality

Cont Imprvmt

Empowerment

Chapter Seven
Changes in Technology

"We're not where we want to be yet, but we're putting the tools in place."
Howard Jones, Chief of Engineering and Construction, 2001

The CADD system produces drawings for the Corps' large civil works projects.

Technological advances in the late 20th century impacted the public and private sector, including the Corps. To increase efficiency and remain competitive, the District adopted a series of new technologies and standards, including the Internet, Geographic Information Systems (GIS), and Computer Aided Design and Drafting (CADD). Learning how to utilize these new tools required additional training and new expertise, but it also had the potential to revolutionize many aspects of the Corps' work and ensure that it remained at the forefront of the engineering and environmental fields.

Incorporating ISO 9000 Standards

Responding to an increasingly competitive work environment, the Corps integrated new standards for its operations. In the 1990s, for example, Corps Headquarters selected the Portland District as one of four districts to implement ISO 9000, an internationally accepted set of management criteria establishing minimum requirements for a quality management system. By using ISO 9000, the agency hoped to improve its business practices, work processes, and employee empowerment.[1] Adopting ISO 9000 offered the Portland District the following benefits: it established clear, consistent processes by reviewing and revising existing written operation procedures, many of which were outdated, redundant, or conflicting; it instituted measurements to gauge improvements; and it introduced more effective customer contact, such as customer satisfaction surveys.[2]

The ISO 9000 is a product of the International Organization for Standardization (ISO), a non-governmental organization established in 1947. The ISO's mission is to "promote the development of standardization and related activities in the world with a

view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological, and economic activity." With some 140 countries involved, this international federation creates agreements that are then published as international standards.[3] These standards contain technical specifications or other precise criteria that are used as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes, and services fulfill their purpose. While creating a good product is important, standards focus

conduct internal audits of the system on a periodic basis using in-house resources. This is complemented by ISO-certified, independent, third-party assessor audits conducted on a semi-annual basis to assure that ISO certification remains intact.[5]

The Corps began investigating the use of ISO in the l990s. By 1995, the Logistics Management Institute (LMI) – a consulting company helping to improve public sector management – had completed a report analyzing how the Corps could incorporate ISO 9000 standards into its engineering and design programs. According to LMI, "In the face of

By using ISO 9000, LMI believed that the Corps could improve its organizational productivity, product quality, competitiveness, and employee motivation, while also lowering its supervision and review rates and reducing lost design efforts.[7]

Responding to LMI's report, the Corps selected four districts, including Portland, for a Headquarters pilot program to implement ISO 9000. By August of 1997, following a two-year internal analysis, the Portland District's Planning and Engineering Division had achieved certification under

The Information Age

The work environment at the Portland District has changed a great deal since 1980, mostly owing to the increasing prevalence of personal computers. When Lester Lynch arrived in Information Management during the early 1980s, "most people still used typewriters." The District had only a few computers – each with 640k of memory. "They were made in a guy's garage in Portland," Lynch recalled. By the late 1980s, Lynch had assisted the District with installing Local Area Networks, and within several years nearly every employee in the Portland District had access to a personal computer. "It's changed the way we communicate," he explained – inside and outside the Corps. District employees quickly recognized the potential of the World Wide Web to enhance communications. Portland was one of the first districts in the Corps with its own website, and fish counts were among the first topics posted.

on the quality of the process, not the quality of the product.[4]

In addition to the Corps, numerous types of companies and agencies use ISO, including both product and service oriented organizations. There are multiple reasons why a group would choose to implement ISO standards. A company may feel the need to control the quality of its products and services, reduce costs, or become more competitive. Other times a regulatory body may mandate the use of these standards. Once an organization decides to engage the ISO standards, it then develops a system that meets the quality requirements specified by one of four standards – ISO 9000, 9001, 9002, or 9003. A characteristic that distinguishes an ISO-based business process from other business processes is that management is required (in order to maintain certified status) to periodically review the effectiveness of its quality management system and to

military downsizing and spending cutbacks, the U.S. Army Corps of Engineers (USACE) must uphold its reputation as this country's preeminent engineering enterprise and be poised to enter the 21st century as its customers' first choice for engineering and design services." To survive in an increasingly competitive business climate, LMI explained that the agency must meet its customers' requirements on time, within budget, and with excellent service, while simultaneously satisfying industry engineering, safety, and environmental standards.[6]

LMI urged the Corps to incorporate the ISO 9000 quality system model into its engineering operations. The ISO 9000 offered the agency the systematic and structured methodology it needed for establishing a total quality management philosophy, while the system's standards formed the foundation "that will enable the USACE to establish itself as a world-class engineering organization."

ISO 9001 criteria (development/design, production, installation, and servicing). The District was only the second Corps office to achieve this certification. During the process of adopting the ISO system, the Planning and Engineering Division instituted an action plan to review, revise, enhance, and measure internal work processes and documentation procedures to improve communication links with internal and external customers, eliminate unnecessary paper work, and streamline the work process. The Division's goal was to achieve results on time, within budget, and to meet the customers needs "the first time, every time."[8]

In 1998 the Planning and Engineering Division was reorganized as the Engineering and Construction Division. The opportunity availed itself to expand the scope of ISO certification to include construction activities and efforts were taken to incorporate the Construction Branch as part of

the overall business process. The culmination of this effort solidified and brought closure to design verification and validation with physical product delivery to the customer.[9]
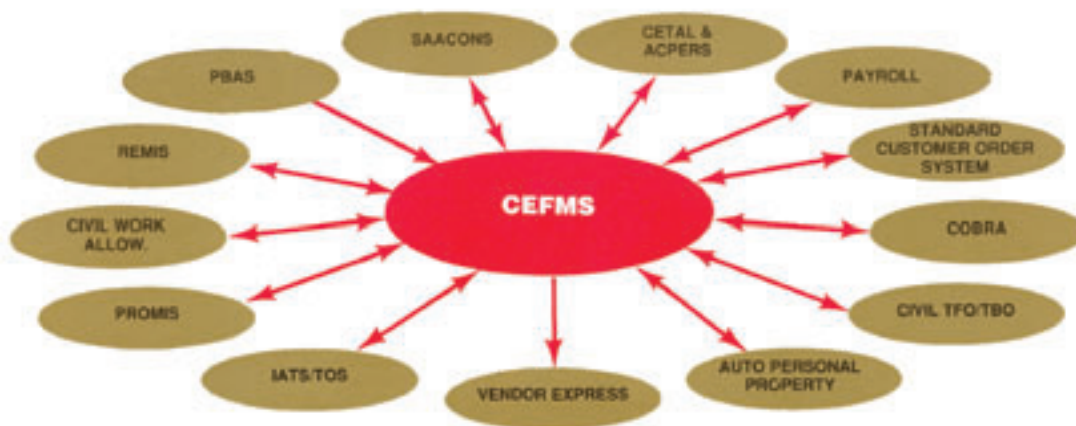
The ISO system affected the daily operations of the District in several important ways. As one employee explained it, the system had three major requirements. First, you have to "say what you do." In other words, workers have a manual of policies and procedures describing what the agency does to plan and manage the quality of its products. Second, you have to "do what you say." This means applying the written policies and procedures in daily work activities, such as work scope

development, review, and approval. Finally, you have to "prove it," which requires subjecting your Quality Management System to an external audit every six months.[10]

The adoption of ISO 9001 was part of a larger trend within the Corps to increase the agency's efficiency and competitiveness. Since 1980, several national trends, such as a greater reliance on the marketplace and a smaller role for the federal government, placed increasing pressure on the agency, both reducing and transforming its workload. By instituting a set of international standards, Portland's Planning and Engineering Division took a step toward ensuring that its products would meet its customers' needs into the 21st century.

Corps of Engineers Management Information Systems (CEFMS)

In the early 1970s, the private sector and government agencies began to face the challenge of how to incorporate rapid advances in computer technology into their business practices. Many agencies, including the Corps, had to modify aging, clumsy systems and procedures. In the mid-1980s, for example, key-punch operations in divisions and

districts prepared data cards for an array of systems, such as COEMIS (Corps of Engineers Management Information Systems) and AMPRS (Automated Management Project Reporting Systems). In addition to these Corps-wide systems, personal computers, connected through a local area network within the district or division, ran numerous commercial software packages for word processing, spreadsheets, or graphics. Responding to technological advances, Headquarters initiated the Corps of Engineers Automation Program (CEAP) and launched an information systems planning study.[11]

One of the areas in need of updating was the Corps' finance and accounting system. In the early 1980s when a Corps study team for Information Systems Modernization

Program (ISMP) considered the agency's automated systems, the finance and accounting module of COEMIS – in place since 1972 – received the sharpest criticism. In January of 1988, the group assigned to work on the system concluded that the agency should move toward a financial management system, rather than designing a new accounting system that would only record how funds were spent after the fact. As a result, planners in Headquarters searched for a system to purchase. Unable to find one, they determined that the Corps needed to design a system specifically to fit its needs.[12]

To create the system the Corps used a technique called rapid prototyping in which developers

CEFMS provided a complete financial system that consolidated numerous fiscal applications.

writing computer code received nearly instant feedback on how the system satisfied users' functional and regulatory requirements. This initial development phase was conducted at the Huntsville District; the Fort Worth District was in charge of testing the program prior to full-scale implementation. By the mid 1990s the new software application was formally named CEFMS – Corps of Engineers Financial Management System.[13]

As a complete financial management system, the Corps designed CEFMS to allow employees to conduct all their financial business through the computer. CEFMS maintained virtually every financial transaction, including travel orders, payments to contractors, labor time and attendance, and civilian

pay. Developed during the same period as the agency adopted project management, the Corps intended the new financial system to benefit project managers by enabling them to monitor their projects' financial status. "The idea … was that it was supposed to supply managers with more readily available financial information," explained David Beach, Operations Manager. In particular, the system's ability to provide financial information in real time (as funds were expended), rather than 30, 60, or even 90 days later, and its electronic signature capability to authorize transactions on a computer, promised to aid managers. CEFMS also integrated information from other automated systems in the district. The Corps hoped that ultimately the new system would save time and money by streamlining business processes, projecting savings of $270 million over ten years.[14]

Despite the Corps' intent to improve its handling of financial information, when the Fort Worth District began testing CEFMS in June of 1995, many initially found the system complicated and not very user-friendly. "At first, it was a total disaster," recalled Texas engineer John Riddle. Produced for civilian needs, it did not incorporate forms, such as purchase orders, required for military projects. Over the course of a year, the Fort Worth District helped the development team make essential improvements to the new system. Besides the human issues, problems the District had to overcome in adapting CEFMS to district business centered on fine-tuning the interactions with other project systems involving contracting personnel, logistics, and real estate.[15]

Even after Fort Worth's input, the system continued to challenge Corps' users. Carol Ann Job, an administrative officer in the Engineering and Construction Division, explained that one of the problems was that the system was
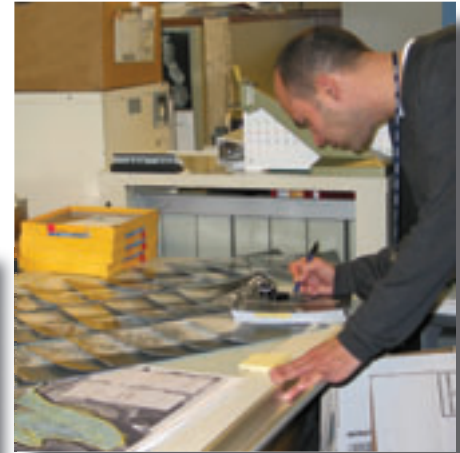
Geographic Information Systems (GIS) include remote sensing/image processing, imagery, land surveying, photogrammetric mapping, and cartographic mapping.

fielded before many of the bugs were worked out due to political pressure to get it up and running. Different programmers, for example, worked on each module, which meant that commands and instructions were not standardized. This made training and use of the system challenging.[16] Others in the District agreed that the software was difficult to use. "After being used to being able to point and click and work Microsoft's array of software it was difficult," said Beach. "Most software is neutral, friendly, and intuitive," he added, but CEFMS is "very cumbersome." Beach also wondered if perhaps a commercial system would have been better and felt disappointed that a more intuitive system was not developed. [17]

Diana Brimhall, Chief of Public Affairs, acknowledged that District personnel had mixed feelings about the system. She explained that one of the reasons for the resistance may have been due to the fact that the District's financial and accounting staff was already extremely familiar with the existing system and the financial terminology required to work with it. The new

CEFMS users, however, were not well-acquainted with the financial vocabulary, which took a good deal of time to remedy. Another reason for the system's lukewarm reception was that in the process of creating a centralized financial management structure, the Corps made it harder for smaller offices, such as Public Affairs, to conduct some of its business. Whereas once employees in Public Affairs simply had to type up a requisition form and take it to contracting, they now had to "do multiple strains of these different codes and things that don't really mean a whole lot to us." Furthermore, according to Brimhall, "Then somebody else has got to verify it, and I have to go in personally and approve it; I can't just sign my name on a piece of paper." The result was a more time-consuming process. One positive result of CEFMS was that it allowed for closer tracking of funds; however, many of the reports it generated were not user-friendly and were difficult to interpret. CEFMS continues to be used at the District, but, according to Job, training for new employees on

the system remains inadequate and is up to the individual offices.[18] While CEFMS posed many obstacles for Corps personnel, other technological advances proved far easier to incorporate into the agency.

Using GIS and CADD

In the late 20th century the Corps adopted Geographic Information Systems (GIS) and Computer Aided Design and Drafting (CADD) into its operations. Portland's GIS program is operated out of the GIS, Survey and Mapping Section, which provides support services to all technical offices in the District and to other agencies through partnerships in six distinct technical areas. These include the following: GIS, remote sensing/image processing, imagery, land surveying, photogrammetric mapping, and cartographic mapping. The merger of these technical components into one section provided a number of benefits, such as cross training, improved coordination and communication, and efficient management of the digital data collection process. Over the years, GIS has become an integral component of all these technical functions.[19]

GIS technology is based on referencing objects to a spatial coordinate system and attaching a rich database of attributes. GIS enables a user to query the database to obtain specific information and is helpful in many types of land management activities.[20] Portland has been actively involved in the georeferenced digital data collection process since 1976. It was not until 1983, however, that it acquired its first true GIS software, ERDAS (Earth Resource Data Analysis System). The ERDAS system, with its image processing component, provided an ideal match to the geotechnical, hydrologic, and environmental focus of district projects.[21]

In 1985 the District purchased an Intergraph system to support its cartographic and photogrammetric operations. The development of certain software eventually enabled


The Computer Aided Design and Drafting (CADD) system is used for drafting civil works projects, providing complete services that are better, faster, and cheaper to customers.

Portland to acquire and implement Intergraph GIS software. In 1989, the District added Arc/Info software to its GIS operations to facilitate communications and data transfer with other agencies. Later, the agency supplemented the software with ArcView; both have been integrated with the Intergraph system and are used extensively.[22] While GIS expanded the District's capabilities, a fair amount of work remained. "We now have the capability to essentially put all of our information on all of our projects, such as cultural resources, into a GIS data base," explained Howard Jones, Chief of Engineering and Construction. "We're not where we want to be yet, but we're putting the tools in place."[23] In the future the District plans to continue its expansion of its GIS capabilities by implementing an "Enterprise GIS system, which would improve corporate database and development, storage, and access as well as facilitate the growth of GIS."[24]

The District's GIS program maintains close links with its CADD system. CADD vendors define CADD as a "system of primitive graphic elements incrementally placed to create an engineering graphic." Commands are strung together through computer programs to generate elaborate graphical products, such as two-dimensional or three-dimensional drawings. Within the Corps, CADD has generally been used to represent a building and its elements. For civil works projects it is also used for large scale site work, such as channels and levees, surveying and coordinate geometry packages for site and transportation, and geotechnical subsurface modeling. In using CADD, the Corps aimed to "provide optimum products and services to our customers, delivering completed projects 'better, faster, and cheaper.'"[25]

The Corps has relied on some form of CADD in its design work for almost two decades. Computer-Aided Drafting (CAD) has been used in the Corps to produce production drawings since the mid 1980s, and resulted in a three to one savings over manual drafting methods. With the advent of work stations and the availability of computer programs from the CAD vendors for all phases of the life cycle of a project, an additional 'D' was added to CAD, making it Computer-Aided Design and Drafting (CADD).[26]
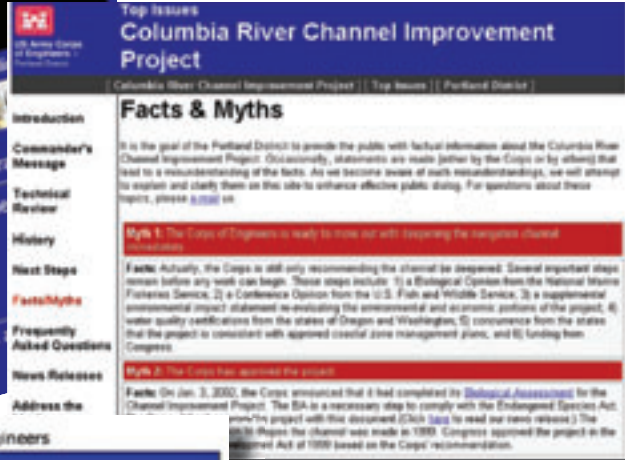
Portland District
internet pages

relies on a variety of tools, such as news releases, interviews, and workshops, to provide information about its projects to the public and the media. The creation of the Internet added an additional tool. Following the lead of the Vicksburg District, one of the ways Public Affairs incorporated the new technology was by generating a "top issues" web page, addressing controversial projects or developments. This page included breaking information, as well as a list of facts and myths about each project. District Commander Colonel Randall J. Butler described the concept behind the facts and myths page:

"We have found that folks are using the Internet for information. So we have created different web pages and different ways for folks to hear our side…. One of the key things is when a newspaper or other media puts out something that we think is not truly the facts, we will call it a myth. … What we will then do on our web site is say, here are some of the myths that have been put out there, and here are our facts. We actually give them counter points."

When Vicksburg created its "facts and myths" page, district personnel apparently received criticism from various organizations. "They got calls back from groups saying that you can't do that, you can't counter our story," recalled Colonel Butler. "Basically, Vicksburg said why? These are the facts, and you can tell the facts like they should be told and let people make their own decision."[29]

Brimhall found the top issues page extremely helpful in dealing with questions both from the public and the media. During, for example, the controversy over releasing water from Detroit Lake [See Chapter One], the web page enabled the office to "directly address some of these pieces of information that are

Over the last decade, CADD users in the Corps have expressed interest in integrating engineering software programs into CADD programs. Industry has produced some powerful programs, but they have not been well accepted by users, perhaps due to issues such as cost, the learning curve required, and adaptability. While exceptions do exist, the primary usage of CADD remains as a drafting tool.[27]

Taken together, GIS and CADD are essential tools for the District's civil works projects, and, in fact, the Corps continues to work on integrating the two technologies. Recognizing the downsizing trend of the past two decades, the agency has also begun considering ways to "adopt a different business paradigm." According to the Corps, "the days when every design office had several engineers of one kind … has gone; now they only have a few

engineers specializing in one area." Therefore experts and resources now need to be pooled between offices. With the advent of the Internet, CADD and GIS knowledge and products can be shared throughout the Corps, creating a "true enterprise-wide virtual office."[28]

The Internet

The development of the Internet transformed the way the Corps conducted its business in the late 20th century. The agency used the new technology in numerous ways, including storing and retrieving documents, communicating internally, and interacting with customers and the public. Perhaps the most visible impact of the Internet on the Corps has been in this last category – public relations.

Communicating with the public is an ongoing task at the District. Portland's Public Affairs Office

out there." The web page informed the public, while reducing the number of people calling and writing to Public Affairs, saving the office a good deal of time and energy. "It helped drastically because Detroit was having a 'Save our Lake' rally," explained Brimhall. "Matt [Rabe] was getting calls from news media people wanting to know our view on that, or our take. He said, 'Well, as a matter of fact, why don't you check out this web site, we just posted the box of myths.'" Many of the callers responded enthusiastically, and, according to Brimhall, the web site "saved him a lot of time and effort as well."[30] Colonel Butler also observed that information presented on the site could help diffuse contentious situations. Furthermore, he noted that reporters who visited the site were more informed. "What we found is that reporters … go to the web site first before they ask the questions," he explained. "I think that's great

because then they are able to at least see what we've put there" and "can tailor their questions and ask the specifics that they want."[31]

Additionally, the top issues web site helped inform District employees outside of Public Affairs. "We're also letting our own people know that those pages are there," explained Brimhall. "Frequently they get asked questions by their neighbors and other folks, and they know where they can go to get information if they need it." Another benefit of the web site was that it offered visitors a chance to be added to a mailing list, further strengthening communication between the agency and the public.[32]

A related technological advance was the adoption of electronic mail (email) by the District. The Corps of Engineers Headquarters encouraged access to email for all employees, and in the mid-1990s email became standardized throughout the agency. At the District, email was primarily

used at Headquarters and on larger projects. To meet the Corps' goal of email for all employees, the Portland District Information Management formed a 'traveling road show' installation team that installed Microsoft Outlook and Internet Explorer at all the Portland District projects over one summer. The team included software configuration and installation on all the computers at a project and also delivered classroom teaching on how to use email and the Internet. A community college was used for multiple weeks in The Dalles to teach project staff from Bonneville and the The Dalles/John Day. This concentrated effort made email available to all the Portland District staff.[33]

The Internet and email benefited the District's communication efforts with the public, but, as Brimhall cautioned, it could not replace more traditional tools. "I think the Internet is great … we're making

You've Got Mail!

The introduction of electronic mail (email) had an immediate impact on the Portland District. This new communications tool, which gained widespread use in the district during the 1990s, brought advantages and disadvantages. Email greatly increased the Corps' ability to interact with the public and media – and the Public Affairs Office was quick to recognize the possibilities. The Public Affairs Office created electronic mailing lists to keep people informed of the latest news regarding a particular issue. "We're trying to be more proactive than the Corps traditionally has been," explained Diana Brimhall, Chief of Public Affairs. Email also made exchanging information within the District easier – a particularly important factor for an agency whose project personnel were located across the Pacific Northwest.

The very ease with which people could send emails, however, also created difficulties. The sheer volume of emails could be overwhelming at times. Brimhall regularly received between 50 and 60 messages a day, while Deborah Chenoweth, Operations Manager at Bonneville Lock and Dam, spent "a minimum of two hours a day just dealing with my email." With so many messages coming in, district employees also faced the difficult task of deciding which messages were important and which could be deleted. "People … are inundated with so much information that they don't know what's important," said Brimhall. An additional frustration was that the increased dependence on email meant less face-to-face communication.

To avoid overloading the system, electronic mailboxes required regular sorting and cleaning. This could be accomplished if a person was in the office, but weekends and vacations posed a problem. "If I don't keep up with my email over the weekend, Mondays are a nightmare," reported Chenoweth. "The problem is there are a lot of folks that do their email at night, so you can't clean out your box and go home and come back the next morning, because there is stuff as soon as you walk in the door." The challenge became even more pronounced with an extended absence from the office. "Some people take their laptops with them on vacation so they can check their email," explained Brimhall. "You … go on a two-week vacation, and you get relaxed, refreshed, and ready to come back to work. You walk in and you've got 200 email messages and … it undoes all of the good that the vacation did." To avoid such a scenario, many employees took laptops on vacation, periodically sorting through their emails.

a lot of information accessible to people," she said. But she added, "What we have to remember is not everybody has access to the Internet. Not everybody wants to get their information that way." Even within the District, employees felt that there were some negative impacts associated with the emerging technology. Surveys and discussions revealed that employees wanted more face-to-face communication. "There is too much dependence on sending an email or giving out [information] electronically," Brimhall explained. "People are overwhelmed … with so much information that they don't know what's important, what's not, and how does it affect them?" Furthermore, some employees felt that staying on top of their email correspondence had the potential to prevent them from accomplishing other work. "Am I going to read through email or am I going to try to get some more work done?" was a question that Brimhall often asked herself.[34] Overall, however, District employees remained enthused about the technology's possibilities. Beach – whose channels and harbors projects were one of the first in the District to have a web site – expressed excitement about the new communication tool. "The Internet is fantastic," he said. "We've been able to do a lot there with communicating with the public and telling them what we do. It greatly increased our accessibility."[35]

Becoming Part of the National Recreation Reservation System

Further enhancing its strength as a communications tool, the emergence of the Internet also transformed the public's ability to access Corps recreation sites. As part of an effort to make the nation's recreation sites more accessible, in October of 1998, the National Recreation Reservation System (NRRS) began taking reservations at Corps and National Forest Service campgrounds. This system allowed

campers to make reservations either through a toll-free number or on the Internet. As of May 2000, four Corps-managed campgrounds in Oregon and Washington were part of this directory: Pine Meadows at Cottage Grove Lake, Schwarz at Dorena Lake, and LePage and Plymouth, both of which are located upstream of John Day Dam. The Corps still reserved a limited number of sites available on a first-come, first-serve walk up basis.[36]

The Portland District's Integration and Implementation Branch (IM-I) played a crucial role in implementing the NRRS. The branch established the Interagency Contract Management Office (ICMO) to perform the contract-related startup activities and NRRS program activities, such as financial management and contractor performance monitoring. The IM-I Branch developed the inventory data collection system, which was distributed Corps-wide. After personnel entered the data for each campsite and reservable facility, the files were returned to Portland for consolidation and subsequent transfer to the contractor's center.[37]

Meanwhile, the IM-I Branch established the office automation infrastructure for ICMO, and the Telecommunications Branch developed the communication links from the contractor to the CEAP network and the Internet. The IM-I Branch also assisted in the configuration of personal computers to be placed at campgrounds and installed a modem bank, allowing all campground locations to

communicate with the central reservation system. Furthermore, IM-I personnel provided leadership in the design of the financial models required to support the agencies, developed management tools, and worked with the contractor to implement the NRRS. The District's Information Management Office also had a role in the campground reservation system. The office supported the NRRS infrastructure, monitored various aspects of contractor performance, and refined the Financial Management System.[38]

Conclusion

During the late 20th century the Corps faced a number of challenges. As both its workload and workforce underwent significant changes, the agency struggled to stay competitive. The District's adoption of a wide range of new technologies and standards demonstrated its ability to adapt to changing conditions and helped ensure its continued presence in the areas of engineering and design. Furthermore, technological advances, such as the Internet, transformed not only the agency's internal operations and work products, but also its interactions with the public. Web sites provided information on controversial issues, for example, and the National Recreation Reservation System made the Corps' recreation sites more accessible. While the transition to new technologies could be difficult, the Corps generally embraced these new tools, finding innovative ways to incorporate them into its work.

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