INTRANET DEVELOPMENT IN LARGE ORGANIZATIONS:
A CASE STUDY USING EDI ANALYSIS TOOLS
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Abstract

Several years ago, the media discovered the Internet. This 'Internet explosion' exposed the non-initiated to a worldwide computer network. Forged by the fear of the nuclear fulfilment of the Cold War, this network had for over twenty years been the domain of academia, precocious computer firms, the government and the military. As the resulting technology continued to develop and thrive, the business community, attracted by the prospect of open systems and low costs, began to investigate the feasibility of applying Internet tools for internal information system and distribution needs. The concept of such 'intranets' has grown increasingly pervasive and persuasive, especially when their costs and development time are compared to equivalent proprietary systems.

This paper examines some of the technological, economic and organizational considerations involved with intranet development. This author undertook a feasibility study in several departments of a large company in an attempt to identify the factors. A methodology originally developed for electronic data interchange (EDI) was used to help analyze the results.

This analysis indicates the Company is ill-prepared to take advantage of intranet technology. However, the recent maturation of Java and the network computer paradigm (the former allowing applications to run on any platform without recompilation and the latter greatly reducing the administrative costs of bringing
computing power to the desktop) may provide the Company with a relatively inexpensive method of leveraging the benefits of an intranet.
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Note:

Referencing sources available online presents a unique challenge. There are few precedents upon which to call. Many times, there exists no paper equivalent of an electronic source, and there is no guarantee that the reference will be available later. Given the rapid growth and frequent change of Internet and intranet content, it is quite likely that many of these links will no longer exist in five years, let alone one.

However, given the nature of this paper, I felt it a requirement to use and rely on electronic sources of information. The fleeting nature of information on the web is more than overcome by the wide-spread availability it provides.

Notation to sources is a universal resource locator (URL) in angled-bracket notation, (e.g. <http://www.ubc.ca> ), which over the past two years has become the *de rigueur* method of reference on the world wide web. Given the continuing integration of web technology into standard desktop applications, many email programs and word processors will recognize these URL’s, activating a link to the page or site in question.

While a web page may move several times during its existence, increasing numbers of sites are providing pointers from the outdated link to the current location of the information. As the Internet and its derivatives grow and mature, better archiving technology will inevitably make content more durable. A case in point is the
Internet Engineering Task Force's proposal of a system of unique document identifiers for each revision of a document on the web. This will allow reference to URLs that are no longer active. These universal resource names (URN) are necessary because of the estimated 44 day life span of most URLs. (Kahle, 1997)
CHAPTER 1: INTRODUCTION

1.1 MOTIVATION

The term 'intranet' was rarely used before the summer of 1995, but in retrospect its recognition seems a natural outgrowth of the media frenzy that has surrounded the Internet since 1993. The key difference between the two is that Internet sites are for the consumption of anyone in the world with a browser, while a corporate intranet is more narrowly focused, designed to assist an organization's employees in their day-to-day work.

The foundation of intranets and the Internet are open systems. Anecdotal evidence suggests that this is responsible for a rich variety of software. Though not necessarily as integrated as proprietary solutions, those applications forged in the Internet foundry fulfilled much of the same functionality for a cost that was often over an order of magnitude lower. The browser paradigm is regarded by most as easy to learn and is not limited to a single hardware or software system – it is platform agnostic. Additionally, this interface can be shared among many web-based applications. In this environment, the time to market seems to have been shortened as well, even including electronic delivery of the software.

1. In the spring of 1995, Netscape Navigator sold for approximately $50, while a Lotus notes seat was above $500.
These factors led many organizations began to develop intranets, but from the ground up - individuals or single departments would quickly and cheaply develop intranet components rather than wait for the corporate IT department to deploy a solution. This often caused friction with the IT departments, but the sheer momentum of Internet technology and rapid, inexpensive functionality of intranets has been a powerful argument.

This thesis was the result of an extended internship at a large company. For several years, the Company has been contemplating the retirement of its mainframe system which runs many of its mission-critical applications as well as handling some corporate electronic information distribution. An opportunity arose to test Internet-based technology as a potential replacement for some of these services.

1.2 **Objective**

This thesis will examine the technological, economic and organizational factors concerning the development of intranet components in this company during the feasibility study in question (with the results being applicable to intranet development in general). The framework for analysis was initially developed for electronic data interchange (EDI) by Iacovou *et al*, but this methodology seems thorough enough to be used for other IT analyses, including that of intranet development.
Additionally, though not the focus of this paper, the fundamental characteristics of EDI seem to be included within the capabilities of an intranet. Corporate departments are increasingly being viewed as cost-recovery centres and/or profit centres. Given this, there appears to be a useful analogy between small businesses within an economy and independent departments within an organization that yields further credence to the applicability of such a framework. Both have to be concerned about imposition of and compliance to standards, limited financial resources, competition from external services, internal knowledge of information technology and amalgamating the technology with existing systems. These concerns are discussed in further detail later in this paper.

1.3 THESIS ORGANIZATION

This thesis is organized into 6 sections. Chapter 1 gives a briefing of the thesis and its goals. Chapter 2 reviews literature relevant to intranet development and IT adoption and provides the reader an overview of the technology and standards that make an intranet possible. Chapter 3 presents the research methodology and details of the Company in question. Chapter 4 discusses the initial findings, while Chapter 5 analyzes them in light of the modified Iacovou methodology and puts forth recommendations for future intranet development. Chapter 6 concludes the thesis and is followed by a bibliography and appendices.
CHAPTER 2: BACKGROUND

2.1 LITERATURE REVIEW

A challenging aspect of investigating a technology as rapidly developing as intranets is the limited amount of academic literature available. The term 'intranet' only became prevalent in the business community after the summer of 1995, (the beginning of the period of research for this paper), and little appeared over the next year. (The very fact that for academic works, there is not yet an established method for referencing on-line sources begins to shed light on the problem.\(^2\)) Relevant studies are almost certainly being conducted, but have not yet been published. Papers dealing with the Internet have been published, but these already seem to lack relevance due to advances in the field. (Anything dealing with the Internet or intranets seems to have an extremely short half-life. Such papers age about as well as cheap wine, and this author does not suffer from any delusions that his paper will be much different.)

However, much relevant information is available electronically, which seems appropriate given the subject matter. Trade journals seem able to respond more quickly than academic journals and have proven a good source of information.

---

2. As previously mentioned, URLs, or universal resource locations, are referred to using bracket notation, e.g. `<http://www.ubc.ca>`, which has evolved ad hoc as the de facto standard of non-browser URL reference.
(Ironically, as the summer and autumn of 1996 progressed, this became an embarrassment of riches, as the trickle of intranet coverage in such journals quickly became a deluge.)

As noted, intranet technology has spread widely, but not necessarily deeply. Attewell (1992) speaks of the diffusion of technological innovations in general and computer use in large organizations specifically. He notes the difference between signalling (the "communication about the existence and potential gains of a new innovation," p. 15) Notation to sources is a universal resource locator (URL) in angled-bracket notation, (e.g. <http://www.ubc.ca>) which over the past two years has become the de rigueur method of reference on the world wide web. Given the continuing integration of web technology into standard desktop applications, many email programs and word processors will recognize these URL's, activating a link to the page or site in question.) versus technical know-how (the ability to actually implement such innovations). In the past, large entities were the first to deploy many systems, while those at the 'periphery of communications networks' adopted later. This contrasts with today, where information about new systems is more widespread (especially with the near-instant access provided by electronic sources). Distribution is also hastened in this environment. However, know-how still plays a critical role, and will continue to do so as long as computing innovations are "scientifically demanding, fragile and lumpy." (p.15) Despite advances, it is safe to say that intranet technology remains somewhat 'lumpy.' This is discussed further
Additionally, rate of adoption seems an important factor. Tyre and Orlikowski (1994, p. 98) suggest "there exists a relatively brief window of opportunity to explore and modify new process technology following initial implementation." Once these processes are set, the users may have to deal with non-optimal solutions until the next technological shift.

Van de Ven (1986) comments on innovation in organizations. He notes that there are four basic problems to be aware of when dealing with new ideas in a business environment:

- a human problem of managing attention (businesses tend to focus on existing practices)
- a process problem of managing new ideas into good currency (innovation may be an individual activity but acceptance requires group approval)
- a structural problem of managing whole-part relationships (given the number of factors involved, individuals often lose sight of the entire problem - how does one put the whole into the parts?)
- a strategic problem of institutional leadership
  (Van de Ven, p.215)

2.2 TECHNOLOGICAL OVERVIEW

An overview of the technologies and concepts relevant to intranets is beneficial to understanding how intranets can be applied in practice.

2.2.1 CLIENT-SERVER TECHNOLOGIES

Tapscott and Caston (1993) discuss the client-server paradigm at great length. They
define client-server in terms of a network computing environment, which:

provides the means for user to access a wide array of information, applications, and computing resources without worrying about where they are or how they are interconnected. (p. 124)

They state that the primary function of the client is to handle the presentation of interface and take input from the user. “If a client is not capable of responding directly to a user request, the client passes the task to an appropriate server,” which then handles the users’ requests. When responding to the client request the server can:

- be closely coupled to the client workstation or some other part of the network;
- break its tasks into two or more subtasks;
- activate other applications on different system resources through remote procedure calls;
- dynamically shift processing to a platform that is best suited to perform the specific task.

(Tapscott, 1993, p.126)

“All these functions are transparent to the user.... As far as the user is concerned, the entire process might as well be occurring on the personal workstation.” (Ibid) A computer can simultaneously be a client to one computer and a server to another. In fact, there is nothing preventing a client from being its own server. Different software packages running on the same machine can act as servers and clients to each other.

A client-server system is often described as what it is not – namely, a set of ‘dumb’ terminals connected to a mainframe computer. This centralized design contrasts
greatly with the more distributed nature of client-server computing. In fact, Sheldon (1994, p. 268) defines distributed computing as being “client-server computing on a wide scale.” The further one moves towards distributed computing, certain advantages arise, including:

- local managers having control over their own data;
- when data is replicated, protection from loss or downed systems;
- distributed processing;
- hardware advantages, specifically with hardware upgrade.

Disadvantages are:

- Synchronizing data (assuming replication);
- accessing foreign data structures;
- increased management and supervision;
- apparent loss of control of data (from departmental viewpoint);
- challenge of dealing with mainframes and legacy data. (Ibid, p. 268)

Many of the disadvantages are being addressed through a multi-tiered client-server paradigm. An example would be where legacy data is dealt with by a single specialized server rather than being directly accessed by the individual clients – desktop clients access a data warehouse which in turns accesses a legacy billing system on a mainframe.

2.2.2 THICK AND THIN CLIENTS

Depending on the processing power of the hardware and the sophistication of the software, differing degrees of client-server computing can be established. A client can be considered either “thick” or “thin.” Part of the differentiation depends on the hardware setup of the client. “Thick” clients are full fledged desktop computers, capable of standing alone, while “thin” clients contain fewer components, making
the most of the network.

Industry studies suggest that email, word processing and web surfing make up the vast majority of business computer use, functions for which many feel thick clients are overkill. A 1996 Gartner Group report has estimated that the total cost of ownership (TCO) of a desktop PC to be $11-$15,000 per year. While some criticize this study, it is considered to be a conservative estimate by others in industry.

According to Sun Microsystem’s Java Computing white paper (1996), part of the high cost of thick clients is due to:

- a high (and growing) cost of desktop management
- a proliferation of expensive to run 'fat clients' (primarily networked PCs) whose sole purpose is running 'thin' applications (e.g. word processing and data entry)
- a rigid application architecture that limits the ways in which computers can be used to add value (for example analyzing data, servicing customers, executing transactions, etc.)

The Gartner Group notes the following points on thick client expenses:

These costs include depreciation, maintenance, support, training and the administration of upgrading software. Hidden costs in lost time and productivity can be as much as half of the total cost... These can include the time lost when highly paid professionals help colleagues fix computer problems, time wasted by people struggling to understand the complexities of a PC and the effects of viruses or other interruptions.

Over the typical three-year life span of an office PC, costs can mount to over $40,000.


The concept behind thin clients are embodied in the first generation of what are
known as ‘network computers,’ a standard proposed by major hardware and software companies. These thin clients do not consist of much more than a processor, RAM, network connection, and industry-standard ports (for video, keyboard and mouse). There is no internal hard drive. The operating system, configuration, files and programs are loaded off of a server, but run locally. This contrasts with a dumb terminal, (an ‘anorexic’ client, to coin a phrase), which contains no processor – it relies on a mainframe for all its computational needs.

This is not to say that the NC’s are not powerful – Sun’s NC currently contains a mid-range workstation processor approximately equivalent to a mid-range Pentium or PowerPC chip. It will be capable of running any program written in the Java language with the graphical interfaces and responsiveness that users take for granted from thick clients. The centralization of the operating system yields what some in the industry call “near-zero administration” – the high cost and time requirements of thick clients and their configuration problems are radically reduced. Sun feels that a network computer paradigm can answer the following shortfalls in thick client computing:

- Too much complexity
- Too expensive
- Inadequate security
- Inadequate reliability
- Applications not available to all users
- Software development too slow

<http://www.sun.com/JAVACOMPUTING/whpaper/ch5_prob_java_address.html>

3. Apple, IBM, Netscape, Oracle and Sun.
However, Gartner Group predicts that NCs are currently best suited to replace dumb terminals, not existing thick clients:

NCs will not displace many PCs in commercial environments but are well-positioned and priced to replace the large installed base of terminals, and PCs used primarily as terminal emulators. With the ability to access personal productivity tools on servers, the promise of future personal productivity tools based on Java, and the future growth of intranets in the enterprise, NCs should eventually take a 10-percent to 20-percent market share of commercial desktops. NCs' first major successes, however, will be as terminal replacements and terminal alternatives. <http://www.gartner.com/hotc/pc1216.html>
The table below compares the cost per seat of various weights of clients, as estimated by Gartner and Sun Microsystems.

Table 1 - Yearly Costs of Thick and Thin Clients

<table>
<thead>
<tr>
<th>Type of Client</th>
<th>Description</th>
<th>Cost per Seat per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterogeneous, highly customized fat clients and servers</td>
<td>(Wintel, UNIX, OS/2, Mac, MVS, etc.) with primarily local applications and local data file storage:</td>
<td>$10,000-15,000</td>
</tr>
<tr>
<td>Homogeneous, standardized fat clients and servers (i.e., clients and servers are desktop-centric and binary-compatible -- Solaris clients and Solaris servers, for example):</td>
<td></td>
<td>$9,000-12,000</td>
</tr>
<tr>
<td>X-terminal clients</td>
<td>backed up by very-high-bandwidth network infrastructures and high-performance servers:</td>
<td>$7,000-8,000</td>
</tr>
<tr>
<td>Diskless clients</td>
<td>backed up by very-high-bandwidth network infrastructures and high-performance file servers:</td>
<td>$6,000-7,000</td>
</tr>
<tr>
<td>Homogeneous dataless clients</td>
<td>with all applications and data files stored on servers of the same architecture; e.g., Solaris servers with dataless Solaris clients that have a local hard disk only for virtual memory:*</td>
<td>$4,000-5,000</td>
</tr>
<tr>
<td>Projected cost of dataless thin clients with all applications and data files stored on servers (i.e., Java devices):§</td>
<td></td>
<td>less than $2,500</td>
</tr>
</tbody>
</table>
*This data is based upon the experience at Sun of moving to a homogeneous dataless network architecture for its 35,000 internal-use network nodes.

§This estimate is based upon an analysis and extension of the cost elements of the homogeneous dataless environment that has already been implemented internally by Sun.

X-terminal clients rely on a central server for both processing and storage. Response time is therefore highly dependent on network latency.

Diskless clients store all files remotely, whereas dataless clients use a local disk for virtual memory/swap space. In both cases the operating system is run locally, but loaded from a file system on a network.

Other data is from Gartner Group (1996), via <http://www.sun.com/javacomputing/whpaper/ch5_prob_java_address.html>.

These figures and their repercussions are discussed further in Chapter 5.
2.2.3 **Open Systems**

The Open Group, a consortium of organizations whose “brand mark is recognized worldwide as a guarantee of compliance to open systems specifications,” defines an open system in the following way:

Unlike proprietary environments, an open systems environment allows users to choose from a wider selection of computers that fit their business needs. These systems also offer increased interoperability, scalability and portability, permitting different systems to fit together, and software developed on one platform to run on another with minimal adaptation. Users also have the assurance that future purchases will easily integrate with existing systems, decreasing their reliance on a single supplier, and the need to replace an entire system. (Open Group 1996, <http://www.xopen.org/public/news/feb96/whitepap.htm>)

**Gartner Group** defines an open system as:

a compliant implementation of an evolving set of vendor-neutral specifications for interfaces, service, protocols and formats designed to effectively enable the configuration, operation and substitution of the entire system, its applications and/or components with other equally compliant implementations preferably available from many different vendors. (Gartner, 1993, p.3)

These specifications are to be defined by a multilateral association which must:

- be representative of a broad cross-section of the computer industry
- be open to new members
- publish the rules of membership
- operate according to democratic principles (Ibid)

**Netscape Communications Corporation** states:

- Open standards are defined as published specifications that enable multiple vendors to create independent implementations of a given technology. These implementations must interoperate on heterogeneous computing platforms.
- Innovative changes and proposed new standards can come from users, vendors, or standards bodies... Ongoing evolution of open standards should
occur in an open forum, trusted to a vendor-neutral standards body, so the market can benefit from innovation, regardless of its origin.


However, as Tom Sheldon notes, “Recent trends have moved away from striving for complete openness and more towards acceptance of in-place standards.” (Sheldon, 1994, p. 675) TCP/IP, a widely used networking protocol that resides in the public domain, is an example of this – an ‘open’ alternative existed, but TCP/IP proved far more popular, especially given the “program of testing and certification carried out by the government to ensure that developers met... standards which are published and available to the public free of licensing arrangements.” (Ibid, p. 879)

Gartner Group (1993) suggests two criticisms of official standards - it takes too much time to produce a vendor-neutral specification, and a reference implementation is not produced. Often, non-official standards bodies will fill the void, or a ‘ported proprietary’ solution will become the de facto standard.

A slightly different approach is interoperability, which includes support for multiple protocols. As an example, the most recent version of Netscape’s Enterprise Web Server can deliver documents over IPX, a networking standard from Novell, as well as TCP/IP. Other networking software can encapsulate protocols within protocols, so an alternative to the above would be to encapsulate the IPX packets as they travelled over a TCP/IP network, allowing them to travel ‘incognito’ until they
reached a point where they could travel natively. However, there is often a tradeoff as this can create more network traffic than the native method. Sheldon (1994, p. 667) remarks that interoperability is often as important as openness, but that this interoperability has been made possible by “advances in processing power, multiprotocol routers, and middleware software.”

2.2.4 THE INTERNET

The Internet Engineering Task Force (IETF) standardizes Internet protocols. It is a volunteer effort in which working groups (with open membership and participation) create “rough consensus and working code.” (Associate Press, 1996) It distributes a set of documents known as RFCs, or “Request for Comments.” These have been the authoritative source for protocol definition and Internet information for more than two decades. RFC 1206 states:

The Internet is a large collection of networks (all of which run the TCP/IP protocols) that are tied together so that users of any of the networks can use the network services provided by TCP/IP to reach users on any of the other networks. <http://www.cis.ohio-state.edu/htbin/rfc/rfc1206.html>

Encapsulation can also be applied to file types as well. A common exercise while sending a binary file as an email attachment is to encode it into text. (An example would be a binary file (an image, Microsoft Word document or sound ) ‘binhexed’ or ‘uuencoded’ into a larger text file.) This is often necessary because many email hosts only know how to speak ASCII, the ‘standard’ set of 128 letters, numbers and symbols. This 7-bit data path ($2^7 = 128$) is not ‘wide’ enough to handle documents, such as those mentioned above, which use the upper-level characters of 8-bit ASCII ($2^8 = 256$ characters). Thus for an 8-bit file to make it through a 7-bit email server, it must be ‘squeezed’ down. This is akin to taking a roll of Pillsbury chocolate chip cookie dough and trying to get it to fit through a napkin ring. You can roll it to make it thinner, but this also makes it longer.
The Federal Networking Council unanimously declared the following resolution in 1985:

RESOLUTION:

"The Federal Networking Council (FNC) agrees that the following language reflects our definition of the term "Internet":

"Internet" refers to the global information system that --

(i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons;

(ii) is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions/follow-ons, and/or other IP-compatible protocols; and

(iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein."


The Internet’s roots date back to efforts in the 1960’s to allow better communication and collaboration of military-funded researchers. The result of this was one of the first packet-switched networks. When data is send over such a network, the information is divided up into ‘packets’ of small size. In addition to the data, the packets contain addressing information. Unlike a phone call, where a dedicated connection is established between two points, with packet-switching, there exist “many different possible physical connections and routes that a packet can traverse to get to its destination.” (Sheldon, 1994, p. 693)

Some sources say that the U.S. Department of Defense demanded a communications system that could withstand a nuclear attack and the resultant loss of switching
stations, with the data being routed around the damage. This is considered by some to be an 'urban legend.' Vince Cerf, one of the pioneers of what became known as the internet, writes:

In 1973, the U.S. Defense Advanced Research Projects Agency (DARPA) initiated a research program to investigate techniques and technologies for interlinking packet networks of various kinds. The objective was to develop communication protocols which would allow networked computers to communicate transparently across multiple, linked packet networks. This was called the Internetting project and the system of networks which emerged from the research was known as the "Internet." The system of protocols which was developed over the course of this research effort became known as the TCP/IP Protocol Suite, after the two initial protocols developed: Transmission Control Protocol (TCP) and Internet Protocol (IP).

However, he states that the military did not become directly involved until 1978, nearly a decade after the first research started.

According to Bruce Sterling, it was actually RAND, "America's foremost Cold War think-tank," that pondered the question, "How could the US authorities successfully communicate after a nuclear war?" (The study initially dealt with voice communications.) RAND researchers, realizing that the centre of a network would be the first to go in a nuclear assault, came up with a radical notion - a network that had no central authority and would be designed from the beginning to operate while in tatters.

All the nodes in the network would be equal in status to all other nodes, each node with its own authority to originate, pass, and receive messages. The messages themselves would be divided into packets, each packet separately addressed...

Basically, the packet would be tossed like a hot potato from node to node to node, more or less in the direction of its destination, until it ended up in the proper place. If big pieces of the network had been blown away, that simply wouldn't matter; the packets would still stay airborne, lateralled wildly across the field by whatever
nodes happened to survive. This rather haphazard delivery system might be "inefficient" in the usual sense (especially compared to, say, the telephone system) -- but it would be extremely rugged.

<gopher://lib-gopher.lib.indiana.edu:70/0/pub-data/internet-room/history/history-bruce-sterling>

Legend or not, the result has been a highly resilient, peer-based, widely distributed open network protocol that has scaled extremely well.

The early 1990s saw the lessening of governmental involvement and funding of the day-to-day operations of the Internet (especially the backbone, or the high-bandwidth networks that connect together the smaller networks). With this, entities were allowed to use the Internet for commercial purposes for the first time. Though an exact census is impossible, most authorities agree that at the least, tens of thousands of networks and many tens of millions of users and computers make up the Internet. This is a significant increase from the four nodes in California and Utah that made up the Internet's most distant ancestor.

Distributed electronic mail has existed almost as long as the Internet has - the first protocols were developed and messages sent soon after the first network connection was established. File transfer and newsgroups (electronic bulletin boards) soon followed. However, these were somewhat arcane and posed significant barriers to entry, limiting usage to military and civilian researchers and academics users pursuing technology for technology's sake. It took Tim Berners-Lee, a British researcher at CERN, to propose the protocols for the World Wide Web.
(<http://www.w3.org/pub/WWW/History/1989/proposal.html> is the location of his original proposal), and Marc Andreeson and other programmers of the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champlain (UIUC) to create Mosaic, the 'killer app' that brought the Internet to the public eye.

Why was the World Wide Web so popular? This can be partially answered by study that examined using a Web-based interface in place of a windowing system for a specific application. It found that the use of HTML–compliant browsers:

- attracts a large user community
- improves the rate of user acceptance
- avoids software installations and distribution problems
- dramatically reduces turnaround time for software development

(Rice, Farquhar, Piernot and Gruber, 1995, p. 110)

However, there are significant limitations, as HTML defines content, not layout. Programs, written in portable languages such as Java and using the web page as a delivery mechanism, can make up for such shortcomings. Also, HTML's layout capabilities are being strengthened by players such as Netscape and Microsoft. However, this is much to the chagrin of traditionalists who look on HTML as a timeless standard. They note that while the ASCII-based HTML maybe readable, there is no guarantee that layout specifications, such as specific fonts, will be available 50 years from now.

2.2.5 INTRANETS

As the Internet grew and its content, capacity and quality increased, corporations saw
the advantages of deploying mini-Internets internally. They provided corporate-wide connectivity for reasonable costs. The open framework allowed organizations to avoid proprietary hardware and software lock-in.

Forrester and Associates (1996) narrows an intranet to five critical components: directory, e-mail, file, print and network management. Sun defines the basic infrastructure for an intranet as consisting of:

- an internal TCP/IP network connecting servers and desktops, which may or may not be connected to the Internet through a firewall. The intranet provides services to desktops via standard, open Internet protocols.


Oracle's July 1996 intranet strategy white paper outlined some advantages of intranets over various alternatives designed to replace legacy systems. These advantages include:

- Open, non-proprietary standards
- Lower cost of application deployment and management
- Universal access to information and applications
- Self-service information systems
- Lower training costs

But there are other factors that must be considered in intranet design and implementation before it can be considered mission critical:

<table>
<thead>
<tr>
<th>Confidentiality</th>
<th>ensuring that data is not improperly disclosed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrity</td>
<td>protecting data against corruption or unauthorized change.</td>
</tr>
<tr>
<td>Authentication</td>
<td>having confidence in the identity of users, hosts and clients.</td>
</tr>
<tr>
<td>Assurance</td>
<td>security mechanisms are robust and correctly implemented.</td>
</tr>
</tbody>
</table>

2.2.6 **JAVA**

Java, once the domain of eye-catching (if not somewhat tiring) animations embedded in web pages across the globe, has progressed dramatically since its release in the spring of 1995. Now appreciated as a robust and secure programming language, Java is applicable not only to the Internet but to intranets as well.

Sun Microsystems defines Java as:

A simple, object-oriented, network-savvy, interpreted, robust, secure, architecture neutral, portable, high-performance, multithreaded, dynamic language.

<http://java.sun.com/doc/Overviews/java/>

Characteristics associated with Java include:

- Applications are much more secure than schemes running native code because the Java run-time system (part of the Java Virtual Machine) inspects all code for viruses and tampering before running it.

- Applications are adaptable to changing environments because users dynamically download application code from anywhere on the network.

- Shortened application development and deployment through code reuse, easier testing and rapid deployment via intranet.

- Portability across computing platforms because the Java Virtual Machine is available on all systems.

- Applications are fast because today's processors can provide efficient virtual machine execution. JIT (just-in-time) compilation and direct Java execution in silicon can deliver even more performance.

- Simple to learn and use with component-level object programming.

- Graphical applications and GUI functions are high performance because of Java's built-in multithreading.

- Robustness because the Java run-time system manages memory. (Memory management errors are a major bug source in traditional software.)


Since its release in May of 1995, Java has spread faster than anyone had predicted,
even surprising its creators at Sun. However, it is more than just a programming language.

Java's true power comes when it is combined with a new hardware paradigm. Guy Tribble, Sun's chief Java architect, gives a thorough overview of the relationship of Java and its use in a new approach to computing:

The essence of Java Computing is a client/server model in which Java application code is dynamically downloaded from server to client on-demand. In some cases, the applications are stored in cache on a hard disk at the client location and in others, they are stored only in DRAM. Since applications normally reside on the server and are delivered only as needed, all administration can focus centrally on the server, and users are assured of access to the latest application release level.

Java applications can run anywhere the Java Virtual Machine software is installed. Thus, they can run in any Java-enabled browser (e.g., Netscape Navigator or Internet Explorer). This is a key feature that allows a gradual migration to a simpler-to-manage client -- a Java device. This is a desktop client machine that is connected to the network and can download and run any Java application, but is free of the complexity and client administration needs of a traditional PC.

Rather than a traditional OS, the Java device contains a simple Java OS with a Java Virtual Machine. The Java OS and Java Virtual Machine can be stored at the client in flash ROM or can be booted from the network. Client data storage is done centrally on a file server or servers, and all client administration and configuration control is accomplished centrally.


2.2.7 ELECTRONIC DOCUMENT MANAGEMENT

While the Internet is sometimes criticized as lacking for content, businesses tend to be more focused in terms of deliverables. When it comes to their intranets, one such application is electronic document management.
The Gartner Group estimates there are some 318 billion pages of documents on file. More frightening is their projection “that U.S. businesses alone generate one trillion pages of documents each year, and “that companies will spend between six and ten percent of their gross revenues publishing these documents.” (Interleaf, 1994(2))

Computer printouts make up approximately 775 billion pages of the one trillion. Some 92 billion additional pages are filed each year. (Miller, 1994; Sprague, 1995)

A working definition of Electronic Document Management (EDM) is as follows:

Electronic: the use of modern information technologies
Document: a set of information pertaining to a topic, structured for human comprehension, represented by a variety of symbols, stored and handled as a unit.
Management: creation, storage, organization, transmission, update, and eventual disposal to fulfil an organizational unit. (Sprague, 1995)

With this kind of volume, paper is not only pervasive but expensive and difficult to manage as well. Network Support Incorporated estimates that:

- Managing documents can cost up to 10% of a company's corporate revenues and take up 60% of its time.
- Knowledge workers spend 15 to 40% of their time seeking and gathering information.
- 3% of documents are misfiled. It costs an average of $200 to recover each misfiled document.
- The average business document is copied 19 times during its life.

In his 1995 paper, Sprague presents three "perspectives" to help build an EDM structure. He lists and defines these as follows:

technology: What are the technologies that will make EDM possible, and how can they be assimilated into the organization's IS infrastructure?
benefits: What are the application areas for which documents are
mission-critical, and what is the plan for implementing them so that they are integrated?

What are the roles and responsibilities of the organizations departments and functions for which EDM will be strategic?

Cleveland (1995) of the National Library of Canada points out that the elements of a document management system “include software to perform all functions necessary to manage the document across a organization from cradle to grave.” He notes several points that should be considered:

- Underlying Infrastructure
- Authoring
- Workflow
- Storage
- Library Services
- Presentation/Distribution Services

2.3 SUMMARY

Having examined the details of these technologies and factors, we can now see how they fit together. While the initial retreat from the centralized mainframe computing model during the 1980’s led to an increased adoption of client-server systems, financial and organizational gains were not as large as predicted. At the same time, though not in the commercial mainstream, the highly distributed Internet was developing rapidly, taking advantage of open systems. All the while, higher order tasks such as electronic document management were waiting for a technology base easy enough to deploy but strong enough to be functional.

The open-system philosophy sped and gave credence to the adoption of Internet technology and paradigms by the commercial world, thus yielding intranets. Java
and on-the-fly creation of content diversified Internet and intranet content. The client-server model was further refined into 'thin' clients and 'thick' servers, taking advantage of the network and the delivery model provided by corporate intranets and the Internet.

Many see this as a return to the centralized mainframe model, and they are correct in the sense that much of the administrative burden associated with desktop computing is being recentralized. However, it is critical to note that a thin client is not a dumb terminal. (Some have commented that the network computing model is client-server finally done right.) With such a dynamic, reliable and scalable underlying infrastructure, tasks such as electronic document management and connection to legacy systems can be facilitated more easily, as will be shown in the following chapters.
CHAPTER 3 RESEARCH METHODOLOGY

3.1 CASE STUDY

3.1.1 ANONYMITY

This case study was conducted in a company that wishes to remain anonymous for reasons of competitive advantage. However, the integrity of information that can be revealed has not been compromised and is still detailed enough to yield valuable information on intranet development for both the Company in question as well as other organizations.

3.1.2 RELEVANCE

A case study was deemed relevant in this situation, primarily because of the nature of the technology and its near-exponential growth demanded rapid analysis. Also, the case study was conducted during an internship which was of limited time span and uncertain funding. Equipment and software was on short-term loan and could not realistically be kept for more than six months. Additionally, it was hoped that this could be a starting point for more in-depth studies and deployments, given the apparent need for new IT options within the Company.

3.2 ORGANIZATIONAL AND DEPARTMENTAL DESCRIPTION

The Company provides services throughout the province and has strategic alliances with other organizations providing similar services throughout the nation. Portions of the Company are subject to government regulation and supervision,
though these requirements are diminishing over time. A large multinational firm owns a majority stake in the Company, but is not directly involved in its day-to-day operations.

There are several autonomous profit centres that exist beneath the parent company. One of these is unprofitable, but the others are doing well, giving the Company as a whole a reasonable profit. The Company has not lost money in recent memory.

The Company's employees number in the thousands. This level has decreased notably during the past decade, largely through early retirement and voluntary separation, though some employees have been released 'involuntarily.' However, employee headcount is approaching the level desired by senior management.

Approximately 85% of the Company is unionized. The union is strong and in the past the Company has been the site of several intense strikes. The current relationship between management and union members is strained, especially given the recent drawdowns, but the two sides are still communicating. However, the union's contract expires soon and could be a source of concern. It is also important to note that the current contract contains a 'technological redundancy' clause, which guarantees employment if a position becomes outdated by technological advancement.
A few departments and organizations within the Company were directly involved with or had an affect on the study. Department Alpha is responsible for planning for future capital expenditures. It also coordinates the creation and distribution of the administrative guidelines for the Company. Department Beta provides support for financial analysis and decision support systems. Department Gamma supports a portion of the Company's in-house information technology needs. Group Epsilon is one of the autonomous profit centres, and is an IT outsourcing organization. It is a joint venture between the Company and a nationwide IT outsourcing firm. The nationwide firm is in turn owned by a large multinational firm.

Employees can access the IT resources several ways. Perhaps most ubiquitous are the 'dumb terminals' or 'green screens' that connect to the mainframe. Services include email and distribution of corporate information. However, the mainframe is aging and expensive. It is maintained by Group Epsilon.

At the 'thick client' level, the Company has settled on an Intel standard. There are a significant number of 286's and 386's. 486's are not as common and are largely in the hands of managers. Pentium class machines are usually only in the hands of developers. There are a limited number of Macintosh-class machines, mostly Power PCs or 68040's. These are mainly used for graphics or publishing. A number of Sun workstations are in place, usually used for high-end financial and numeric analysis.
Company officers estimate that only between 25% to 35% of employees have access to a machine that is capable of running current releases (at least 2.0) of Netscape-class browser software. Policy papers that discuss the need to retire the 286's and 386's have been distributed, but for the past year and for the foreseeable future, little of the budget has been allocated for desktop PC acquisition. This is partly due to the high costs associated with fat clients.

A unique condition of the Company's computing environment is a section of the labour agreement that declares installation of software a union duty. This has been interpreted by the union to mean that all computers coming into the Company must have their operating system reinstalled by the union. Company management petitioned this to the provincial labour board for binding arbitration. However, the Company lost the appeal and the section remains in effect. This is estimated to add approximately $3000 to the cost of each PC entering the Company.

For the Intel-based machines, the predominant operating system is Windows 3.11. This is gradually being superseded by Windows 95, though many users are hesitant to upgrade as the process has not been a smooth one. The Macintoshes are running either System 7, 7.1 or 7.5. A few users are running OS/2 Warp.
3.3 IACOVOU MODEL

3.3.1 DESCRIPTION

In his 1994 paper, (later published in MIS Quarterly in December 1995), Iacovou et al propose a methodology to be used to analyze the adoption and impact of electronic data interchange (EDI) in small business. In the original model, three independent variables — Perceived Benefits, Organizational Readiness, and External Pressure — affect the dependent variables Adoption & Integration and Impact. A chart of his Small Business EDI Adoption Model is included as appendix 1.

Perceived benefits “refer to the level of recognition of the relative advantage that EDI technology can provide the organization.” (Iacovou, 1995, p. 468) These include benefits, both direct (operational savings, reduced inventory levels) and indirect (increased competitiveness, better customer service). Iacovou refers to the indirect benefits as ‘opportunities.’

Organizational readiness “refers to the level of financial and technological resources of a firm.” (Ibid, p.469) Financial readiness deals with the concerns surrounding setup, implementation, integration and ongoing expenses associated with the EDI system, while technological readiness “is concerned with the level of sophistication of IT usage and IT management in an organization.” (Ibid, p.469)

Competitive pressure and imposition by trading partners are components of
external pressure to adopt in the Iacovou model. "Competitive pressure refers to the level of EDI capability of the firm’s industry and, most importantly, to that of its competitors." (Ibid, p. 470) Iacovou notes that weaker partners are "extremely susceptible" to the standards set by imposing partners.

In Iacovou’s model, while adoption and integration are grouped together, they may or may not occur simultaneously. “EDI adoption is the process during which a firm becomes capable of transacting via EDI,” while “EDI integration is the process during which a firm alters its business practices and applications so that they interface with its EDI applications.” (Ibid, p. 468)

Iacovou’s dependent variable impact “refers to the actual benefits adopters receive from utilizing EDI.” (Ibid, p. 468, italics Iacovou’s) Iacovou uses system integration as a measure of direct benefits.

Iacovou stated during an interview with this author that his model would be appropriate for IT adoption in general, as well as EDI specifically.

3.3.2 Applicability to Intranet Adoption

Before proceeding, consider the four essential features of EDI as per Pfieffer:

1. At least two organizations (not necessarily ownership-independent) having a business relationship must be users of the system.
2. Data processing tasks at both (all) organizations pertaining to a
transaction are supported by independent application systems.

3. The integrity of the data exchange between application systems of trading partners is guaranteed by ex ante agreements concerning data coding and formatting rules.

4. Data exchange between the application systems is accomplished via telecommunication links. (Pfieffer, 1992 via Iacovou, 1994)

Given that Internet technology easily fulfils these four features, it seems reasonable to assume that such technology can act as a superset to EDI. Applying this to an intranet, this approach seems even more appropriate if parallels are drawn between small businesses and departments within an organization acting as cost recovery centres. Under such conditions, point one has been covered. The second point is given credence by the multitude of systems running within each department. The standards formulated by organizations such as the IETF fulfils point three, while the last point is satisfied by the network links that connect most departments.

I propose to take Iacovou's EDI adoption model and use it to examine intranet adoption within the Company. However, within each independent variable (perceived benefits, organizational readiness, external pressure), analysis will be sorted into three sub-sections, technological, economic and organizational. These are standard categorizations found in introductory IT textbooks such as Lauden and Lauden (1994). Details concerning these sub-variables are covered in Chapter 5.

I propose that the modified Iacovou model will be able to extract the detail necessary to adequately explain this project's success or failure, even considering the limited scope and non-empirical nature. However, these subcategories should not be set in
stone. They exist for convenience of analysis and should not be used if the situation does not warrant that level of introspection.
CHAPTER 4  FINDINGS

4.1  OVERVIEW

During the internship at the Company, several projects were investigated to see if they would be feasible candidates for inclusion within an intranet. Two proved worth pursuing: conversion of the administrative guidelines of Department Alpha into hypertext markup language (HTML), the language of Netscape and other web browsers; and the creation of a mock-up HTML version of the Company's expense statement (thus delving into database connectivity), which was sponsored by Department Beta.

4.2  ELECTRONIC DOCUMENT MANAGEMENT

4.2.1  ADMINISTRATIVE GUIDELINES

The Administrative Guidelines seemed an attractive intranet candidate. Along with the facts cited in the literature and technological review, the excessive cost of physical, on-demand distribution of paper documents to multiple offices spread throughout the province seemed to justify the examination of electronic delivery.

The guidelines consist of largely text files with some tables and diagrams. These files are stored in WordPerfect 5.1 (DOS) by the Word Processing department. The study focused largely on the conversion and distribution process.
4.2.2 INFRASTRUCTURE

In the study, the administrative guidelines were served from a Sun Microsystems Sparc 5 (and later an Ultra 1, as described in the next section) with 96 megabytes of RAM and a 2 gigabyte hard drive over a 10 base-T (10 megabits per second) ethernet connection, running the Solaris 2.5 operating system. The HTML documents were delivered by Netscape Corporation’s Communication Server 1.0, and were authored on an Apple Macintosh PowerBook 520, using PageMill 2.0 and BBEdit 3.5.

The minimum client system required to access the administrative guidelines is a 386 class IBM compatible running Windows 3.1 (or 68020-class Macintosh) and a Netscape 1.x equivalent browser. Theoretically, HTML allows text-only connections (e.g. Lynx), but this ‘lowest-common denominator” approach strips the administrative guidelines of most character formatting and all graphics. The benefit over the printed version is questionable, though the system of hyperlinked pages is preserved, adding navigational benefit to such text-only online versions.

4.3 ONLINE EXPENSE FORMS (DATABASE CONNECTIVITY)

4.3.1 DESCRIPTION

The Company creates and distributes hundreds of forms for data collection, the vast majority of which must be rekeyed by data entry personnel. Department Beta undertook a study to examine the feasibility of creating an online expense form in an Netscape environment. Though not directly within its purview, (other than
having to generally do with finance), Department Beta realized that it would accrue additional benefits such as learning more about database connectivity in a web environment.

The manual expense form is intended for recording expenses associated with employee travel and out-of-pocket expenses. The charges are billed to the appropriate budget centre, which must approve the charges before the employee is reimbursed. This process takes up to two weeks.

An informal review determined that many organizations of the Company's size have online expense entry, authorization and reimbursement procedures. This led members of Department Beta to believe it would be worthwhile pursuing such a solution for the Company.

4.3.2 INFRASTRUCTURE

The online expense form/database connectivity study was deployed on a Sun Microsystems Ultra 1/140, running the Solaris 2.5 operating system. A beta version of Netscape's LiveWire database extension was used along with the Netscape Communication web server. Oracle's WebServer 1.0 also ran the expense form/database connectivity project in parallel to the Netscape server software.

Both the WebServer and the Livewire/Communication Server accessed a data
warehouse running Oracle 7.1, running on a Sparc 2000 with 8 processors. This
database contained 13 months worth of the Company's revenue and organizational
data, which amounted to approximately 300 gigabytes, though only a limited subset
of this data was used in the online expense form/database connectivity trial.
CHAPTER 5  ANALYSIS

5.1  IACOVOU MODEL

Even with the applicability of the Iacovou model to analyzing the deployment of an intranet in an organization moving towards a cost-centre model, it is beneficial to modify the model to gain more detail and resolution. (It is important to note that the author of the original model concurs with this assessment.) As previously mentioned in during the discussion of the original model in Chapter 3, this is achieved by combining a standard technical/organizational/economic analysis within each variable of the Iacovou model. The following analysis reflects this approach, and is illustrated in the modified Iacovou model matrix shown below.
Table 2 - Extended Iacovou Model

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Technical</th>
<th>Organizational</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Benefits</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Organizational Readiness</td>
<td>√</td>
<td>n/a</td>
<td>√</td>
</tr>
<tr>
<td>External Pressure</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Technical</th>
<th>Organizational</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adoption &amp; Integration</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Impact</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

**Independent Variable Overview:**

The independent variables reflect the state of the Company upon the eve of the intranet test. The first variable, perceived benefits, reviews the perceptions and considerations of deploying intranets and the associated technology. The economic analysis covers the assumed financial costs of software and hardware, while the technological review discusses the opinions concerning their deployment and use. Philosophies concerning use and deployment of electronic information, as well as some of the cultural and contractual consequences of dealing with information technology, are analyzed in the organizational section.
As per Iacovou's original model, perceived benefits are divided into direct and indirect benefits. However, the limited scale and scope of this study may prove a barrier in effectively measuring the latter. Direct benefits will largely be covered in the economic and technical sections of the modified model.

**Organizational readiness** deals largely with factors internal and specific to the Company itself and this study in particular. This includes technical preparedness of department and personnel, and financial conditions and the effects upon projects. This section is complicated by the intersection between organizational readiness and its organizational subsection. Because this paper uses organizational, technical and economic factors as subsections within the three original Iacovou independent variables (as opposed to existing as a completely different set of independent variables), the detail not included within technical and economic areas is covered in the 'organizational' subsections of the other two independent variables.

Note also that in Iacovou's original model, organizational readiness "refers to the level of financial and technological readiness resources of the firm." (Iacovou, 1993, p. 468) This lends credibility to the absence of an organizational vector within the organizational readiness variable.

**External pressure** examines influences arriving from outside the Company and/or
departments. Organizationally, it encompasses political forces and choices (which have affects on technical and economic decisions.) These economic and technical factors include costs of current systems and their comparision to current market hardware and software trends.

Iacovou notes that when dealing with EDI, smaller companies are often subject to imposition by larger trading partners. However, this may not be the case with intranet technology and departments being treated like cost-centres. Given the standardization found with intranet-base hardware and software, smaller departments may gain additional leverage in demanding such non-proprietary solutions. Solutions proposed for deployment have usually evolved in the crucible of the Internet and are well developed. In fact, smaller departments may enjoy collective negotiating power and together could conceivably dictate to larger departments which standards will be deployed.

**Dependent Variables Overview:**

Adoption & Integration covers events and factors that arose during the period of the study. As in the original Iacovou model, adoption is the period of time in which an organization becomes capable in the technology, while integration is the alteration of the organization’s business practices in order to interface with the technology. Details of the two major components of study (electronic document distribution and the online expense form) are covered in the technical section. Organizational
concerns (again including political issues) are discussed, as well as economic costs of adoption and integration issues.

Economic considerations have to be approached differently in the final dependent variable, impact. Whereas other variables considered the financial cost, impact is better served by investigating the economic benefits of adoption and integration. Impact measures the actual benefits of the adoption and integration of the technology in question. Organizational issues involve any change in work patterns by employees or departments. Technical issues include the effect on institutional memory and deployment and usage of new hardware and software. Iacovou's subdivision of benefits into direct and indirect subsections does not map cleanly into the modified model's subcategories; however like in adoption and integration, economic and technological concerns seem better suited for direct benefits.

The above example of 'misalignment' between the original model and the modified model is a prime example of why the subcategorization of the modified Iacovou model must be dealt with on a case-by-case basis. This is a suggested framework which will hopefully reveal additional detail. It should not be forced on the analysis as a matter of course. Attempting to apply it to inappropriate circumstances will cause the analysis to suffer. The danger of artificial constructs will benefit neither the writer nor the reader.
5.1.1 INDEPENDENT VARIABLES

5.1.1.1 PERCEIVED BENEFITS

Perceived Benefits: Economic

The economic advantages to an intranet were apparent in the Company, despite some studies that show client-server technology as being more expensive than mainframe based systems. (Gartner 1995) The Company was involved in a highly priced contract with its outsourcing firm, Group Epsilon, at a cost of tens of millions of dollars per year. For many tasks, web-based server configurations (both hardware and software) were seen as being much cheaper, even when considered for parallel deployment across the Company at the departmental level. Hardware costs were low – existing desktop PC's could be used as servers in many cases, and the Company could buy new servers with appropriate hard drive storage and memory for under $20,000. At the time, web server software ranged from free to $5000. Other servers that make up an intranet (mail, directory, print, file and network servers) were priced within the same order of magnitude.

The low cost of web browsers (ranging from $10 with volume discounts from Netscape, to free in Microsoft's case) seemed worth the potential functionality, though the logistics of getting the software to the desktop was a concern. As well, the promise of low-cost network computers could also help bring this power to desktops throughout the Company.
Perceived Benefits: Technical

Of the technical benefits, the foremost perceived benefit was ease of setup. Many web servers are fairly straight-forward to set up and maintain. Client browser software is generally agreed to be easy to learn and simple to use. (Tyre, 1996)

A higher level of technical expertise is assumed for the servers, especially with the setup. However, the trend of basing most if not all of the web server administration within a web page containing forms is growing more popular, greatly simplifying the process. Some web servers can be up and running literally within 5 minutes after installation.

While web browsers may be easy to use, they can be challenging to install. However, this is more an issue with the operating system, especially with Windows-based platforms. Another issue is the divergence from a pristine operating environment that occurs after a user has been able to 'futz' with the computer. Extensions, libraries and resources may vary greatly from machine to machine, making a 'standard installation' difficult.

'Groupware' solutions, namely Lotus Notes, deployed within the Company were anecdotally reported to be more complex to administer than web based solutions, as well as their taking up considerable system resources.
Perceived Benefits: Organizational

Organizationally, some mid-level managers and employees found the idea of keeping control of the distribution of information at the departmental level attractive (as opposed to a central source, as currently maintained with the mainframe system). However, whether those in the Company as a whole found the idea attractive or not was becoming irrelevant, especially since a cost-centre model was being imposed upon the departments by management. Many departments, especially Alpha and Beta, felt that the charges that group Epsilon (and soon department Gamma) did and would soon impose were unreasonable. This included group Epsilon charging departments $55 dollars per user per month for Lotus Notes support. (Assuming 80% penetration across the Company, this could come to nearly $8 million a year.)

It seemed to some in the Company that these groups were stuck in a cost-per-CPU-cycle mentality and not prepared to provide the best value for the customer. The current organizational plan calls for continuing to contract services from company departments for two years. After that point in time departments will be able to garner most services from any source, inside or outside the Company. Many departments were biding their time until alternate support sources became available. However, this assumes that the political leadership and philosophy of the Company remains constant, something not guaranteed given that the current president is likely to retire in the near future.
5.1.1.2 ORGANIZATIONAL READINESS

Organizational Readiness: Organizational

Given the nature of the matrix representing the modified Iacovou model, the intersection between 'Organizational Readiness' in the Iacovou model and organization factors is somewhat redundant, and is largely covered in the organizational sections of 'Perceived Benefits' and 'External Pressure' as well as the technical and economic factors in this section.

Organizational Readiness: Technical

As previously mentioned, senior management was pushing the departments towards a cost centre model. However, many felt the Company was not providing the necessary technical support for such a venture to succeed. Some employees went through or created unofficial channels to obtain such support, this study being an example. This author was a member of a group of employees which could be called the 'intranet underground.' This group originally included representatives from Department Gamma. Though initially somewhat facetious, the moniker became unfortunately poignant a few months later when the Company transferred the majority of Department Gamma's personnel to Group Epsilon. Meetings that had once been open exchanges on technical and development issues became almost impossible to schedule. In fact, a week after most of Department Gamma had been absorbed by Group Epsilon, a meeting had to be cancelled due to Group Epsilon's
insistence that their attendance be financially compensated by the cost centres of the
attending representatives. This was met with outright incredulity on the part of
other members. Any good faith that had existed with Department Gamma and
Group Epsilon degenerated into skepticism at best and hostility at worst.

Organizational Readiness: Economic

Very little funds were available for research and development. Given the ongoing
cutbacks, it is unlikely this project would have started had it required a dedicated,
full-time permanent employee. No money was available for hardware, especially
given the effective freeze on PC acquisition. However, individual departmental
managers were generous with the resources they had available. Any criticism of
funding difficulties is attributable to higher levels of the organization.

5.1.1.3 External Pressure

In Iacovou’s original EDI adoption model, external pressure refers to any
requirements large companies impose on their smaller partners as well as
competitive pressure. In this environment, the former can include: requirements
imposed by executives, IT guidelines, pre-existing infrastructure limitations, or even
requirements departments place upon each other. Also, competitive market forces
are a factor, especially since departments will soon be able to choose outside
contractors and internal departments for services. Additionally, the rapid rate of
intranet technology evolution (and the computer industry as a whole) can be a
competitive pressure. This is especially apparent when the 'state-of-the-art' is compared to existing infrastructure.

External Pressure : Technical

One of the largest technical issues was the aging mainframe infrastructure. The 'dumb terminals,' or 'green screens' which provided mainframe access are only capable of display text. This access cannot take advantage of advances in graphical user interfaces (GUIs) of the past decade, namely bitmapped fonts, high-resolution colour graphics and multimedia content. Hypertext, i.e. active links within a document, is possible but extremely limited – the viewer loses page layout, formatting and other interface benefits. Given that several thousand users still relied on dumb terminals (or low-end PCs with terminal emulation software), most in the Company were unable to garner access to the emerging intranet, let alone the resources on the Internet.

External Pressure : Organizational

Perhaps one of the largest barriers to the adoption of an open intranet was Group Epsilon's favouritism towards Lotus Notes. For several years, Epsilon had been pushing Lotus Notes as a solution to the Company's infrastructure and information distribution problems. Though a technically sound solution, many in the Company felt that Lotus Notes was overkill for most users, especially for the $55 a month per user that Group Epsilon charged. Several managers estimated that only five to ten
percent of their employees would require that level of 'groupware.'

Many managers resented Group Epsilon’s attempts to force them to accept a solution that they did not particularly want or need, and found the concept of a Netscape front end attractive, especially given the low entry cost. The ‘openness’ of Netscape was also considered a factor in its comparison to Notes. Regardless, at the time both solutions suffered from the requirement of a high-end PC at the client end. It is somewhat ironic that Group Epsilon was pushing a solution that most users could neither use, nor would be able to use in the near future, given the near-freeze on PC acquisition. Some managers suggested that the partnership between IBM (which owns Lotus Notes) and Group Epsilon could account for this behaviour.

Other forms of external pressure began to present themselves organizationally, namely other intranets and the Internet itself. After the summer of 1995, as more people realized that ‘intranet’ was not a typo, company employees began to discover examples of other organizations which had successfully built intranets of various scales, ranging from an enterprise-wide solution used by Sun Microsystems to a simple document distribution system deployed by BC Hydro. In addition, company employees with Internet connections at home discovered the resources available

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5. Note that determining the cost per employee of a system is challenging, especially when support costs are taken into account. But even given this, Group Epsilon’s rate was considered extreme. However, web-based technology has recently caused IBM to cut Lotus Notes’ price dramatically and to endow it with many more web features.
which could be of benefit to the Company, such as online software distribution, upgrades and e-mail contact with contractors and vendors. Employees began asking their managers to obtain high-speed Internet access from within the Company, and the president of the Company set a date by which this was to be accomplished.

However, some individuals, especially those in Department Gamma and Group Epsilon, saw this as a security risk for two reasons. The first concern was that of outsiders accessing internal company systems. The second was insiders accessing external systems. The latter included a concern about employees generally wasting company time by ‘web-surfing,’ as well as their stealing company data and electronically sending it to competitors.

This resistance caused the president’s deadline to be missed by a wide margin. Employees’ already negative opinion of the reticent IT groups increased in intensity, especially among those who truly required Internet access. Plans were in place to provide internet access to the Company’s customers before they were considered for employees. While some concerns, such as outsiders breaking into the Company’s computers, were considered to be valid, others, especially those of employees electronically stealing data, were met with derision – some in the firm responded that to be safe, the Company should rid itself of all telephones, fax machines and envelopes and doors, as those too could be used to export data.
However, in the spring of 1996, the security department allowed a few hundred employees access to the World Wide Web and external email by setting up a firewall between the Company’s internal network and the Internet.

*External Pressure: Economic*

One component of external pressure on the existing environment is the mainframe environment. It is extremely expensive, costing the Company approximately $16 million per year. Though these costs are well understood within the Company, and a plan to retire the mainframe has existed for nearly half a decade, no action had ever been taken on it. (Interestingly enough, if Lotus Notes were deployed to every employee at $55 per month, Group Epsilon would only receive $9 million.)

Another economic issue is the cost of PC’s, as mentioned earlier. On average, a PC had a three year life span, yielding a total cost of ownership (TCO) of anywhere from $25,000 to $45,000. These kinds of numbers could explain why the Company has been hesitant to continue upgrading its desktop hardware and why only 25% of the Company’s employees have what could be considered a ‘modern’ desktop.
5.1.2 Dependent Variables

The dependent variables reflect the state of affairs after the feasibility study.

5.1.2.1 Adoption and Integration

Adoption and Integration: Organizational

This section is complicated by the fact that the Company did little to adopt or integrate either of the two projects described in this study. A few other web servers still exist, but as of the summer of 1996, there was neither a cohesive movement towards an intranet, nor a strategy in place to construct one.

Despite the actions and efforts of a few departments and individuals within the Company, organizationally, intranet deployment and use was essentially a failure and remains an aberration in the Company's IT infrastructure.

Unwillingness to dedicate resources or personnel was a significant obstacle. Although the creation of intranet content can be as simple as saving a file in a word processor, a certain level of technical expertise must be achieved. This requires trained, dedicated personnel. The location of these personnel would ideally be at the departmental level with a small amount of support from a centralized IT group such as Department Gamma, though during the initial stages a roving team of 'intranet gurus' might be enough to spread the basic seeds of knowledge.
Weak IT leadership is a recurring theme in the Company and permeates much of the topic at hand. A prime example, details of which are discussed in the technical sections, is the mainframe ‘sunset.’ This ‘plan’ has been in existence for nearly a decade, yet virtually no decision has been made or action taken on it, other than ‘it would be a good thing to do.’ This indecision on the part of the IT personnel, which in this case consists of both Department Gamma and Group Epsilon, made it very difficult to convince other entities within the Company to consider alternate information delivery mechanisms, such as an intranet. (It is ironic that an intranet is an ideal solution to the problem of maintain connections to legacy systems such as the Company’s mainframe and the information on it.)

Group Epsilon’s favouritism towards Lotus Notes (whether their reasons are technical or political is not relevant) also caused hesitation among departments to adopt an alternative system, even though many did not want a solution as complex and expensive as Notes. Ironically, an intranet and Lotus Notes can (and do) exist side by side quite peacefully, but for some it seems to be an all-or-nothing proposition. Realistically, the two ‘ideologies’ seem to be converging to a significant degree. Web-based products’ low costs and Lotus Notes’ integration are encouraging (if not forcing) the other to improve. 6 However, web-based solutions are still more open and enjoy a wider development base.

6. In the fall of 1996, Lotus released a new version of Notes which included a well-integrated web publishing functionality, and Netscape began to develop collaboration software.
Adoption and Integration : Technical

As mentioned above, a concern of intranet development was training of those involved with the creation of distributed documents. This is as much an economic and organizational concern as a technical one, but it is included in the latter category because as the tools that allow creation of intranet content evolve, they also tend to become easier to use, and thus require less training. As per Gartner, training and time spent mastering software is a significant portion of the total cost of ownership of most computer systems.

The Internet has been chided for being little more than a mechanism to spread one's vanity to global extremes and derided for having little content. While perhaps appropriate for the literati and university undergraduate students, most business prefer more serious content. Fortunately, like most tools, Internet technology can be used for both good as well as evil: the potential exists for in-depth content, and an intranet can be used as an easy-to-use interface to existing though difficult to access information. Gateways can be created to bridge the gap between an intranet and the corporate data stored on the mainframe. Once the intranet interface is set up as an abstraction layer, the source data can eventually be ported to another system entirely. If done properly, the user will not notice the change of source.

The two systems picked for the study, Administrative Guidelines and database connectivity, and their relationship to an intranet are examined below in further
Concerning the administrative guideline electronic distribution, a few technical points are in order. This directly deals with the creation of hypertext markup language (HTML) and issues concerning a web browser as an interface.

The latest versions of most word processors contain a ‘Save As HTML’ command, which is adequate for converting different font sizes and typesets (such as bold and italics). Many also provide the ability to convert the word processors internal indexes and footnotes to clickable hypertext links. These conversion processes were helpful in conversion, but definitely not complete.

Other word-processing constructs can also be replicated in HTML. For example, HTML has a built-in bullet-based outlining method. Testing showed that the WordPerfect word processor provided surprisingly good conversion from its hierarchical bulleted lists to HTML. However, it was very syntax dependent.\(^7\) ‘Find and Replace’ commands were useful in locating these idiosyncracies, but many had to be replaced by hand.

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\(^7\) As an example, it would not convert ‘dashed’ lists. Additionally, it was quite particular as to the kind of tab utilized. Specifically, an ‘indent’ had to be used, as opposed to a normal tab. Needless to say, tabs far outnumbered ‘indent’ in the existing Guidelines.
HTML handles tables well, and Word Perfect's conversion of its tables into HTML was quite robust. However, tables that stretched beyond one page were broken up into separate HTML tables. These required rather inelegant measures to fit back together.

This illuminates a significant difference between HTML documents and word processing documents. Upon creation, most of the latter are bound by the size of the printed page. Web-based documents are not bound by the limitations of paper, nor should they be. Entities such as a large table can either be scrolled through or saved as a separate web page.

A significant problem occurred when previous users 'cheated' and used WordPerfect tables as a structure to make line charts and diagrams. This does not convert well. Ideally these diagrams would be saved as an image that would appear within the final HTML document. Other users created diagrams using only ASCII characters (i.e. 'typewriter art'). Though somewhat inelegant, these can be converted into HTML. The output will vary depending on the font used.

HTML allows the inclusion of hypertext links that allow the user to connect to 'anchors' within the document, in addition to other documents. As will likely not be a surprise, the HTML conversion process in this regard is helpful but not complete.
These examples should indicate that while the tools exist to convert existing word processed documents, (Administrative Guidelines or otherwise), the process is still a fairly complex one and requires a strong knowledge of HTML. Most employees dealing with the guidelines lack such qualifications at this time. (This, however, is due largely to a lack of exposure as opposed to ability.) Note also that the challenge lies in converting documents that were poorly constructed to begin with (not to mention stored in a proprietary format). Basic planning during the initial creation process can save hours if not days of editing when converting to HTML.⁸

That noted, HTML editing tools are growing more powerful by the day and each generation requires less knowledge of HTML syntax. Many graphically orientated tools are now on the market, making it increasingly easier to construct web pages. A combination of such software and a basic familiarity with the requirements and limitations of HTML will likely be enough to allow adequate conversion of existing documents.

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⁸ The difficulty in converting WordPerfect documents into an open format such as HTML suggests that mission-critical documents should not be archived solely in a proprietary format. ASCII and RTF, while fairly universal, lack many of the features found in current word processors. As noted, HTML was designed to preserve content, not layout. Adobe's PDF preserves layout, but unfortunately is not a published standard. Postscript requires a large memory footprint, though less than image files (e.g. GIF, JPEG, TIFF). Corel is taking an interesting approach – its next generation office suite will be able to 'Save...' documents as self-contained Java applets. Not only is this open, but it eliminates the need for an viewer application.
Ideally most of the HTML conversion will be handled by the employee who initially writes the Administrative Guideline. If the process is to be made as painless as possible, the employee will receive document creation guidelines and templates (from the intranet, of course) that will ensure consistency in addition to minimizing maintenance and administrative costs during the life of the document.

There also must be some overlying structure or authority that will oversee links between Guidelines as this is one of the most powerful characteristics of the web. Site maintenance is a critical issue when it comes to web technology. Outdated information and broken links do not make an attractive and useful site. Also important is the maintenance of a central directory of Guidelines (and other electronic documents for that matter). A search engine can be very helpful in this regard.\(^9\)

*Adoption and Integration : Technical : Online Expense Form*

While investigating the second thrust of the project, the on-line expense form and database connectivity, technical limitations of HTML came more into play. Though all of the elements of the paper expense form could be implemented in HTML, the result was awkward and inefficient. This was due partially to the limited space on a standard computer monitor, resulting in a great deal of scrolling. Additionally,

\(^9\) Lycos, Infoseek and Excite are examples of public search engines which automatically traverse and archive web pages on the Internet. The hardware and software packages that make up these are being bought by organizations with large intranets and deployed behind their firewalls.
questions arose on how closely the paper form should be emulated to begin with. Some effort went into designing a different format for recording employee expenses that better took advantage of the electronic medium. This included breaking the form up into multiple pages and automatically populating some of the fields according to the identity of the user.

One advantage of using a web-based form is instant feedback (especially on input errors, such as putting letters in a numeric field), as well as providing menu-driven selection of data (such as a selection among departments).

Database access was quick and effective (though this was not done directly through the expense form due to database restrictions). As previously mentioned, two web servers were running concurrently, Netscape’s and Oracle’s. Netscape provided access to the database though standard query language (SQL) calls in JavaScript. (JavaScript is a scripting language embedded within the HTML files and is designed to run when the web page is loaded. It is intended to add additional functionality and dynamism to a web page. Its object-oriented syntax is based on Java, but it is not Java.) Oracle connected to the database through PL-SQL which then dynamically created a web page. Note the difference between the two setups – JavaScript is embedded within pre-existing web pages, where PL-SQL scripts create HTML (and thus web pages) on the fly.
Of the two approaches, Netscape's was easier to implement, both with the server itself and the database access. JavaScript's syntax is easier to follow, and code can be embedded within objects on the web page. The ease of the web-based administration did not consume time better spent creating content. Oracle's strategy was far less elegant. The server was extremely difficult to set up and maintain, and PL-SQL was more difficult to work with, though the dynamic generation of HTML was very promising. However, it must be remembered that the HTML functionality was an add-on to PL-SQL, whereas JavaScript was designed with web access in mind. Oracle's implementation will likely become easier with time.

Adoption and Integration: Economic

There is a cost to an intranet, regardless of the technical considerations. An intranet requires both the client and server software to be in place. Obtaining the server software was simple, as Netscape was happy to set up a trial and was quite understanding of the political situation and the slow decision-making process within the Company.

While copies of Netscape's web browser are available for free to those in academia, corporations must pay for them. Unfortunately, this proved difficult to accomplish. It was necessary to estimate the number of users in order to calculate the cost of a site license. This number was debated internally, and it ranged from zero (from the Lotus Notes supporters) into the thousands (for those who believed a company
intranet would grow like the Internet). Given the study's quasi-official status, funds for purchasing the software were close to non-existent.

A different department, working with an internet service provider on a separate project, was unaware of our efforts and was negotiating a license with Netscape for over one hundred thousand users. We attempted to contact the individual in charge of this effort many times but our calls were never returned. Our feeling was that the Company could leverage off of this site license and take advantage of the low cost. (The site license for that magnitude would have come to under $10 per client. This contrasts with around $30 per client for 1000 users and approximately $50 for a shrinkwrapped single copy.)

After months of futile effort, this approach was dropped when we discovered that other parties were negotiating to be included in the site license of the Company's multinational owner. Our site license was valid for version 2.0 of Netscape, the latest release at the time. Ironically, we later discovered that the other internal effort to obtain a site license was only for version 1.0, at that point over a year out of date.

5.1.2.2 IMPACT

Impact: Organizational

While this study did not have a significant affect on the day to day operations of the Company, it did reveal that several departments and groups were willing to
experiment with and adopt intranet technology.

Impact : Technical
Part of the technical learning curve was overcome by this study, but the benefit in the long term is questionable as the chief instigator of the study did not seek long term employment with the Company. Although position papers and technical briefs were submitted, these do not replace first hand knowledge of the systems and information in use. The lessons learned from the feasibility study did not permeate the Company's institutional memory.

Impact : Economic
While this study cost the Company very little, (the main cost was salary, as almost all of the hardware and software was loaned), economic benefits were limited as well. The critical mass that would have been required to actually show a measurable return on investment was not achieved. While adopted to a certain degree, the technology was not integrated with existing business practices. Hopefully some of the lessons learned will be applicable in later intranet development within the involved departments, especially since potential benefits, both direct and indirect, were well understood.
5.2 Recommendations

The lacklustre success of the study was not due to technical failure. Most shortfalls were rapidly addressed by the software development companies. Organizational factors (such as poor IT leadership) and internal economic issues (including cost of desktop hardware) were the main barriers to adoption. This being noted, two elements, if adopted by the Company, could greatly ease the implementation of an intranet, both at the departmental and corporate level. This would be applications written in Java running on network computers.

5.2.1 Network Computers and Java

Recent hardware developments have given the Company (and others like it) an alternative to the administrative issues associated with the standard desktop PC. Thin clients, also known as network computers (NC's), are computers with a full-fledged processor but no local storage. This lowers the costs of the hardware, but more importantly, it dramatically reduces the costs associated with administration and upkeep. The cost of the hardware itself can be under $1000, and the total cost of ownership (TCO) is estimated to be $2500 per year.

IBM, Apple, Netscape, Oracle and Sun have formulated an open hardware standard (NC-1, soon to evolve to NC-2) for network computers. The operating systems which run on top of this hardware standard differ, however. Apple uses a simplified version of MacOS 7.5 and Sun is leveraging its Java programming
language to create a JavaOS. At the time of this writing, IBM and Oracle have not yet defined their software standards, though Netscape, which has created an 'appliance' operating system known as 'Navio,' and Sun's JavaOS are leading contenders. Various third parties are also working on NCs. Sun Microsystems' NC was the first to be released, and has a very well defined model, which they refer to as the 'Java Computing' paradigm. This was described in greater detail earlier in chapter 2.

At the present time, it is unlikely that NC's will sweep fat clients out of the organization:

"There is certainly a role for thin clients in the business community," says a Gartner Group analyst of the highly touted network computer, "but it won't replace the PC. Most people will stick with fully configured devices, but employees who can't justify full-function PCs still deserve access to browsing and e-mail." Edupage, 17 September 1996, <http://www.educom.edu>

NC's are well-suited for replacing the 'green screens' or 'dumb terminals' that provide mainframe connectivity. In addition to emulating a VT100 or 3270 session, they can provide graphical interfaces to other legacy systems, e-mail, web access and run Java business applets. Sun, the only major vendor at the time of this writing to have released an NC, (as opposed to merely announcing one), is charging approximately US$700 for a base model. Other industry players are predicting a price range of $500 to $1000.

While some in the industry (specifically Oracle's Larry Ellison) predict a billion NCs by the year 2000, most estimates are somewhat more conservative. According to
Zona research, in just four years, the NC market is projected to equal the size, in units, of the PC market in 1997:

Table 3 – Total Network Computer Market

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>383</td>
<td>1,740</td>
<td>3,445</td>
<td>5,515</td>
<td>6,768</td>
</tr>
<tr>
<td>Consumer</td>
<td>100</td>
<td>2,000</td>
<td>7,500</td>
<td>37,500</td>
<td>70,500</td>
</tr>
<tr>
<td>Education</td>
<td>2</td>
<td>100</td>
<td>292</td>
<td>620</td>
<td>940</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,481</td>
<td>5,831</td>
<td>13,235</td>
<td>45,634</td>
<td>80,208</td>
</tr>
</tbody>
</table>

Source: Zona Research
(PC Week, <http://www5.zdnet.com/zdnn/content/pcwk/1351/pcwk0023.html>)

Some of these figures, especially those concerning the yearly cost figures discussed in chapter 2 along with the idea of the network computer paradigm itself, have been criticized by other organizations.

- Sun's estimates are "highly suspect," according to Pat Gelsinger of Intel, the leading supplier of microprocessors to the PC industry. Installing a network of JavaStations will mean replacing servers, the network and training users -- an "enormous investment," he predicts. (San Jose Mercury News, Nov. 1996, <http://www.sjmercury.com/business/compute/javalll0.htm>)

- Microsoft, Intel and several PC manufacturers announced a 'NetPC' intended to simplify PC management in October 1996. However, this was seen by many in industry as a knee-jerk reaction to Sun's JavaStation announcement. However, unlike Sun, which actually had a product to demonstrate, NetPC's are not expected to appear until late 1997 or early 1998.

- The Economist raised several points against the NC:
  - The initial cost of NCs is higher than promised.
  - The maintenance cost of NCs is higher than promised.

The Economist article may be justifiably critical of these points, but it is important to
remember that the network computer paradigm is still very new (at the time of writing, Java as a language is not yet two years old.) The initial cost is certain to go down in time, especially with Intel and Microsoft developing their own standards. It claims that the additional network traffic and increased server load will require network and server upgrades, thus negating the savings of the thin client. However, it seems that most of the network upgrades would have occurred irregardless of the thickness of the desktop. The Economist also seems to misunderstand the amount of processing that is done on the thin client itself, and is overestimating the server loads. In fact, it is estimated that a single standard Sun workstation should be able to boot nearly a thousand NC’s. However, the number of servers required for application support is a different matter, and depends on how server intensive the applications are. However, the same analysis would have to be undertaken with standard desktop PC’s as well, given the increasing network-awareness of standard software packages.

The last point concerns compatibility. The Economist is correct that currently, NCs from Sun only boot off of Sun servers. However, the booting protocol is open and the limitation on Sun servers is a temporary one. Again, the Economist seems to forget that the NC, like Java, is under constant development and is realistically still in beta-testing.

It is interesting to note that those companies with an interest in maintaining a
thick-client universe (Intel and Microsoft) are highly critical of the NC. (Bill Gates once called the NC "dorky.") Yet despite their criticism, these groups are quickly attempting to build their own NC. As one industry analyst put it,

Oh, and the funniest part about TCO (total cost of ownership)? According to those in attendance, it was listening to Microsoft execs at their recent Developers' Conference talk about the importance of thin NC clients. If the guys who brought you 30MB desktop OSs and 100MB office suites can spin this fast, you'd best be prepared to change too. (PC Magazine, <http://www.pcmag.com/issues/1603/pcmg0130.htm>)

It appears that the makers of PC's and associates have no products ready to fill the dumb terminal space. They are attempting to draw attention away from their own shortfalls (specifically the lack of a product) by criticising the NC for being a poor substitute for a market segment (specifically a full-fledged PC) is not yet intended to fill.

The figures concerning TCO and the methodology used to derive them are defended by those in the industry who have actually deployed and used network computers:

• "The Gartner Group figures are dead on, with regard to the total cost of ownership of PCs and our estimates for the projected costs of NCs agree with Sun's," says Bill Phelan, FTD's vice president of technology. JavaStations are easier to maintain than PCs and provide more functionality than "dumb terminals," he adds. FTD plans to install up to 10,000 NCs in florist shops across North America. (San Jose Mercury News, Nov 11, 1996 <http://www.sjmercury.com/business/compute/java110.htm>)

• FedEx will replace tens of thousands of 3270 terminals--which today run a proprietary application and E-mail--with Java-based NCs. "We fully embrace Java, which obviously puts less emphasis on the desktop OS," said Dennis Jones, CIO at FedEx, in Memphis, Tenn. (PC Week, Jan 20, 1997, <http://www.pcweek.com/news/0120/20ncs.html>)

• Officials at Network Computer Inc., a division of Oracle Corp. that will
manufacture a Java-based NC, agreed that the devices would be used initially as additions to existing systems. "Initial deployments will be as terminal replacements, or for very old PCs -- 286 or 386 systems. But as the Java application software evolves, there will be excellent and viable alternatives," said Bonnie Crater, vice president of marketing at Network Computer, in Redwood Shores, Calif. (PC Week, Jan 21, 1997, <http://www.pcweek.com/news/0120/21enc.html>)

5.2.2 JAVA APPLICATIONS

The one common theme of all of these platforms is support for Java. Applets written in Java and which remain faithful to the open, published application programming interfaces (API's) and libraries which Java provides, will be able to run on any Java Virtual Machine or Java hardware. This is true whether it is a NC, fat client, mainframe or server (or even a cell phone or stereo). Though young in age, the amount of mission-critical software is increasing dramatically and maturing rapidly.

As previously mentioned, mainframe client emulation (e.g. dumb terminals), will likely be one the first and most widespread Java applications adopted by companies, connecting them to their legacy business systems. IBM is licensing Java to write applications that will cross its product line, from PCs, workstations, mini-computers and mainframes. Corel, which bought the rights to the WordPerfect family of applications, has rewritten the entire suite in Java. Software companies ranging from Oracle, PeopleSoft, Baan to even Lotus are also doing major development in Java.
Anecdotal industry evidence shows that most users only use a small subset of the features (often below 20%) of most desktop productivity applications. Given the latest release of Microsoft Office, weighing in over 150 megabytes and $600, many users are questioning the logic of buying software they will never use. Java’s object-orientation and JavaBeans object management means that software can be delivered on demand, and many developers are considering software ‘subscriptions’ or ‘rentals’ for the components that users actually use. Also note that Java applets are significantly smaller than their Microsoft-class applications. There are Java word processing applets that are smaller than 400K, versus over 50 megabytes for the latest version of Microsoft Word. These are not crippled and have most of the functionality and features that most users have come to expect from today’s graphical user interfaces.

5.2.3 Concerns

There are a few issues that the Company needs to consider, both with its current situation and any future path. These include Microsoft’s proprietary nature, availability of Java software, and a union condition that is unique to the Company.

5.2.3.1 Microsoft Lock-in

Industry pundits claim Java and the network computer can break the vicious cycle of Microsoft’s ‘bloatware’ and Intel’s hardware escalation, which requires an
increasingly powerful processor to provide functionality that most employees will rarely use. (This may shed some light on the classic 'productivity paradox,' which suggests that computers and information systems do not actually make people more productive employees. These pundits claim that Microsoft Office is "50 million lines of code to type your name.")

This is especially relevant to the Company given their reliance on Microsoft software and Intel hardware. Since both the NC and Java are non-proprietary, if a vendor fails to live up to promises or expectations, the customer can afford to switch to a more reliable and/or cheaper source.

Another concern is storage of mission-critical company documents in a proprietary format. Many companies rely on Excel, Word and PowerPoint, but the fact remains that these are proprietary data formats. It is questionable logic to hand a single vendor so much power, never mind the long-run implications of an organization not being able to easily access its own data in 10 years, a problem already a factor at the Company.

Microsoft will not give up its position of leadership easily. Though it missed the initial Internet wave, it has made up for lost ground and is pushing an alternative
to Java called 'ActiveX.' Industry pundits have labelled this 'CaptiveX' since it is a proprietary Microsoft standard. An attempt to get Microsoft to release the specifications of ActiveX to an international standards body has met with resistance.

While Microsoft may tout ActiveX as a replacement for Java, it raises some serious concerns. First, as noted, it is not open. Second, it is not portable. ActiveX components must be recompiled every time they are moved to a different operating platform, assuming Microsoft has ported ActiveX to that platform. Thirdly, it is inefficient. This is because most of ActiveX was taken from OLE, another Microsoft closed standard. While effective, OLE was inelegant and used memory inefficiently. While an improvement, ActiveX has inherited many of OLE's roots.

One of these is what makes ActiveX actually dangerous. Java operates in a 'virtual sandbox,' preventing it from accessing local resources such as memory and the hard drive. Java cannot do something unless it is explicitly allowed to do so. ActiveX controls do not operate under such restrictions. In fact, there is an ActiveX control on the Internet named 'Internet Exploder' that, if loaded, will shut down your PC. Another ActiveX control will access the passwords stored in Quicken, a popular personal finance program, and transfer funds from and to various bank accounts.

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10 Technically, ActiveX is an object management environment. Java is often used as a generic term to describe both the programming language and the object management environment. However, 'JavaBeans' is in fact the object management environment for Java. (Note that JavaBeans also cooperates with ActiveX and OpenDoc objects.)
These were both developed by groups concerned with the shortfalls in Microsoft's security approach. It seems only a matter of time before truly malicious ActiveX controls are 'discovered.'

Microsoft has responded that ActiveX controls will be 'digitally signed,' allowing the author to be uniquely identified. However, simply because an ActiveX controls is digitally signed does not prevent it from inflicting damage. (The Exploder control was purposely signed to demonstrate the weakness of relying solely on identification as a security mechanism.) Whereas Java was built from the ground up with security in mind, ActiveX seems to be fundamentally dangerous.

Scott McNealy, President of Sun Microsystems (and no great fan of Bill Gates and Microsoft), once quipped that "the Wintel platform is the petri dish of choice" when it came to computer viruses and trojan horses. This legacy of insecurity seems to have been passed on to ActiveX. However, the implications are much more severe when the transportation vector is a world-wide network as opposed to three-and-a-quarter inch floppies.

Microsoft is attempting to encapsulate Java within ActiveX, claiming that Java is just another language which one can use to write ActiveX components. While this is true, it seems to make more sense to keep programs in a secure and portable language and object management system that does not lock the user into a single
operating system, especially one with well-documented security implications.

5.2.3.2 Availability of Software

At the time of this writing, Java is only 500 days old, and the NC project is only 9 months old. Some have voiced concern over the availability of software. However, there are more books published on Java than C++, and it is estimated that there are nearly 200,000 'serious' Java programmers, compared to 400,000 developing for Windows. The number of serious business applications in Java is increasing rapidly, as mentioned in section 5.2.2. Many major software vendors are rewriting their applications in Java. Even Microsoft has (begrudgingly) licensed Java.

The critical factor with Java, however, is its portability. Once a program is written in Java, it can run anywhere there is a Java Virtual Machine or Java chip. The user does not have to recompile or customize. This protects a company's software investment, and it is unlikely Java will suffer the same porting and legacy problems that afflict other platforms.

As previously mentioned applets are small and operate in an object framework. Because of this, they fit especially well in a networked environment. A core set of applets can be upgraded incrementally, and the user will download the latest version of the sub-applications (e.g., spell-checkers) on demand. Although the source cannot be identified, there is good reason to believe that Java-based
component software is going to be significantly cheaper than Microsoft-class software suites. This follows logically, given the limited feature set of the upcoming Java applets, as well as competitors' desire to break Microsoft's grip on the market.

5.2.3.3 UNION ISSUES

As previously noted, one reason why PC's are especially costly at the Company is the union agreement. Installation of software is a designated union duty. The union has interpreted this as allowing them to reinstall all of the operating system software on computers coming into the Company. This adds several thousand dollars to the initial cost of each PC, perhaps explaining the hesitance of management to acquire more. Network computers are an attractive replacement for many existing desktops. However, there is a serious concern – with a network computer, there is no installation of an operating system since there is no hard drive. A network computer boots over the network. This could potentially cause acrimony with the union, especially given the employee technological redundancy clause. A literal interpretation could be taken that the operating system is being installed each day without union supervision. Though this may seem extreme, the Company's union environment is a unique one.
CHAPTER 6 CONCLUSION

6.1 CONTRIBUTION

Hopefully this paper has shown that intranets are a powerful method for leveraging an organization's existing information system as well as preparing for future advances. They are cheap to build, have proven returns, and help employees access the resources they need to do their jobs effectively. An intranet should allow employees to do things with their computers, not to their computers.

6.2 ANALYSIS OF APPLICABILITY OF IACOVOU MODEL

Analysis of this model is hampered by the failure of the study at the Company. In the end, intranet technology was not advanced beyond the limited scope of the case study, and was not spread to other departments. While it is unfortunate that the model does not gain closure, (the dependent variables, especially impact, are essentially null), inferences can still be drawn as to its validity.

Specifically, the reasons for failure are largely highlighted through the organizational subcomponent across the independent variables. The economic factors were barriers, but not insurmountable ones, and the technology was not a issue in the lack of adoption. (Some of these factors are discussed in greater detail in the following 'Shortfalls' section.) However, the ability to draw out specific organization issues within each independent and depended variable reflects the
strength of the added attributes in the modified Iacovou model. It is uncertain whether the original Iacovou model would have been able to easily reveal such information.

However, there are implications when the independent and dependent variables are broken down into technical, economic and organizational subsections. At times this structure seems unwieldy, sometimes suggesting artificial distinctions to exist in terms of the newfound resolution. If implemented in future studies, the author should decide on a case-by-case basis whether to take the analysis to the full depth. Nevertheless, the benefits of such resolution appear to outweigh its detriments.

A final note on the modified model is that there may be justification for having an ‘organizational’ section within ‘organizational readiness,’ even though the analysis did not suffer because of its absence. Other studies, however, will have different requirements.

6.3 Shortfalls

A major downfall of this study was that the Company took little action in fostering the growth of an intranet. While this paper was only based on a single feasibility study, it still is curious that so few web servers existed within the Company. While there were some obvious constraints of not enough PCs, the networks were largely in place and the software was available. It seems that other companies have the
opposite problem of too many web servers going up. (This author has actually heard complaints at some companies with large intranets that there is too much information available.) The attitude of the internal IS departments and the restrictions imposed by the union remain serious constraints that could partially account for this behaviour.

But perhaps most dampening is an apparent lack of entrepreneurial spirit and enthusiasm within the Company. The average age of managers is approximately 45, and there are very few people under 35 within headquarters. Given that the average age of internet users is in the upper 20's to lower 30's, (Georgia Tech, 1996, MIT, 1994), and the near-absence of younger employees close to the decision making process, this age gap could very well be a limiting factor in adoption of new technologies, though such speculation is the subject of another paper.

Hopefully with the advent of Java and network computers, the Company will be able to jump-start an intranet program and be able to quickly leverage its benefits.

6.4 Areas of further studies

This study was limited to two departments in one building of the Company. More information might have been gained had a wider internal study been undertaken. Though the first study was not successful, this should not prevent further study in the area. However, dedicated resources would have to be put in place for this to
succeed.

Some have jokingly called this paper “How not to Have Intranet Development in a Large Organization.” In all seriousness, much could be learned by examining other organizations of the same size and perhaps even in the same industry. It would be illuminating to discover what factors make an organization more ‘intranet-fertile,’ and how they overcame their organizational limitations.

Another intriguing possibility would be to use the model in a large enough context to assign empirical measures to each of the sub-variables. Iacovou’s original model was empirical in nature – approximately half a dozen small businesses were interviewed and analyzed. The increased resolution may yield interesting results, whether the study is within an organization at the departmental level, or across small businesses as in the original Iacovou model.

6.5 **HIGHLIGHTS TO THE OUTSIDE COMMUNITY**

Given that this paper was developed in a business as well as an academic environment, there are observations that may be of interest to the outside community. First, Internet technologies are highly applicable in business environments. Their non-proprietary nature make them relatively inexpensive compared to standard IT solutions, and their arrival has caused the proprietary solutions (e.g. Novell, Lotus) to not only come down in price but become more open
themselves.

Developing mission-critical software in Java and deploying thin client network computers seems to be a viable solution to creating an intranet. The NCs should be aimed at replacing any existing dumb terminals. If mainframe applications are switched to more powerful 'thick' servers, Java clients can run on both the existing PC base and the NC's, as well as any future hardware implementation that supports a Java virtual machine. However, given that the intranet will likely be connected in some fashion to the Internet, care must be taken in adopting security policies that protect users and their data. It is also important to ascertain that critical documents and systems are not locked into proprietary formats which would be difficult to convert or withdraw from if the vendor fails to live up to expectations.
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Appendix 1 - Original Iacovou Model

(Iacovou, 1994, p. 467)