

An Intranet Primer

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1. Introduction

The purpose of this paper is to provide a relatively simple explanation of what an intranet is, why intranets are so popular with companies, and describe a set of steps that one should follow (and mistakes to avoid) to make a good intranet. At the end of this paper I will briefly comment on the importance of intranets.

2. What is an Intranet?

To answer the question “what is an intranet” we have to know a little about the Internet and how it works. As you no doubt know, the Internet is a “network of networks.” That is, it is a massive set of connections that tie together networks of computers all over the world. When one thinks about it, it is truly amazing that in the span of just five years or so, the Internet has grown so much. One reason for this growth is something called TCP/IP or Transmission Control Protocol and Internet Protocol. These protocols (see Appendix A for a list of the main protocols in the suite) specify the way data gets sent over the Internet. When data is sent over the Internet it is first converted into a digital form and then the digits are packaged into packets. Each packet contains part of the total message to be sent and each packet has the destination address and origination address. This way it doesn't matter if all the packets go by the same route or not. Also the packets can be mixed in with packets from other messages. It is obvious that this makes for much more efficient use of transmission media and improves the chances of the message getting through should there be a communications outage on a particular

link¹⁾. But the real strength behind the TCP/IP protocols is that they are designed to work with any kind of computer, be it a personal computer (PC), a Macintosh, or a UNIX²⁾ workstation.

Another reason for the huge growth of the Internet is advent of the World Wide Web. Thanks to an Oxford University graduate, Tim Berners-Lee, we now have a remarkable system that “rides” the Internet called the World Wide Web (WWW) or usually just “The Web.” Berners-Lee, working for the European Particle Physics Laboratory (CERN) in Geneva, Switzerland saw the need for physicists to collaborate in real-time on their projects. To accomplish this he devised a “hypertext” system that allows one to link from one document to another by “clicking” on a “button” embedded in the first document (Dougherty & Koman, 1994). The “button” is usually one or more words that identify the available document and also contain the Internet address of the document. However, to create such wonderful documents, it is necessary to use a special language called HTML or Hypertext Markup Language. HTML allows the document to be displayed by a browser such as Netscape Navigator or Microsoft Internet Explorer. HTML also allows one to embed these “magic” buttons in the document. When you click on a button you invoke another protocol call HTTP or Hypertext Transfer Protocol. HTTP is the protocol used to retrieve and transfer the hypertext document from the host (or server, if you will) on which it always resides. For example, if you were to go to my home page and click on the button *Shudo University*, you would immediately be “taken” to Hiroshima Shudo University’s home page by virtue of the HTTP protocol retrieving and transferring this document from Shudo’s server. The reason my browser knows where to go is that I have associated the Internet address of Shudo’s home

1) In fact, the Internet grew out of a U.S. Department of Defense (DOD) network (ARPANET) that was developed to provide survivable communications in the event of attack.

2) UNIX is a computer operating system developed by Bell Laboratories and licensed to universities. Although very powerful, its use is difficult to learn.

page (<http://www.shudo-u.ac.jp>) with the words "Shudo University." This address is called a universal resource locator (URL) in Internet talk.

With the ability of the Internet to operate with any kind of computer (cross-platform capable), the development of Berners-Lee's hypertext system, and the advent of sophisticated and usually free ("freeware") browsers such as Netscape Navigator or Microsoft Internet Explorer, it became simple to begin "surfing the Web." Because of the vast amount and variety of information on the Web, more and more people began using it and, as they say, the rest is history. Adding to this explosive growth is the fact that using HTML to create Web documents like home pages is actually quite easy; even before we had all the user-friendly authoring programs that exist today.

Given these three facts: the cross-platform capability of the TCP/IP protocols, the ease with which one can use the Internet due to the advent of sophisticated browsers, and ease of HTML document creation, it didn't take businesses long to put two and two together and begin using this Internet technology within their companies. For example, one of the earliest users of intranets is Sun Microsystems whose intranet grew out of "early work with premarketing versions of Mosaic browsers in 1993" (Taninecz, 1996, p. 47). Now that intranet has evolved into one that gives Sun's 15,000 employees access to 2,000 servers.

So, in summary, we can say an intranet is simply an internal Internet. Typically it consists of one or more servers that "serve" all the company's clients via browser software. It is common for a company's intranet to be connected to the Internet to give its employees at least limited access to that vast resource. In that case something called a "firewall," consisting of security hardware and/or software is used to prevent unauthorized access to the company's intranet and may also be used to limit employee access to the Internet. Now let us look at some of the advantages and uses of an intranet which help explain why it has become so popular with businesses.

3. The Advantages of an Intranet

The advantages of an intranet are many. They can be summarized according to the following list:

- An intranet is relatively easy to deploy
- An intranet is less costly than other networks
- An intranet is easy to use
- An intranet involves everyone in the organization
- An intranet can be “easily” secured
- An intranet does not require the present system to be replaced
- An intranet can be changed easily

An intranet is relatively easy to deploy. Since most corporations already have a network of computers connected via local or wide area networks (LANs/WANs), it is simply a matter laying out just what you want your intranet to do, developing an action plan, and then carrying out the necessary management steps to implement your action plan (Simons, 1996). Of course, depending on the size of your intranet, this deployment could be more or less involved. As discussed in some detail under the section “Making the Intranet” below, there can be considerable work involved in creating an intranet (Guengerich et al., 1997). However, it is easy to “begin small” and then expand the intranet as necessary. The Heyman (1996) article provides an excellent discussion of how a small business can implement an intranet with relatively little initial commitment.

An intranet is less costly than other networks. Compared with trying to get the same features from a conventional client/server system or a proprietary groupware system like Lotus Notes, an intranet is cheaper but it will require some careful budgeting. Especially important is taking into account the continuing costs that are required to control, maintain, and keep your intranet “fresh.”³⁾ However, as

3) According to 1993/1994 studies cited in Guengerich et al. (1997), ongoing operational ↗

Guengerich et al. point out, many companies are now looking for ways to upgrade their old systems and an intranet may well be the least expensive way to do this. Guengerich et al. do provide a set of cost figures for a 5,000 user intranet just to give us a feel for what it might cost: \$67,500. However, this is probably more than the “average” and an International Data Corp. survey cited by Schultz (1996) estimates the average cost per intranet site at \$25,375.

Another “cost” thing to keep in mind is the savings an intranet can generate. A couple of typical examples: the Canadian National Defence Headquarters estimates it began saving \$40,000 a month by putting payroll statements up on its intranet instead of mailing them out twice a month (“Canadian Defense to Cut,” 1996). And Texas Instruments was able to cut its work-in-process inventory by \$130 million by using its intranet to “trim chip-design cycles to a few weeks” (Lange, 1996).

An intranet is easy to use. Just as the Web browser, notably Netscape Navigator, caused an explosion in the use of the Internet, so this same browser technology is one of the main reasons for a similar explosion in intranets. Netscape’s browser and that of its arch rival, Microsoft’s Internet Explorer, both make it extremely easy to access and put content on the Internet and an intranet. Anyone familiar with these browser programs knows that in only a few minutes one can learn how to “click on a button”⁴⁾ that takes you to another document of interest. The new document might have other buttons to allow you to explore further, and so forth. This makes the intranet ideal for presenting information since the information can be easily organized in a way that facilitates user access. In fact, with a well organized intranet document, users can quickly home in on what’s really important to them, saving the time and frustration associated with the usual wading through reams of

↘ IT (information technology) expenses typically account for 85 percent of the total IT budget.

4) See the discussion about “buttons” and HTML/HTTP documents under the section “What is an Intranet.”

hard copy (Holtz, 1966).

With just a little more “training” users can learn how to actually create content for the intranet. There are many “tools” available now that make creating intranet documents (like “home pages”) easy; e.g., Microsoft’s FrontPage (Black & Pforsich, 1996). However, now even word processing software includes many of these capabilities. For example my WordPerfect 3.5 program includes a Web page authoring feature. And, Netscape Navigator Gold, which I used to make my home page, is almost as easy as word processing a document. With only a couple of short (approximately 30 minute) sessions with a knowledgeable colleague, I was able to create a reasonably good home page. It seems each month these authoring tools are getting easier and easier to use.

An intranet involves everyone in the organization. Since it is so easy to make intranet (Web) documents, everyone in the organization can be a part of the intranet. And even during the development of the intranet the users should be consulted to be sure their needs are met and to give them a feeling of ownership (Guengerich et al., 1997). Once it’s up and running, users should be encouraged to use the intranet for inter/intra-departmental collaboration since it surely lends itself to this being able to work with any networked computer in the organization. In fact, Holtz (1996) has this to say to managers: “The more you let employees provide information to one another, the more you will be able to concentrate on those important messages that... ..address organizational strategy.” One other side of this coin is pointed out by Schultz (1996) who says companies must be careful that employees don’t spend too much time just creating content and not doing their job. In fact, they may even ask for a job title change if the use of the intranet is not carefully spelled out and controlled. Of course, this is one of the important considerations during the making of your intranet as discussed by Guengerich et al. (1997) (see “Making the Intranet” below).

And another side of this coin is a caution voiced in a *Business Week* editorial

(“Good fences,” 1996) that tells us to beware of two dangers: units within the corporation not sharing what they know because the organization remains in a “competing” versus a “collaborative” mode, and management using the intranet as a command and control system only. Surely such behavior will nullify one of the biggest advantages of having an intranet: “to allow anyone in the company to tap into the entire organization’s intellectual capital” (Holtz, 1996).

An intranet can be “easily” secured. I’ve placed quotation marks around easily because you do have to do some careful planning to ensure a secure intranet but the technology is available. Fitzpatrick (1996) lists these questions:

- Who should be given access to what?
- Who is authorized to enter what kind of data (e.g., financial reports)?
- How should unauthorized persons be prevented from gaining access, such as hackers who may attempt to do damage?

An intranet can be easily linked to the Internet and in most cases should be to take advantage of that valuable resource. When that is the case, preventing unauthorized access to company data becomes doubly important. To place the necessary barrier between your intranet and the Internet you need appropriate hardware and/or software called a “firewall.” Also, you may want to use various authentication and encryption systems. But the point is, all this technology is available; it is just a matter of determining your requirements and then applying it. It is often good to seek the advice of experts in this area to be sure you’ve “covered all your bets” since intranet security can be vital to your business.

An intranet does not require the present system to be replaced. As Guengerich et al. (1997) say, “it is a parallel infrastructure that sits ‘on top’ of any existing network.” With the addition of the Web server and browser software your existing system suddenly becomes an intranet. As for your existing applications and databases, these too can be integrated into you intranet at a time most convenient for your company. Of course this is one of the main reasons the intranet is so rela-

tively inexpensive. The Guengerich et al. (1997) book provides information about how to connect to your database and migrate existing applications.

An intranet can be changed easily. One of the beauties of the intranet is that most of the controlling software resides on the Web server. Therefore, you only need to make changes at the server versus at each user site (Taninecz, 1996). However, as Guengerich et al. caution, this doesn't mean you shouldn't continue to follow good change control procedures. And be sure to keep a record of all changes so you know just what's been deployed where and what effect (good and bad) its had.

4. The Uses of an Intranet

The uses of an intranet are also many. However, they generally fall into these categories: communications, delivering information, getting information, sharing information, and "other."

Communications. As with the Internet, an intranet can provide communications, usually in the form of e-mail. In fact, the two major browsers, Netscape Navigator and Microsoft Internet Explorer both have a good e-mail capability.

Delivering information. One of the often cited examples is putting human resource (HR) information up on the intranet. For example, things like job listings, benefits information, and phone directories (Cortese, 1996). As Black & Pforsich (1996) note, such an HR system "promotes consistent treatment of employees, provides up-to-date information, and supports adherence to legal requirements." Some other examples: organization charts, policies, procedures, lists of training courses available, etc. Previously, this information had to be delivered to the user via hard copy and at considerable expense. And there was always the question of whether you had the latest version. Now it can simply be made available via the server and the user can conveniently call it up when needed right at his or her desk. Also, when any of these documents are updated, it is a simple matter to replace the elec-

tronic version of the old document on the server with the new one.

As a separate special aspect of “delivering information,” intranets are proving excellent vehicles for delivering training. In fact, Stevens (1996) gives ten reasons for using the intranet for training; for example, *consistency* in that all employees will be seeing the same material, *pull v. push approach* so employees don’t have to try and manhandle the entire training manual at once, and the *interactivity* afforded by the intranet that lets you integrate two-way communications into your training.

Getting information. Closely related to delivering information is how the intranet can be used to make information of potential use readily available to employees. Here are just a few examples:

- Marketing information. For example Murphy (1996) suggests using the intranet to build up a central repository of market information that can be tapped into to correlate with any current survey information thus reducing the need for so many surveys.
- Repair information. Filipczak (1996) cites the case of Raymond Corp., a forklift manufacturer. Because of the rapidly advancing technology in forklifts, Raymond’s field technicians were having trouble keeping up with the changes. Part of the problem was a set of repair manuals that weighed 1,200 pounds! To solve the tough problem of keeping such a set updated and make it a lot easier on the technicians’ backs, Raymond put the repair information on its intranet and gave its technicians laptop computers and a way to remotely access the company’s intranet. Interestingly enough, since the technicians can also communicate back to the company, this solution had the serendipitous result of making it easy for the technicians to share their knowledge; especially when they discovered a good way to fix something.
- Customer service information. If a receptionist, for example, can be given access via an intranet to this type of information, he or she may be able to help

a customer then and there instead of the annoying transfer to someone else (Filipczak, 1996).

- **Databases.** With the proper type of interface, intranets can be used to give employees access to any database. This is discussed in Guengerich et al. (1997). In fact, with its user friendly interface, the intranet may prove to be the ideal “front end” for database access. Cortese (1996) mentions a good example from Silicon Graphics Inc. called Silicon Junction where employees can access “more than two dozen corporate databases... ..by [simply] clicking on bright-blue hyperlinks.”
- **Information for clients.** It is possible to make portions of your intranet accessible to your clients so they can, at will, get information. In a tax advisor context, Black & Pforsich (1996) mention some possibilities: “(1) a glossary of tax terms; (2) frequently asked questions (FAQs) and their responses; (3) certain accounting tools (e.g., spread sheet templates for bank reconciliation, macros); (4) special-interest articles and speeches; (5) an internal professional and staff e-mail directory hot-linked to their mail boxes, so that a client can e-mail them; and (6) a section of useful shareware that clients could download directly from the intranet or hyperlink from another Net site.” Of course, as is now often done over the Internet, you can make product and service information available. For example, maybe your customers/clients would like to have access to product specification details.

These are only a few of the possibilities and you can tell by their varied nature that only one’s imagination need limit how one might make information available via an intranet.

Sharing information. One of the best uses of the intranet is to share information. Some examples:

- **For product development.** The intranet can be used to give everyone involved in bringing a product to market easy access to the project. By posting

the design to a designated site (like a home page), anyone involved can see it and, with appropriate controls, certain people can participate in the design ("Bringing Intranets to Life," 1996).

- For video conferencing. With a camera and microphone by each computer, the current browsers (and special small programs called "plug-ins") allow video conferencing to take place at the office, home, or, with a laptop computer, anywhere (Black & Pforsich, 1996).
- For general sharing of information of common interest. With an intranet, it is possible to set up internal discussion group that employees can use to post or retrieve the latest information of interest.
- In general in lieu of groupware such as Lotus Notes. It seems there is a lot of discussion about which is better, Lotus Notes, the most famous groupware software, or simply Web based technology such as available with an intranet. However, the sense I get from the literature is that unless your groupware requirements are especially sophisticated, it is probably not necessary to invest in Notes (Heyman, 1996; Guengerich et al., 1997).

Other. The uses are really endless and, as just mentioned, limited only by one's imagination. For example, another use cited by Black & Pforsich (1996) is electronic preparation of a purchase order that is sent immediately to the vendor who electronically converts it into a shipping advice and invoice. Or, how about using the intranet for convenient electronic form completion both by employees and customers as is common on the Internet today.

5. Making an Intranet

For this part I will draw mainly on Guengerich, et. al. (1997). Although not as well organized as it could be, this is still an excellent reference and seems to be both comprehensive and up-to-date. Of course, by the time you read this, many of the book's references to intranet software products will be out-of-date due to the speed

with which this software is being promulgated. Be that as it may, the book's core design and implementation principles remain valid and it is these we will overview.

According to Guengerich, et. al. there are 12 steps to building an intranet:

- Step 1: Should we implement?
- Step 2: Do we need help?
- Step 3: Enlist user support.
- Step 4: Address organizational issues.
- Step 5: Determine technical architecture.
- Step 6: Decide on applications and prototype.
- Step 7: Complete registration and IP addressing.
- Step 8: Finalize the plan.
- Step 9: Implement the architecture.
- Step 10: Develop the applications.
- Step 11: Implement intranet policies and procedures.
- Step 12: Managing the intranet.

Let's take a brief look at and discuss the most salient points of each step.

Step 1: Should we implement? Here the authors rightly stress starting with a careful analysis of your business values followed by an information needs assessment. Although a bit self-serving⁵⁾, they offer their I-TIPS (Intranet-Tech-nology Infrastructure Planning Service), a three to five day planning session, as a way to ensure good planning for your intranet.

Step 2: Do we need help? To determine if you need help, first do a skills assessment of your current staff. From this you can then decide what training is needed, who you need to hire, and if you need to use outside resources. If outside resources are to be used, you should consider the merits of partnering versus outsourcing. As with many of the planning activities, the book provides specific

5) The authors work for BSG Corporation, an information technology (IT) services company.

guidance to help you select good outside help; e.g., "Is the [outside] firm large enough to comfortably manage a project of your size?"

Step 3: Enlist user support? User support should be sought both at the higher management levels and at the grassroots level. At the higher levels you need a "champion" who understands and can communicate to other influential executives the value of the intranet. This means you must communicate regularly with your champion both to understand possible objections to the intranet and to keep him or her informed of the real "bottom-line" advantages of the intranet. At the grassroots level, you need to cultivate the support of "advocates," that is, key grassroots leaders who will help sell the intranet to the general user community. These advocates should be persons interested in technology, respected by their peers, and endowed with a "can-do" attitude. It might prove helpful to form these advocates into a formal or semiformal user input group to get their opinions as the intranet is being developed and implemented.

A final way to enlist user support is to use whatever communications means are available and suitable for the organization's culture. For example: posting information on electronic bulletin boards, creative brochures and posters, and e-mail. The goal of such communications is to keep the general user community informed of the progress towards an operational intranet and, especially, the benefits it can expect. Keep the communications concise and simple and the expectations realistic. Also, always include provisions for getting feedback from the prospective (and later actual) user. Because the creation and continual development of an intranet involves the user so much more than, say, a traditional client/server system, this feedback is more important than ever. Lastly, at some point, you should schedule a demonstration of a simple intranet that will let your users actually experience the benefits of intranet technology. Such a demonstration can be obtained from the Web and will let you see users' reactions to an intranet.

Step 4: Address organizational issues. This step recognizes the impact an

intranet is likely to have on your organization. For example, how will the corporate structure change? Will a special intranet development team be needed and how will it fit in with the existing information systems (IS) department? How will your existing IS infrastructure change? Are we willing to commit the resources required? Will your intranet be part of an Internet marketing program?

By its very nature, the intranet is bound to induce significant cultural changes with its open, collaborative potential. For example, your company may find itself moving faster and faster in terms of product development due the leverage offered by an intranet/Internet capability. Another key cultural issue is openness versus security. Because the intranet makes inter/intra-departmental communications and, if Internet connected, external communications very easy, careful attention must be given to just how much control is needed. The trick is to exert only the control necessary to secure sensitive corporate information so the creative use of the intranet is not hampered. If users are given access to the Internet, Guengerich, et. al. (1997) suggest you consider the following issues that are likely to arise: productivity loss due to too much time "surfing the net," corporate liability should an employee post potentially libelous comments on a newsgroup, and employee access to sexually offensive material. Such things should be addressed in a use policy to be discussed next.

Another important organizational issue is having a clearly stated intranet use policy. Such a policy should be formulated by the senior IS executive and approved by senior management and the legal department. The policy should define acceptable (and non-acceptable) business-related and non-business-related usage. Concurrent with establishment of this policy you should decide on how and to what extent you will restrict access to the Internet. The best way is to employ server security software that sits behind the firewall and can't be user modified. A sample intranet use policy is at Appendix B.

Two other issues are organizing the implementation project and integrating the

intranet with the IS organizational structure. Regarding the first, it is important to understand these key points:

- Typically the project will start small with rapid growth dictating a need for a modular, flexible architecture.
- As opposed to the traditional client/server systems, there will be much more user participation from requirements determination, through prototyping, and continuing as users develop their own intranet presentations (home pages).
- There is no substitute for a good, detailed implementation workplan. Without such a workplan, the implementation is most likely to come in late and over budget⁶⁾. Appendix B of the Guengerich, et. al. (1997) book provides an example of a complete workplan.

As far as integration, you should decide on the support functions that will be needed for your new intranet and ensure these are incorporated into your existing IS structure. Guengerich, et. al. list five functions:

- Intranet/Internet services. To promote new technology and applications, to set and disseminate use policy, and to help users implement specific IS (Information Systems) projects. The group that provides these services should include representation from throughout the company.
- Web library services. To help users with specific information needs and administer tools for information management such as directories and search engines.
- Web publishing services. To assist authors in the design of Web pages.
- Corporate communications services. To monitor the content of both external and internal Web pages to ensure it is not damaging to the corporate image, of questionable legality, or offensive in any way.
- Web technical services. To provide the technical infrastructure—hardware,

6) It may come in late and over-budget anyway but a detailed workplan will surely minimize these problems.

software, and network connectivity—to support the intranet.

The final “organizational issue” discussed by the authors is legal. Here you have to worry about protecting both your information and that of your partners and customers such as medical or credit information. Some areas to consider:

- E-mail. Don’t send anything “you wouldn’t feel comfortable seeing blown up on a three-foot by five-foot court-room exhibit.”
- Intellectual property. You may want to register your property internationally and, even, block access from regions that don’t offer protection.
- Domain names⁷⁾. Be sure to reserve several names so you still have one if some are challenged.
- Copyright. It is now more important than ever to register for copyright protection with the wider distribution documents get over the Internet.

These are only a few of the potential legal issues that a company might face. Of course, as with any legal matter, the best advice is to consult a lawyer; in this case one knowledgeable in “cyberlaw.”

Step 5: Determine technical architecture. The technical details of determining the intranet architecture are beyond the scope of this article. However, in general terms, the architecture will consist of these ten elements:

- The presentation layer. Here you consider what the “look and feel” of the intranet will be since this is the user interface. See some guidelines at the end of this section.
 - The client browser. The two most popular ones are Netscape Navigator and Microsoft’s Internet Explorer.
 - The network communications services. These are for communicating among
- 7) A domain name is the non-numeric address for your Web site. For example, Shudo University’s domain name is “shudo-u.ac.jp.” When someone types this domain name—for example to send me e-mail at austen@shudo-u.ac.jp—it is automatically converted into Shudo’s numeric IP (Internet Protocol) address for processing by the IP protocol (see Appendix A).

computers and use the TCP/IP protocols (see Appendix A). Each machine has a unique address making address management very important.

- The Web server⁸⁾. This is the “heart” of any intranet and supports the exchange of information with a client. Also this server typically holds all the intranet software for supporting security, data processing, and database connectivity. Some of the most popular Web servers (software) are: Apache Server, Netscape Enterprise Server, Microsoft Internet Information Server (IIS), and WebSite from O’Reilly & Associates. If you are a small company you may wish to contract out your Web server to an Internet service provider (ISP) until your intranet becomes big enough to warrant your own in-house server (Heyman, 1996).
- The server application interface layer. This element passes information between the business applications and the operating system of the Web server and isolates the applications from other parts of the system so they can be changed or upgraded easily.
- Application layer. Here the various applications that process the business data reside. By making these applications modular, it becomes easy to stay up with the need for ever more sophistication in business data processing.
- Service interface layer. The purpose of this layer is to “abstract” or hide the “underlying data repository, transaction system, or other service from the actual application” making it easy to change or update these “underlying” services without much effect on the application.
- Service layer. The underlying services. Examples include the database management system (DBMS), document manager, and e-mail.
- Operating system services. These services provide the file, print, and program execution services. Some examples are Microsoft NT, UNIX, and

8) A server consists of a computer such as a PC, a workstation, or a mainframe, and the software that let’s it work with client computers.

Novell Netware.

- **Hardware.** Hardware includes all the various client and server components. The most important piece of hardware, already mentioned, is the Web server and it deserves your most attention.

Given that these are the elements of an intranet architecture, the next thing is to determine the type of architecture. This could range from a simple content distribution type to full collaborative computing. Other architecture issues Guengerich, et. al. (1997) discuss which, again, are technically beyond this paper are: server software components for performing various functions such as e-mail, different server configurations such as stand-alone or multiserver systems, and mainframe integration.

Step 6: Decide on the applications and prototype. Guengerich, et. al. really don't say much about the application part of this step. I guess it is assumed any competent IS department already knows how to decide on the applications. However, a set of criteria provided by Black & Pforsich (1996) is worth mentioning here in terms of what sort of company documents would best qualify for an intranet application:

- Relatively short documents (reformat your longer documents using hyperlinks)
- Documents that are frequently updated
- Documents that are frequently used
- Documents used by multiple users
- Documents created/updated by multiple authors
- Paperless documents (for example documents such as purchase orders or contracts that can remain in electronic form until needed)

The prototype will be an application that you will demonstrate to the users to sort of show off the capabilities of the intranet and get user feedback. The prototype can range from very simple to complex but simple is better and will provide a higher chance of initial success and user acceptance of the intranet.

Step 7: Complete registration and IP addressing. The advice here is simple: register your domain names early and register several. The reason for this is names are disappearing rapidly and the one you want may soon be used by someone else. Also, if the first name you register is already taken, you have others to fall back on. This is also the time to establish an addressing convention for the entire organization so a set of unique internal addresses exists.

Step 8: Finalize the plan. Again, Guengerich, et. al. are a bit vague on this step but I interpret it to mean complete all the design details related to your intranet. Here the issues that need consideration are:

- **Performance.** Here we are talking about such things as the performance of the servers and client machines (provide plenty of memory and processing capability), limiting “complex data types” such as large image files, the use of caching (keeping often used data closer at hand), and how databases are accessed.
- **Cost.** Consider placing more of the processing on the server to reduce client costs and try to make do with as low a bandwidth as possible, especially for remote clients, to keep communications costs down.
- **Security.** Here they discuss several major threats such as unauthorized access, packet sniffing (extraction of packets from the Internet), abuse of access, denial of service (by repeated calls to your site), and threats to your communications infrastructure. Security solutions involve encryption, authentication, and physical security measures.
- **Manageability.** Now is the time to think about things that will make managing your intranet simpler; e.g., naming conventions, standards, procedures, documentation, style guides, use of site management tools, centralization of data and caching, and how you will handle the complicated matter of multimedia production.
- **Usability.** Now is also the time to think about things that will enhance the

usability of your intranet, things like consistency, “forgiveness,” a standard user interface, bookmarks, hot links, and cookies (provide management information such as which parts of the intranet are visited most often).

Finally, all these issues need to be considered in a total context for trade-off purposes. In general, however, they recommend choosing a fast server with lots of memory, a fast communications connection to the server, and the least expensive connection to remote clients. Also try to minimize the use of images and other complex data, and, lastly, don’t sacrifice security for costs!

Step 9: Implement the architecture. Some of the things to keep in mind while implementing the architecture are:

- Your communications infrastructure. Here you will be dealing with an Internet service provider (ISP) and/or a telecommunications vendor such as one of the telephone companies in your area. Besides your main connection to the Internet, you may have remote clients to worry about. It is best to give your order to the vendor early since “the installation of the local link(s) for any broadband lines you need... ..is a notoriously slow process.” The book provides considerable guidance on how to select a good ISP.
- Acquiring and installing the hardware/software. Begin with the server(s) and client machines and then install the Web server software and any additional services planned. Then install your “backend” applications; typically a database. Be sure to register all your components to make it easier to get technical support. Complete this initial installation by connecting the local segments and, as soon as the lines are available, the ISP and remote clients. Once these connections are made and your firewall is established, you are ready for the next step: testing.
- Testing. As with any large system, there are typically three phases to the testing: testing individual units or functions, testing a combination of units/functions that make up a single system, and testing the entire system once all

the applications are installed in the production system. Usually you should run the new system in parallel with the old one until you are sure it is OK to cut over functions. This is also good time to review your existing IS structure and be sure everything is compatible.

- Developing your help system concepts. Some suggestions are to develop a hypertext index to help documents, have a “well-crafted” help desk that includes access to a Web-enabled help desk database, and providing the users a good search capability to help them find the information they need.
- Application migration. Here you need to consider just how you will migrate new applications and/or port existing applications to your intranet. Plan to use a simple version-control system, for example, UNIX’s Revision Control System (RCS).
- Data conversions. You will have to replicate and convert your production database to make it accessible to the intranet. The conversion can be real-time or beforehand with the latter preferred. There are several conversion tool vendors.
- Performance issues. Be aware of likely “bottlenecks” such as network bandwidth on a remote segment, router⁹⁾ throughput, processing speed, memory capacity, and system input/output (I/O) capacity. You should plan on having at least 50 percent reserve capacity and employ good system tools for stress- and volume-testing purposes. Finally, be sure you have a viable contingency plan that includes backup tapes for data and backup hardware for critical components. Clear and easily activated backup implementation procedures should exist and be tested periodically. If possible multiple servers should be set up to take over each others’ clients if necessary.

Step 10: Develop the applications. Now that your intranet is up and running

9) A router is a combination of hardware and software that work together to move digital traffic from one network to another.

its time to complete development of the applications. Guengerich, et. al. (1997) discuss all the classic steps in developing an application such as defining the application's purpose and scope, writing the functional specification, resource planning, establishing a timeline, developing standards, following an iterative process, testing, and final user acceptance testing. To help you prioritize all your applications, the authors present an example prioritization matrix that lets you rank them according to various weighted factors such as urgency, stage in life cycle, and user cooperation.

Step 11: Implement intranet policies and procedures. To effectively manage the intranet, a good set of policies and procedures is a must. Some areas recommended for coverage:

- **Documentation.** Document everything! This includes all system configurations, all hardware and software service contracts, your hardware/software inventory, and all other policies and procedures.
- **Hardware and configuration maintenance.** Ensure complete maintenance information is maintained including maintenance logs, spare parts inventory, and the location of all set-up and configuration disks and CDs.
- **Mission-critical systems.** Here you need to be sure a list of all mission-critical systems and related files are maintained as well as a priority list of applications that need to be reloaded in the event of a disaster. Minimum vendor response times also need to be a part of your policies.
- **Operating system implementation and maintenance.** Procedures here should include how support personnel locate original and/or backup operating system installation software, when upgrades are required, and what the preset user storage levels on the server will be.
- **Security.** Here policies and procedures regarding simple security matters are needed; for example, having restricted areas and locking equipment consoles. Some other security matters are: how passwords will be used, virus protec-

tion, and tracking user access.

- Fire protection. A full set of fire protection policies and procedures should be developed and enforced. For example, use of smoke detectors and minimizing the use of flammable materials.
- Communications. Your policies/procedures should completely document your physical communications plant and cover such things as how throughput will be monitored and how the system will be made fault tolerant.
- Backup/restore procedures and off-site storage. Here the all important backup and restoration procedures must be established and tested on a regular basis. The detail in these procedures should include the names of those responsible for backup/restore activities and it should be kept up-to-date. The use of off-site backup facilities should be considered.
- Help desk, problem resolution. All help desk procedures should be clearly documented to include exactly how user questions will be handled, how calls will be tracked, service-level agreements with the users, etc. Having standardized help procedures greatly eases stress, especially when the help desk is encountering overload.
- Administration. Here we are talking about both day-to-day activities such as processing new users or directory services, and a strategic plan for directing future expansion of the intranet.
- Workgroup productivity. To enhance user productivity, policies and procedures should cover such things as enforcement of a standard user interface and training/retraining.

Step 12: Managing the intranet. Guengerich, et. al. (1997) stress the need for a comprehensive management framework that addresses not just the new intranet but your entire information system and where it fits into your plans for successful business operations (your strategy). A couple of reasons cited for going to the trouble of developing such a framework are: (1) risk of network failure including

failure due to overload if your intranet suddenly becomes *too* successful and (2) the high cost of downtime once the intranet becomes central to key collaborative and decision-making functions. Such a framework must encompass the following: planning, procurement, installation, technical support, operations, training, and administration.

In particular, some of the new things an intranet adds to the *operations* function are:

- Content management. Now the data management task is increased since there is likely to be a lot more content and content that is constantly being created. It may be a good idea to index the context and, with large systems, it makes sense to automate the indexing process. Also, content must be kept up-to-date and “fresh looking” (not boring!). With the addition of complex data types such as images, this content management task is even more demanding but, with the use of such things as object-oriented databases, the task is certainly doable.
- Link management. Again, the task of keeping many links, both internal and to partners, suppliers, etc., current and accurate could become formidable. However, according to the authors, tools are being developed to help.
- Use measurement. Besides simply measuring basic server use, you should measure which applications get the highest use and which ones “serve particular user profiles.” This sort of use information will help you determine what changes need to be made to your applications and/or intranet.
- Performance management. The early identification of performance problems will help you solve those problems before they become critical. Develop and use performance metrics.

When considering *training* requirements, categorize the users in these terms: new mouse users, intermediate users, and super users. Establish a core set of elements everyone needs to know and then add or subtract from this depending on the level of

the user. Be sure to always get feedback from your users to help you continually enhance the training material.

As part of *administration*, change control requires the same steps as for any system but one of the nice things about the intranet is the ease with which changes can be made. This is because it is usually only necessary to make the change at the server since this is where the client looks for almost all information. Be sure to keep good records of your changes so you can know exactly what technology has been deployed and to see if a change as either cleared up problems or created new ones.

Although already mentioned, because it is so key to good management, we must again mention the help desk. The collaborative features of the intranet will allow your help desk personnel to share their collective knowledge. It is recommended they be given access to the Internet even if no one else is so they can link to vendors and relevant discussion groups. Help desk personnel will have to be familiar with all the software and communications protocols that comprise your intranet. Your help desk will also likely be asked a lot about the Internet and intranet applications; at least until the users become familiar with these things.

As the authors say "Eventually, if not immediately, you will probably want to consider automating your intranet management activities." Such automating will allow you to spend more time doing the higher value-added non-routine management activities, reduce support expenses, and avoid potential disaster for a fast-growing system. Three approaches for automating the management are described: Tivoli Systems' net.Commander, Hewlett-Packard's Fully Distributed Network Node Manager, and Computer Associates' Unicenter/Internet Commerce Enabled.

This brings us to the end of the 12 steps, but one area that Guengerich, et. al. (1997) devoted considerable attention to and here deserves mention is the user interface. Some of the user interface design principles they discuss are:

- Consistency. By keeping things like header graphics, text styles and formats, and background colors/patterns consistent you will go a long ways to-

wards making the interface easy to use and instilling a “positive user perception of the system.”

- **Simplicity and intuitiveness.** For example, buttons should be obviously “clickable” objects, actions should be intuitive and predictable, and the user should *always be in control*.
- **Audience awareness.** Determine exactly who the users are and what their computer experience is and what uses they will likely be making of the intranet. In making these determinations, talk with the users and let them tell you what they think. Let this knowledge of the user guide your design.
- **Aesthetic integrity.** Here we’re talking about the “intelligent application of color, texture, shape, and space.” Although this principle is difficult to define precisely, almost everyone has probably experienced a page on the Web that *didn’t* have aesthetic integrity.
- **General look and feel.** Some of the specific page elements that can markedly contribute to a good (or bad) look and feel are: the background, color scheme, interface metaphor (for example a “desktop” metaphor if the users are used to Macintoshes or Microsoft Windows), and how your site is structured. Regarding the latter, you need to take some time to find a optimum breakdown of menus and submenus that keep the structure balanced and easy for the user to understand. Also consider the use of a “site map” that will give them quick access to any page.
- **Graphic tips.** Although graphics can greatly help your user interface, they should be used with restraint lest they “slow your site to a crawl and try your users’ patience.” Therefore, your graphics should be as small as possible, use as few colors as possible, and save at a resolution of 72 dots per inch (dpi) (to reduce the file size). As a rule of thumb, a page should not take longer than 30 second to load (and, hopefully, much less time). Finally, be sure any essential text in a graphic is backed up by an “alt-tag” which will cause the

text to be displayed even if the user can't receive graphics for some reason or has turned the graphics feature off.

The authors stress that guidelines and standards should be set before any coding begins. Also consider the use of templates to help standardize page development. Also you may wish to have "gatekeepers" who thoroughly understand user interface design principles and your local standards to review all new pages before they're put on the intranet.

Typical Mistakes Made When Implementing an Intranet

Now let's look at some typical mistakes made when making an intranet and some appropriate remedies. Guengerich, et. al. (1997) list 30 of these "gotchas" (as they call them) and group them into these four categories:

- Lack of planning
- Failure to seek expert assistance
- Lack of a management framework
- Application development gotchas

Let's look at some representative examples in each category.

Lack of planning—

Lack of long-term planning. There was simply no plan to expand or manage the intranet once it was developed by the company's skunk works and became wildly popular. Lessons:

- Plan for a logical expansion
- Plan to link to the Internet
- Be sure you have enough resources
- Seek outside help when needed
- Implement a management framework

Underestimating use. Another a case of being "too successful;" the system got overwhelmed and the user became disenchanted. Once this happens it then be-

comes *really* difficult to sell the system. Lessons:

- Plan ahead for plenty of growth (have at least a critical capacity reserve of 50 percent)
- Do your stress testing

"Me-too" mania. In this case a lot of "bells and whistles" were quickly put together but they "failed to address any real business needs." Lesson:

- Review Step 1 (Should we implement?) and be sure your applications relate to your defined business goals

Skipping the prototype. This project began without any prototyping of applications. Midway through the development the project team realized system performance would be unsatisfactory and had to begin all over again. Lessons:

- Thoroughly research the tools you will use to build the intranet to include "test-drives"
- Prototype the applications and build in time for changes
- In general, do a lot of "up-front" work to ensure success later

Failure to seek expert assistance— This is especially important when you need to understand the underlying intranet technologies and implementation issues you'll likely face.

Lack of expertise. Here the company entrusted development to a group that had successfully put up a Web site. Unfortunately, those people didn't understand things like internal integration and staff resistance; i.e., planning! Lesson:

- Be sure to do Step 2; i.e., do we need to expand/train our in-house staff and/or use outside help?

Design blunders. This company's intranet developers were not familiar with good design principles resulting in pages that were unattractive and difficult to read. Users were quickly discouraged from coming back. Lessons:

- Employ someone with design expertise
- Follow good design principles such as those at the end of the preceding sec-

tion (Making an Intranet)

Breaking the law. In this case some popular cartoon characters, licensed as part of the company's marketing effort, were put up on the intranet in violation of the licensing agreement. Lesson:

- Review what you know about potential legal pitfalls (for example, some of the things discussed in the preceding section (Making an Intranet))
- Always seek legal advice regarding things being put up on your intranet, especially if it is connected to the Internet

Lack of a management framework— Here we're talking about such things as assigning responsibility for managing content and controlling use. Again, these are things that should have been addressed in the initial planning phase.

Testing (or the lack thereof). This company tried to bring the intranet to use too quickly without sufficient testing and the result was "broken links, bottlenecks, and application errors" that ultimately resulted in the IS department and the intranet losing credibility. Lessons:

- Follow the testing guidelines of the preceding section (Making an Intranet)
- Be sure to include unit and system testing in your development plans
- Remember testing is an ongoing process
- Continually seek user feedback (the best source for information on the intranet's utility and functionality)

Failing to keep current. This company failed to date its policies and procedures that were put on the intranet and users had no way to know which were the latest.

Lessons:

- Have a clear set of intranet content control procedures including designated responsibilities for each department
- Date documents!
- Provide access to previous versions so people can see what's changed and/or what was in effect at a particular time

- For any parts of the intranet that change regularly, have a schedule and stated responsibilities for this
- See the guidance in the preceding section (Making an Intranet) regarding establishing a use policy and managing the intranet and its content

Technology cul-de-sacs. In this case the vendor went out of business as the company was just starting to use its “wonderful” software. Lessons:

- Be sure the vendor is likely to be around for a while
- Look for flexibility in design and some portability¹⁰⁾
- Design your system to easily incorporate future changes; for example by employing a modular or object oriented approach

Application development gotchas— Remember you not only have to build your intranet but also build or migrate the applications that will run on it!

Distributed development. Here a company let all its departments and regions independently develop their intranets assuming the TCP/IP protocol would take care of compatibility problems; it didn't! Lesson:

- Establish standards and guidelines (including those for tool selection) along with a design that ensures portability and platform compatibility

Reinventing the wheel. Although this company's IS staff did a good job of developing its groupware, it wasn't supportable except through *that* IS department (and probably cost a lot more than off-the-shelf applications). Lesson:

- Don't “do-it-yourself” when there is good software available (and there is plenty of inexpensive software available for intranets!)

The bleeding edge. Here a love of Virtual Reality Markup Language (VRML)¹¹⁾ seduced this company into creating overly-complex virtual reality applications that

10) Portability means the software can operate on any platform as opposed to being restricted to a particular vendor's platform.

11) VRML is a language for rendering real-time, interactive three-dimensional worlds on the computer.

cost too much to develop and maintain (could be maintained only by the team that developed them). Lesson:

- Confine your “bleeding-edge” development work to your skunk works; only when proven should technology be employed—especially as part of your mission-critical systems

Conclusion

As must be obvious by now, the potential of the intranet is unlimited. As Tom Peters emphasizes in his book *The Tom Peters Seminar* (1994), the competitive edge will go to those who know how to capitalize on information management. This means not only within the company but being able to quickly mobilize external sources of expertise into teams to carry out tailor-made projects. It is conceivable the Internet and intranets will be able to play key roles in this sort of activity and probably already are.

Another way intranets can help businesses is by providing them a way to much more easily collect and store information on their customers. And to give customers/clients access to their intranets when appropriate. Again this is a horn Tom Peters toots about getting “close” to your customers (1987). Perhaps one of the best known examples is FedEx’s famous Web page that lets customers check the status of their deliveries at any time. As an aside, it proved so effective that FedEx’s own employees began using it themselves for internal operations.

Suffice it to say, intranets are winners and, in the months and years to come, we can expect even more remarkable advances in Web technology to make them even more useful. It will be interesting to see how the fierce competition between Netscape Communications and Microsoft contributes to these advances. And, as the art and science of information technology (IT) advances with concepts such as the data warehouse (see Austenfeld, 1997), we will find businesses doing more in terms of understanding their customers and rapidly closing the gap between what

those customers want/need and what's available.

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APPENDIX A

THE MAIN PROTOCOLS OF THE TCP/IP (TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL) SUITE

(Feibel, 1996, p. 985)

- SMTP (Simple Mail Transfer Protocol) provides a simple electronic-mail (e-mail) service. SMTP uses the TCP protocol to send and receive messages.
- FTP (File Transfer Protocol) enables users to transfer files from one machine to another. FTP also uses the services of the TCP protocol at the transport layer to move the files.
- Telnet provides terminal-emulation capabilities and allows users to log into a remote network from their computers.
- SNMP (Simple Network Management Protocol) is used to control network-management services and to transfer management-related data.
- TCP (Transmission Control Protocol) provides connection- and stream-oriented, transport layer services. TCP uses the IP to deliver its packets.
- UDP (User Datagram Protocol) provides connectionless transport-layer service. UDP also uses the IP to deliver its packets.
- IP (Internet Protocol) provides routing and connectionless delivery services at the network layer. The IP uses packet switching and makes a best effort to deliver its packets.

APPENDIX B

A SAMPLE INTRANET USE POLICY

(Guengerich et al., 1997, p. 85)

With technology comes both opportunity and responsibility. Use of the Company intranet, including the software, hardware, and information that compose it, constitutes your agreement to adhere to the following:

1. The Intranet is solely for Company information dissemination and use.
2. Intranet components including browser software and modems are for Company business use only. They are not to be used for Internet/World Wide Web access, Online Service Providers (e.g., CompuServe, America Online), or access to noncompany entities.
3. If you require external access, contact the IS department for information and follow the External Access Policy.
4. If you do access external entities of any kind, you are responsible for performing virus scans as appropriate and taking other reasonable precautions to protect the Company from external agents and security breaches. Refer to the External Access Policy for more information.
5. Viewing, distributing, and/or downloading of material of any kind and in any medium that is in conflict with Company values is strictly prohibited. This includes anything that can be construed as libelous or offensive. Refer to other Company policies on Equal Opportunity, Nondiscrimination, Sexual Harassment, Conduct, and Gaming/Gambling for more information.
6. Failure to adhere to this policy constitutes grounds for termination.