OPPORTUNITIES CREATED BY INFORMATION TECHNOLOGY FOR THE
EXECUTIVE IN THE ENGINEERING AND CONSTRUCTION INDUSTRY

by

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Submitted to the Department of Civil and Environmental Engineering
in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Civil and Environmental Engineering

at the

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ABSTRACT

This thesis examines the opportunities created by information technology for individuals at the executive level in the engineering and construction industry, in particular with respect to networking and interaction.

The foundations of this research emerge in part from a project initiated by the World Economic Forum in the late 1980s aimed at connecting its members, executives of global companies, through a virtual network. The project was called Welcom for World Electronic Community, and it was a first attempt in developing an information technology solution focused on executive’s needs.

To understand how information technology today, primarily through the Internet and the web, can be utilized at the executive level, it is critical to analyze these needs. This analysis is done in this thesis via a survey of about 20 executives from the engineering and construction industry. The survey is based on a series of interviews, followed by a questionnaire. The interviews reveal critical tasks for executives such as interacting and networking with clients and peers. How information technology is used to add value to these tasks and in particular the aspects of virtual versus face to face interaction is examined. The questionnaire acts as a follow-up to the interviews and reveals the interest of using the web as a content provider to executives for issues such as industry specific economic and financial information.

The thesis combines literature research on the information technology revolution, the analysis of the Welcom initiative, and the survey. This provides us with insight about how information technology is having an influence on the way executives in the engineering and construction industry interact, communicate and do business today, and the potential opportunities for the future.

Thesis Supervisor: Professor Fred Moavenzadeh
Title: Professor of Civil and Environmental Engineering
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Chapter 1

Introduction

1.1 INTRODUCTION

The commercialization of the personal computer in the early 1980s and the growth of the Internet and the World Wide Web in the 1990s have had a tremendous impact on our personal and professional lives, and will most likely continue to have an influence in the future. Interconnecting people through computers has put us in the midst of a social and cultural revolution that some authors compare to the industrial revolution initiated by the invention of the steam engine over two centuries ago.

Examples of how our personal and professional lives have been affected by information technology (IT) are numerous. E-mail has changed the way we communicate and exchange information. The Internet and the emergence of electronic-commerce have influenced the way we buy and sell goods redefining some of our needs. For corporations, Internal networks, Intranets, have enabled to centralize data and share knowledge between employees more efficiently, eliminating paper work and saving time and money. The increasing number of telecommuters is yet another example of how information technology has influenced our lives. Finally, the globalization process that
allows even small corporations to reach beyond their geographic boundaries and seek business on a global scale is largely driven by information technology.

Analyzing how information technology is changing the way we live and conduct business would be an ambitious endeavor, and goes beyond the scope of this research. However, I have decided to analyze a portion of what some call the “information revolution,” and focus my attention on a specific group of people, namely individuals at the executive level in the engineering and construction industry (hereafter referred to as the E/C industry).

Information technology today has penetrated all levels of the corporation, and is primarily being used at the operational level. Exchanging CAD files electronically and monitoring project development through the company Intranet are typical examples for the E/C industry.

However, there is little information on how CEOs and executives, in particular in this industry, have used information technology as a provider of added value to their responsibilities and obligations. More specifically, with today’s technical possibilities, what are the opportunities created by information technology for the executive in the E/C industry? This question captures the scope of my research.

1.2 FOCUS AND OBJECTIVES

The primary focus of this research is to analyze the impact of information technology for executives in the engineering and construction industry. To answer this question, it is critical to analyze the specific tasks of this group of individuals and how information technology can add value to these tasks. The job of an executive primarily involves interaction and networking with clients and peers. I will therefore particularly emphasize the aspects of communication and interaction enabled by modern information technology.

A) The Welcom initiative

The foundations of this research emerge in part from a project initiated by the World Economic Forum (WEF) in the late 1980s aimed at connecting its members, primarily
executives of global companies, through a virtual network. The project was called Welcom for World Electronic Community, and it was a first step in developing an information technology solution focused on executives needs. The idea was to establish a process where executives could network and interact virtually on an on-going basis in between traditional meetings and conferences.

One of the original groups targeted by Welcom were members of the WEF from the E/C sector. It was believed that Welcom could serve this group’s interest of building a community of executives, enhance collaboration and help them address issues like environmental policies and infrastructure development.

Welcom went through various technological changes from a simple e-mail system in 1989 to a stand-alone videoconferencing system in 1995, and finally onto the web. The project was put on hold in 1999 due in part to a lack of momentum, but I had the opportunity to participate in the development of Welcom in 1997 and analyze its implications for executives in the E/C industry.

B) The situation today

Welcom was primarily established to create a virtual community of executives enabled by information technology. Today, the Internet and the web offer numerous opportunities for this group to communicate, interact, access information and do business.

When we trace back the evolution of information technology we see that 15 years ago, the first personal computers (PCs) were primarily used for word and data processing at the lower levels of the corporation. The capability of interconnecting computers and more powerful hardware and software allowed people to start sharing their work and increase the information flow between project teams for example. Today, we see the computer “creeping” its way into the boardroom as executives are starting to pay attention to the opportunities created by information technology.

This research analyzes the tasks of executives from the E/C industry, how familiar today’s executives are with the PC, and how information technology in general can help them perform these tasks more efficiently. Specifically, it will explore how information
technology can be utilized considering that the primary tasks for executives revolve around networking and interaction with clients and peers. The opportunities created by the Internet and the web through the provision of content and information as well as electronic commerce possibilities will also be discussed.

C) Objectives

Executives I interviewed believe that the opportunities offered by information technology are heavily underutilized at present at all levels of the corporation. New concepts such as knowledge management are being defined, and serve as an indication that the 1990s only mark the beginning of the future possibilities enabled by information technology and the web. Companies struggling to keep up with the rapid evolution that we have experienced these past years and trying to define a proper IT strategy for their business supports this statement.

The objectives of this research are to assess the use of information technology at the executive level in the E/C industry, and point out the critical issues that are relevant for this select group of individuals. I do not intend to propose a particular solution for the use of IT for executives, but rather show what has been done so far in that field, where we stand today, and how these elements might have an influence in the future.

1.3 Approach

This thesis consists of two parts. First, a literature research traces the evolution of information technology and its implications. This research explores how this evolution has affected our personal and professional lives, the consequences for the E/C industry, and how information technology is “creeping its way” into the boardroom of companies and being adopted at the executive level in the industry.

The second part is based on direct contact with a group of executives via a series of interviews followed by a survey. The interviews analyze the tasks critical to an executive in the E/C industry and the impact of information technology on performing these tasks from a personal perspective, in particular with respect to networking and interaction on a peer-to-peer level. The survey acts as a follow-up to the interviews and analyzes the
opportunities created by the Internet and the web that could be critical to doing business at the executive level in the E/C industry.

Chapter 2 outlines the literature research primarily based on articles from industry-specific and non industry-specific publications, books from the information technology sector, case studies and evidently information found on the web. Chapter 3 sets the groundwork for the personalized interview and survey approach, and chapter 4 analyses the feedback from these interviews and surveys.

Finally, chapter 5 summarizes the combined lessons from the literature research, the interviews and the survey. The conclusion uses these lessons to assess the situation today and plausible scenarios for the future.
Chapter 2

THE EVOLUTION OF INFORMATION TECHNOLOGY

2.1 INTRODUCTION

This chapter looks at the evolution of information technology and the impact it is having on our lives and the corporate world. I intend to analyze how information technology is being used today in the E/C industry and in other industries and in particular the use of the Internet at the executive level in companies. I will underline this part with the analysis of Welcom (World Electronic Community), an early attempt to use information technology as a communication and networking tool for executives.

The research is based on articles and case studies as well as literature from the information technology field. Note also that a tremendous amount of information was found on the web. A list of the most relevant web-sites is given in the reference.

The online encyclopaedia dedicated to computer technology (www.webopaedia.com) defines Information Technology (IT) as “the broad subject concerned with all aspects of managing and processing information, especially within a large organization or company.”
The definition also mentions that computers are at the center of managing and processing this information. Hereafter I will use this definition and refer to information technology primarily in terms of the use of personal computers (PCs) and related computer networks.

2.2 THE IT REVOLUTION: IMPACT ON OUR LIVES

The literature about how information technology is changing the world we live in and will influence the future is abundant these days. The impact will be created on our personal lives on one hand, with more sophisticated and cheaper technology that enable us to communicate and be entertained, and on the business side. This study focuses on the latter. On the business side, companies have managed to exploit information technology to either provide new types of services, or lower their costs in providing their traditional services. Dell Computers for example has successfully used the Internet as a sales channel making $14 million of sales over the web daily, equivalent to approximately 30% of their total $18.2 billion annual sales of computer equipment (www.dell.com). Another (more recent) impact has been the emergence of new companies that solely rely on the web to provide goods and services. Amazon.com (www.amazon.com) is an example selling $610 million worth of books and CDs exclusively over the web over the course of last year (Standard & Poor’s Industry Survey, 1999).

These are just examples of how computers, and in particular the Internet and the World Wide Web (the web), have started to have an influence on our corporate as well as our personal environment. According to Professor Dertouzos from the Laboratory of Computer Science at MIT we are at the eve of a social and cultural revolution comparable to the industrial revolution, initiated by the invention of the steam engine in the middle of the 18th century (Dertouzos, 1997).

An article written by two MIT professors in 1991 captures the scope of this new revolution and the impact it will have on businesses by describing that: “The revolution under way today will be driven not by changes in production but by changes in coordination.” (Malone & Rockart, 1991) They make an analogy between today’s information technology and the “transportation technology” brought by the industrial revolution. First, people used the new transportation means like trains and cars as a more
efficient substitute to horses and carriages. The second effect of this technology is that people began to travel more, which created an impact on where they lived and worked. Ultimately with the availability of cheap transportation and an efficient infrastructure, urban environments were completely reshaped into what we are familiar with today as people started to live in the suburbs, and businesses started to expand beyond regional boundaries. The social and economic structure in which people lived was completely transformed.

Similar to the transportation technology, information technology’s first effect will be a substitution for human coordination tasks. As information technology becomes cheaper and more efficient, the amount of coordination that can be done will increase tremendously leading towards more “coordination-intensive structures” in the corporation, ultimately reshaping responsibilities, tasks and activities of individuals inside and outside of the work place (Malone & Rockart, 1991).

Today, these predictions are happening. People working from their home while fully connected to their offices, also known as telecommuting, is just an example of social change that is taking place through information technology. A survey by FIND/SVP estimates the number of telecommuters in America at 15.7 million in 1998, a strong increase from the 4 million in 1990.

On an other level, and in relation to electronic-commerce that I will discuss in sector 2.5, with the availability of data in form of text, music or video over the web, peoples’ demands for books, music and movies are being transformed. An example is the debate in the music industry over the availability of MP3 files (a version of CD quality music files) over the web. The recording industry sees the use of the web for distributing MP3s as a threat, but for artists it’s a way to gain access to a broader audience (www.wired.com). How this will ultimately affect the whole of the music industry is speculative at this point, but this industry will certainly have to adapt to the Internet as a new mean of providing entertainment to consumers.

The question of how information technology may completely reshape the society we live in is an ambitious one, and certainly beyond the scope of this research. My intent here is to
lay the groundwork of what is happening today and what the implications may be for the executive in the E/C industry. Nevertheless, reading from individuals from the information technology environment, it is clear that there will be a significant impact on the workplace in the years to come: “Information technology will affect much more than the physical location and supervision of employees. The very nature of almost every business organization will have to be reexamined” (Gates, 1995).

### 2.3 CONNECTING PEOPLE: THE INTERNET AND THE WORLD WIDE WEB

In order to understand how we arrived at this stage of a “coordination-intensive” society, I propose to look at the history of interconnecting people through computers. This will give us an idea of where we are today, and what the opportunities are for the future.

The Internet takes it’s origin in the 1960s when the United States Department of Defense created the Advanced Research Project Agency (ARPA) and provided funds to laboratories and universities to put emphasis on the development of computer technology. Aside from developing computer languages and operating systems, interconnecting computers to communicate, share data and access remote applications was a primary area of interest. The Arpanet was born, linking military sites and universities. (Dertouzos, 1997).

Eventually, the Arpanet became the Internet partly through the development of the TCP/IP protocol (Transmission Control Protocol/Internet Protocol), which dictates the “rules” of transferring electronic data, and through connecting disparate networks that developed into a “network of networks.”

The Internet grew in the 1980s from 1,000 connected computers in 1984 to over 100,000 in 1989 (OECD, 1995), but it was still somewhat esoteric given that one had to be computer literate in order to exploit its potential like accessing data, and communicate via electronic mail. Enter the web. The World Wide Web (the “web”) appeared in 1989 with the invention at the European Center for Nuclear Research (CERN) by Tim Berners-Lee of a language that enables text documents, graphics and files stored on Internet servers to be linked to each other, namely the Hyper Text Markup Language (HTML). In 1993, the
first browser, Mosaic, appeared which gave the web a friendly graphical user interface and made its access available to non-technical people. Today, the dominant web-browsers are Netscape Navigator and Microsoft’s Internet Explorer. Note that the web is a part of the Internet, not all Internet servers are part of the web.

The web marks the origin of the explosion of the use of the Internet as users worldwide can connect share information and communicate more easily than ever before. Today, the number of users worldwide is estimated over 100 million (Standard and Poor’s, 1999).

2.4 E-MAIL AND OTHER TOOLS

One of the features that makes the Internet so attractive is the possibility it gives us to communicate with each other primarily via the use of electronic-mail, e-mail. E-mail existed already in the early years of the Arpanet and Internet, but today it has become a powerful and easy to use tool, and it will continue to be so in the future (Dertouzos, 1997).

Prior to E-mail, primary means for communicating over distance were the phone, the fax, and regular postal mail. I have identified the following features that make e-mail attractive in comparison to the more traditional means of communication:

- *It is time and location independent:* one can send out an e-mail to the other side of the planet, and the recipient will read the message as soon as availability permits
- *Nowadays it is easy to use:* an absolute critical factor for executives who are not always familiar with the use of computers
- *It can be informal:* you can send an e-mail message in reference to a subject you would not usually call a busy colleague about
- *It offers powerful additional features:* you can send all types of files through e-mail such as text, images, sound, reports, CAD files, web pages…
- *Spectrum of reach:* anyone that has access to the Internet can set-up a personal e-mail account

Another interesting communication feature of the Internet is the use of video. In the construction industry it offers the possibility of virtually “touring” a construction site in a
foreign location from the company headquarters for example. This is used either to monitor a project, or to showcase the company's activities to a potential customer interested in a particular project.

Based on the interviews I conducted however, I discovered that using videoconferencing to communicate outside of occasional group meetings between different locations (room-based videoconferencing) is not very attractive at this time for the following reasons:

- The advantage of having a visual image is still offset by the low quality of current systems (compared to television image quality for example)
- Today it is by far not as widespread as e-mail because of the additional technology needed and the cost it incurs
- For people not familiar with computers it may seem complicated to use without technical support
- The price to value of a quality system is still to high for smaller companies
- Videoconferencing, unlike e-mail, is not time independent

Executives whom I talked to and who tried videoconferencing systems were not convinced by its efficiency as a business tool. Most of all, it seems that today videoconference sessions are still often organized beforehand over the phone or over e-mail which adds a level of complication to the use of the system. This is undesirable for the time constraint executive.

Nevertheless, we can expect that this technology will evolve in the near future and that computers will have integrated camera and speakers for video-communication. The great advantage of adding image when communicating over distance is that it is closer to face to face communication than the phone or e-mail. The interview analysis in chapter 4 will place emphasis on face to face communication at executive level. Videoconferencing may provide an alternative for face to face communication in certain situations.
2.5 ELECTRONIC COMMERCE

Aside from accessing and sharing information, and communicating via e-mail electronic commerce is a powerful feature that enables businesses to seek an added value in using the Internet.

Looking at the literature, there are various definitions of the term e-commerce. According to Dertouzos (1997), there are two ways to look at e-commerce. First, “indirect electronic commerce” which consists in the trading of physical goods, but where the information necessary to handle the transaction is done on-line. An example would be buying a computer or a book online. The second aspect is “direct electronic commerce,” where the goods themselves are information that can be “shipped” online. Examples for the construction industry could typically include CAD files, or even entire Requests For Proposals that could be submitted online. Today, the “indirect electronic commerce” is the primary model that takes place on the Internet.

Another way of looking at electronic commerce is to analyze the parties among which the goods are exchanged. I have identified the following categories:

- Business to consumer: typically the buying of a book, a CD or any retail item from online “stores.” The buyer securely enters a credit card number on the company web-site, gets charged, and the item is sent to him/her within a few days

- Consumer to consumer: typically a transaction taking place over an auction site like eBay (www.ebay.com), where individuals can auction off their possessions (used bicycle, collector items) to the highest bidder

- Business to business: Dell Computers for example is in this category (as well as in the business to consumer). Dell sells computers and servers to companies over their web-site

Business to consumer e-commerce has enabled companies to use the Internet as a direct sales channel, reducing costs and paper work. The Internet has also opened the market for new companies who have benefited from these e-commerce opportunities. Online retail
spending for 1998 is estimated at $13 billion, and is expected to reach $95 billion by 2002 (Standard & Poor’s, 1999).

We have discussed as an example in section 2.2 how the music industry is likely to be transformed by the availability of music files over the web. The same certainly holds true for book publishers and movie producers as text and video are just another form of data.

The software industry for one has already been changed as programs can be bought and directly downloaded over the web, completely eliminating the need to go to the local computer store. These are examples of the Internet actually transforming peoples needs and habits via e-commerce.

Business to business e-commerce is believed to be an even larger market with estimates at $43 billion for 1998 rising to over $1.3 trillion in 2003 (Standard & Poor’s, 1999). Dell Computers and Cisco Systems who are strongly established in this market, estimate their daily Internet sales around $14 million and $20 million respectively (Standard & Poor’s, 1999).

In my opinion the engineering and construction industry can typically benefit from e-commerce in the business to business category. An example is provided by Industry To Industry, Inc. (www.i2i.com) a company based in Boston that studies and proposes business to business e-commerce solutions to companies in different industries. For the construction industry, Industry To Industry, Inc. is focusing on the online auctioning of used construction equipment. Sellers can post their equipment online through the Industry To Industry, Inc. web-site and buyers can bid online. The web-site is entirely secure and offers sellers a worldwide audience. Once the auction closes (closing date and time are determined by the seller), the highest bidder wins and the transaction can take place. Security mechanisms are put in place to ensure a proper transaction, and the buyer/seller can request the service of Industry To Industry, Inc. partners who can handle shipping and inspection of the equipment.
This is how e-commerce on the Internet can benefit the E/C industry to broaden its market, reduce administrative costs and paper work, and most of all find the right price for the right equipment.

2.6 A LOOK AT DIFFERENT INDUSTRIES

Before looking at the E/C industry and in particular the impact of IT at the executive level, I will briefly analyze with the help of a few examples how information technology has affected other industries.

A) The automobile industry

Information technology and in particular the Internet have impacted the automobile industry on various fronts. According to Professor Daniel Roos, Head of Engineering Systems Division at MIT, the Internet has primarily had two effects visible to the consumers. First, it enabled dealers to access a broader market than just their geographic region, and second it enabled new players to come into this market such as Microsoft’s CarPoint (www.carpoint.com) or Auto-By-Tel (www.autobytel.com) who use the web exclusively as a sales channel for consumers. In fact the Internet has had such an impact on this industry that today, of all new cars being sold in the United States, 30% are being purchased over the web.

An example of a company that has embraced the web in the auto industry is Edmund’s Automobile Buyer’s Guide. Edmund’s started as a price guide catalogue in the sixties that gave consumers all the information they needed before buying a new or used car (Harvard Business School case study 9-397-016, 1996). Today, Edmund’s is on the web (www.edmunds.com) and acts as a one-stop-shop location with partners that will find a dealer close to you and offer financing and insurance plans. The process of searching and buying a car is done entirely online.

Manufacturers such as the Ford Motor Company have also taken advantage of the web in view to take-up the challenge of an increasingly competitive industry that require improved quality, reduced cycle times and lower costs (Harvard Business School case study 9-198-006, 1997). Ford set-up an Intranet in the late 1980s relying on the TCP/IP
protocol (the protocol which supports the Internet) to network and exchange design and manufacturing files between departments. In 1995 followed a web site primarily for marketing and sales purposes. Later, the now web-based Intranet was used for internal departments to check company news and competitors. Ultimately, Ford used the web to connect with its suppliers in a joint effort with GM and Chrysler to “establish automotive industry Internet standards” (Harvard Business School case study 9-198-006, 1997).

B) The banking industry

The banking industry has also been affected at all levels by information technology. The first and most visible effect is the emergence of ATM machines that eliminate the need for the local branch to get money. Today, certain ATMs can handle over 100 transactions ranging from cash dispensing to mutual fund investing and even trading stocks (Business Week, 1994).

For banks themselves as a corporation, the impact of IT takes on different proportions. It has for example enabled banks to link between each other electronically and handle funds worldwide within seconds, creating huge savings of time and money. An example is the Inter-Bank Online System (IBIOS) created by a group of banks. “For the banks in the system, the profit potential is clear. They can use other’s branch networks to do business in markets they were never able to get near before” (Business Week, 1994). For the group’s corporate clients, savings through speed up transactions that the network enables are not trivial. IBIOS was aiming at connecting hundreds of banks over fiber-optic cables.

These are merely examples of how information technology and in particular the Internet and the web have created new opportunities for the automobile and banking industry. But practically all industries are affected one way or another.

2.7 THE E/C INDUSTRY

A) Cemex case study

In what ways has information technology and the Internet been used in the E/C industry, and how can it contribute to lower costs and offer better service? One interesting case
study points towards the Mexican company Cemex who has fully embraced information technology in various ways (Business Week e.biz, 4/20/1999).

Cemex has invested over $200 million in information technology systems over the past 10 years and used the Internet to link clients, suppliers, and executives worldwide creating “one of the most advanced company networks anywhere,” now the company is looking at e-commerce opportunities.

Cemex uses its Internet-based system to track real time status of their shipments, arriving supplies, and related customs duties. What’s more, the company intents to link its customers and suppliers to the system, so they too can track shipment information and Cemex can view their client’s payment records. The company was among the early ones to launch a web-site in 1995 that provided financial information for investors and other information for their customers. Another interesting use of technology that Cemex has made is to equip some of their ready-mix concrete trucks with global positioning system (GPS) devices, so the client on a construction site can track the concrete delivery and plan accordingly.

Overall, using information technology has enabled Cemex to “make it one of the lowest-cost producers.” Most interestingly for the purpose of this research, Cemex uses the Internet to create “virtual communities” for their business divisions and also for their executives worldwide. Executives can access “everything from inventory to delivery schedules and quality records to oven temperatures.” These communities also allow for communication and information exchange between peers on a global scale.

B) Other opportunities

I used the Cemex case as an example to assess where some of the players in the industry are today. More generally speaking, what does information technology offer to engineering and construction firms? An article in Engineering News Record states that the Internet is “increasingly becoming an indispensable business tool that they [construction firms] will need to use in order to stay aloft.” The article states that engineering firm have actually been among the first ones to use e-mail and the web as a business tool, primarily
to share drawings. On the other hand, opportunities offered by the Internet for procurement of material for example have not really been used so far (ENR, 10/28/1998).

As for any business, the question is how to use IT and the Internet in a profitable manner. One example of what companies are doing today is creating project-specific web-sites integrating software and databases accessible via a web browser. The purpose is to allow the owner and other project participants to access information, share drawings and communicate. MP Interactive (www.mpintercative.com) is a firm that specializes in developing collaboration software and solutions for project management, focusing on reducing communication costs and cycle times.

MP Interactive has been able to lower communication costs up to 60% for certain projects, reduce turnaround time for Requests For Information by up to 80%, and reducing the number of needed site visits by 50% (ENR, 7/13/1998). Other companies like Blue-line/On-line offer similar software that “enables everyone in the project team to work from the same page, improving productivity. It helps accelerate time-to-market, reduce cost, increase revenues and to minimized rework due to communications errors” (www.bluelineonline.com).

The lesson we learn is that online business opportunities are numerous for the E/C industry at the project management and operational level. Today engineering and construction companies are looking into “using combinations of technology to speed up project delivery” (ENR, 7/13/1998).

We can infer from this research that companies in the E/C industry have identified and are actively exploring opportunities enabled by information technology. Some companies like CH2M Hill and Raytheon Engineers & Constructors have even created an internal Internet advisory boards (ENR, 10/28/1998). The question now is to analyze how all these new opportunities affect at the executive level.

2.8 THE USE OF IT AT THE EXECUTIVE LEVEL

Lets first take a look at the history of the use of computer within corporations. Before the appearance of the first web browser in 1993, using the Internet was reserved to a few
computer literate individuals. But companies had already been using personal computers (PC) and computer networks as a business tool for a decade. In fact, since the appearance on the market of the first PC in the early eighties people have been using word processing, spreadsheets, book-keeping and communicate. Until the late eighties/early nineties, word processing and databases were the primary uses of the PC in companies. After 1993, communication gained in importance over other uses (OECD, 1995).

We have analyzed some cases of how information technology is being used in the E/C industry today. In short, if we look at the evolution of IT as a business tool in general, we can observe that fifteen years ago the primary purpose was limited primarily to word processing and data handling on spreadsheets. Today, with Intranets, the Internet and the web, powerful databases and software, performance at the operational level has increased tremendously, in particular for project management.

In the fields of communication, the web and e-mail have made it easy to share information among peers. Tools like videoconferencing are becoming more and more reliable and the quality and simplicity of use of computers is increasing every day.

We can infer from this evolution that IT as a business tool is slowly climbing up the corporate ladder, and “creeping” its way into the boardroom. So how are CEOs and executives adopting this new technology?

According to a recent article in Business Week, one out of four CEOs in the United States (all industries combined) “surfs” the web regularly. Primarily for industry related news and competitor information. The article argues that top executives today recognize the impact of the Internet and in particular e-commerce, hence it is critical for this category of individuals to become familiar with IT. What’s more, today IT solutions become an inherent part of corporate strategy, a fundamental change from 15 years ago where computers were primarily used at the lower levels of the corporation. Two statements support this argument: “You need high level support to get an entire organization to embrace e-commerce” (Business Week, 3/22/1999) and “the key to achieving value with the new information systems technology is to keep sight of the organization’s business objectives” (Grochow, 1997).
2.9 THE QUESTION OF CONTENT

So from a company perspective it is important that executives get acquainted with the use of the IT, but what are the advantages in this particular position? A key aspect is the question of content. With all the information available over the web, how does an executive get the information he/she needs in a form that is useful.

The idea of using the web as a content provider for this industry goes beyond making available specific information, or reorganizing existing information so the executive can take immediate action knowing all issues at stake. Information “content” can take on two forms. First the documents, text-files, images, CAD files that can be shared via the Internet. Second the “delivery of human work over the networks” (Dertouzos, 1997).

Both of these notions can be important to the executive. I would assume that the first notion of content is primarily centered around accessing information through the corporate Intranet, and on the web. Currently a number of web-sites offer industry specific information most often in the form of an online version of the more traditional magazines. One of the most popular ones covering the whole industry is Engineering News Record at (www.enr.com). Other web-sites offer financial information about companies complete with stock quotes and recent press releases (www.bloomberg.com or www.yahoo.com).

The notion of providing content through “human work” deals primarily with communication. We have seen that e-mail and video are tools that can support the flow of communication content. One early experiment that goes along this line was the creation of Welcom (World Electronic Community) by the World Economic Forum (WEF) for its members. The idea behind Welcom is to act as a community building medium, where executives can meet, network and interact virtually.

2.10 WELCOM: SHARING KNOWLEDGE AMONG EXECUTIVES

Welcom was one of the first projects designed to provide executives with a technology enabled solution in views of interacting and networking. The project started around 1989 as an attempt to strengthen the community of executives who usually meet at the WEF
Annual Meeting in Davos, and enable them to communicate and interact virtually throughout the year.

The Welcom project went through numerous changes mainly dictated by technological evolution and is not being further developed today. Nevertheless, in relation to this thesis it is critical to analyze the evolution of this project with respect to executives specific information and communication needs.

A) The original idea

Welcom first emerged as an initiative of the World Economic Forum in the late 1980s. The idea behind Welcom was to use information technology to create a permanent exchange possibility between executives, in particular for working on common projects in the case of the E/C industry. The technology that was used to communicate was an electronic mail system provided by Digital Equipment Corporation, the DEC-Net system.

The system was proposed to about 60 members of the World Economic Forum from the E/C industry, and generated a certain level of interest mainly from executives from the more technologically advanced firms (WEF, 1999). However, the proposed e-mail system in these pre-web times was somewhat cumbersome, and the combined costs of DEC for maintaining the system and communication costs became too expensive. This first version of Welcom was not further developed.

B) Second version

In the early 1990s, the communication costs had come down, and the technology of videoconferencing over ISDN lines, a digital communications standard (www.webopaedia.com), made its appearance. This was a new opportunity to develop Welcom. It was presented at the Annual Meeting in Davos as an on-going community building initiative. The motivation was to “establish a process for industry related strategic issues in non-competitive fields” (WEF, 1999). Typical examples related to the E/C industry are environmental issues and large infrastructure development projects. The technology that seemed best suited for an executives-community through personalized virtual interaction was ISDN based videoconferencing.
Because information technology around 1995 was evolving at a fast pace, in order to ensure a certain level of quality and reliability it was decided to develop a proprietary system that would use pre-configured computer terminals with integrated custom-made videoconferencing capabilities, the “Welcom Terminal”. This terminal was shipped and installed for members of the WEF as the one-stop technology solution for communicating and networking purposes with peers.

Note that the providers of Welcom developed some interesting features. On the technology side, the system was based on the Intel ProShare software and offered the capability for either point-to-point videoconferencing (2 people interacting) or multi-point videoconferencing (more than 2 people interacting). During a multi-point conference the system was voice activated, this means that one would always see on his/her screen the one person in the conference that was speaking at any given time. The silent attendees were hidden. When someone else took the stand, the video image would change automatically for everyone onto that person. On the service side, Welcom proposed round the clock concierge availability. The concierge’s task was to serve as a technical support staff, but more specifically to organize and schedule “virtual” meetings and conferences for the Welcom members. Other features such as creating a database of previously held discussions and a library of content relevant to Welcom members was also in the works. Note however that this was a secondary feature to the communication capabilities offered by Welcom.

C) Future developments

This second version of Welcom was relatively attractive and gained the attention of a number of executives. I had the opportunity to assist at a virtual multi-point conference that was conducted in view of preparing the agenda of the 1998 Annual Meeting in Davos for the members of the E/C industry, and that was conducted successfully. Nevertheless the number of Welcom Terminals shipped was far less than expected and executives lost interest. In 1998, the system was modified from a technological point of view into an “open-client” system. This means that one could access his/her Welcom peers via any computer over the web, and use any brand of videoconferencing system, eliminating the need for the Welcom Terminal. The fact that the web was becoming the de facto and most
easy to use platform to make use of the Internet was the main motivator behind this change. Still, the enthusiasm from the WEF members was not sufficient to make Welcom a success.

D) Lessons learned

Reasons why Welcom did not turn out as successfully as expected, in particular in view of the technological progress since the 1980s can be explained from two points of views: the developers, and the users. I have contacted the World Economic Forum as well as some executives who had followed the development of Welcom and used it. I had also been in contact with the technology development team in 1997 and presented the system at the 1998 Annual Meeting. The following paragraphs reflect the opinion of the parties involved.

(a) The developer's point of view

From the development’s point of view, two main difficulties emerged alongside the second version of Welcom and the designing of the Welcom Terminal. First, the technological promises of videoconferencing systems in 1995 were overestimated. In order to have a system with good quality, 3 ISDN lines had to be installed everywhere a terminal was set-up. This created complication for installation, in particular because ISDN norms were not harmonized between countries at that time. The combined costs of developing the proprietary system, shipping and installation exceeded expectations on the developers and clients side.

Second, developers of Welcom found themselves in a delicate position with respect to installing a Welcom Terminal on the desks of and executives, especially those who were already technologically intensive. The reason is that there was resentment from within companies to adding another computer on a CEO’s desk, in particular one that did not belong to the company IT systems (where one can assume a lot of money was invested into already).

According to the WEF, original interest was high, but the complicating and costly installation, and the non-compatibility with other systems discouraged a large number of
users. Executives who finally used Welcom were disappointed by the low number of participants, which where too few to create a real community. Later, the open-client version of Welcom was chosen so anyone with a computer could participate, but the quality, reliability and security of video technology over the web was not yet sufficient to make it attractive as a communications tool for a executive once more.

(b) The user’s point of view

From the users point of view the key issue was to put the cost and convenience of Welcom in perspective with the cost and convenience of other available technologies. Although Welcom offered an interesting approach to community building, according to users, in 1995 cheaper and more widespread web applications were readily available as a community building platform. Primarily the use of various Internet service providers (ISP) who offer access to the web and a personal e-mail account. Because of the low price and simplicity, executives were more keen to use AOL for example as their daily personal “virtual” networking tool. To this we might add, as mentioned before, that companies had already made substantial investments in corporate Intranets and web strategies. By 1997, quality low priced videoconferencing systems were also available off the shelf. In short, technologically the commercial sector was getting ahead of Welcom.

So from the user’s point of view there are two factors to take into consideration. First, purely as a communication tool Welcom was not judged competitive compared with other emerging web-based technology which were cheaper. Second, we can infer that executives define their own networking needs. In this case, a more flexible and widespread system like e-mail was preferred. By more flexible I mean that e-mail can be used outside of the office while on trips for example. Even though Welcom offered additional services, these were not judged attractive enough to generate a critical mass of users and create a large community of executives.

E) Conclusion

As a conclusion I will say that Welcom was certainly one of the very first attempts to use technology as a communication and networking tool between executives. The idea itself captured the curiosity and enthusiasm of users. However, the availability of cheaper,
easier and more flexible technology was preferred. We can also say at this point that videoconferencing, unlike e-mail has not yet become a standard of communication as was predicted by technology providers 5 years ago (WEF, 1999).

Note that Welcom was primarily developed as a communication tool aimed at sharing knowledge. In the minds of the developers it was assumed that the primary generator of information content that will make the system more attractive would be the knowledge exchange between the users.

Today the project has been put on hold mainly due to a lack of momentum to generate content through the community building process. Nevertheless the idea of Welcom serves as an example of an initiative to use information technology to address executives needs.

2.11 SUMMARY

We have seen in this chapter how information technology has affected our lives and the professional environments we live in. The examples at hand have shown that the E/C industry like others is actively exploring the possibilities enabled by information technology that can generate savings and help better serve customers in a global environment.

Executives today in all industries are also starting to look at information technology not only in terms of overall corporate strategy, but also for personal use like e-mail and searching for information on the web. The analysis of the development of Welcom as an early initiative to create a virtual networking pool for executives serves as an example of how IT can be used for this particular group.

In chapters 3 and 4 I will try to take the analysis one step further and learn from executives from the E/C industry personally what their needs are with respect to using information technology in the business environment.
Chapter 3

METHODOLOGY

3.1 MOTIVATION

In order to focus on the key aspects of my research, the opportunities created by information technology for the Executive in the E/C industry, the best way to collect information was to get directly in contact with executives from engineering and construction companies.

The research method that I used consists of two parts. First a series of interviews with executives from companies in the industry. Second, a short survey which I sent out to all the executives I interviewed, as well as to an additional group of executives whom I did not have the opportunity to interview, but who expressed their interest in my research.

In addition to these two methods, I have integrated relevant material taken from the web, business publications, as well as from MIT courses that relate to the subject and that complement the general research of chapter 2.

Originally I had considered the alternative approach of only developing a questionnaire targeted at a larger number of executives. However, in order to first gain an understanding
of the issues that this particular group is concerned with, I felt that it was necessary to start the research by initiating a direct contact in the form of interviews.

After having conducted all the interviews, I decided to use the questionnaire approach in the form of a short survey as a second phase. The survey had three main goals:

i) Act as a follow-up to the interviews

ii) Gain more in-depth knowledge about certain issues raised during the interviews but not fully exploited

iii) Get feedback about the opportunity of developing services for the E/C industry enabled by the web

The interviews and the survey are complimentary in their approach. While the interviews focus primarily on the tasks of the executive and the implications of information technology with respect to these tasks, the survey focuses on the potentials of the web as a platform to provide certain services relevant to the executive in this industry.

3.2 INTERVIEWS

3.2.1 Approach

The interview process was the key to developing an understanding of how executives today can utilize information technology efficiently. In order to clearly define the focus of my research and understand the issues relevant to the executive, I conducted the first couple of interviews as discussions with the following questions in mind:

- How does information technology today affect the company in the engineering and construction industry, and how does that have an impact at the executive level?

- Particularly, how has information technology affected the way executives interact and communicate?

- What barriers to use information technology are perceived by executives in the industry?

- How will information technology affect the future of doing business at the executive level in the industry?
These general questions enabled me to integrate the feedback to develop a more precise outline for the final interview process. The goal of the interviews was to get a feel of how familiar today’s executive is with information technology, and what opportunities he/she personally sees as contributing to enhance his/her tasks in terms of interaction, communication and networking.

3.2.2 Interview outline

The listing of the questions that I used during the interviews is given in appendix 1. Hereafter I present the general outline and motivation behind the questions raised.

The questions for the interview are built around the three following issues of concern:

i) Peer to peer interaction and networking at the executive level

ii) The impact of information technology

iii) Aspects of virtual versus face to face interaction

A) Peer to peer interaction and networking at the executive level

In order to develop the interviews, I had to make some basic assumptions that were confirmed by the first discussions I had with executives, and later by most executives during the final interview process. The main assumption was that one of the key tasks for an executive today is networking and interaction with people inside and outside the company.

This first chapter of questions does not relate to the information technology aspect of my research. The questions are targeted to gain an understanding about which tasks are important for an executive on a daily basis, and his/her opinion about networking and interacting with peers. Namely:

- How does the executive perceive his/her job today, what does he/she think that this job should be?

- Is there a specific network of people one interacts with, who is part of this network, what are the concerns most often addressed?

- Does the executive consider the company to be relationship driven?
- Has the interaction part of the executive’s job taken more importance in recent years?

Some of the questions raised may seem somewhat trivial, however, and this is the interesting side of the interview process. Each person views his/her job differently. The primary part of the analysis will be to see if a general mindset emerges from all executives who belong to the same industry, or at least if there is a trend from executives of similar companies within the industry.

B) The impact of information technology

This second part of the interviews focuses on two issues. First, how familiar is today’s executive with the use of information technology? Second, how does information technology add value to his/her every day tasks, in particular with respect to networking and interaction?

It has to be understood that the questions in this section are not concerned with how technology is used within the company in general. The questions are directly targeted to individuals at the executive level.

The goal is to understand the following:

- Do executives use tools such as e-mail to communicate? The web to do research?
  Do they take a laptop computer while on trips?
- What are some of the barriers of using today’s tools such as not being familiar with the technology as well as security concerns?
- What does he/she believe the evolution in the use of information technology has been in recent years?
- How does this evolution affect the way executives interact?
- How does this evolution affect other tasks important to the executive, such as strategic planning and decision making?

As we have discussed in chapter 2, information technology today is widely used at the operational level in the industry primarily in terms of computer-aided design (CAD) and internal networks (Intranets). It has also been demonstrated that the revolution brought by
information technology, while coming from the bottom up within corporations has started to reach the people at the executive level of the company.

How does the executive use information technology today, and for what purposes? Aside from the interview questions, one way to analyze this issue was through observation at the World Economic Forum Annual Meeting in Davos. For the past few years, during the Annual Meeting that brings together over 1,000 CEOs and executives from global companies, the organizers have set-up an internal messaging system called “kiosk.” It basically consists of a number of stand-alone monitors distributed around the conference center and in the surrounding hotels. Participants can check meeting schedules, profiles of other participants, and send and receive internal electronic-mail messages.

I had the opportunity to attend the Annual Meeting in 1998 and 1999. Between the two years, I observed that the increase of use of this system was tremendous. This is due primarily to two factors: first, more and more CEOs and executives have become familiar with information technology tools. Second, the simplicity of use of the system has evolved. These observations are critical in terms of the speed of adoption of information technology.

C) Aspects of virtual versus Face to Face interaction

After gaining an understanding of how executives interact and network today, and understand the impact that information technology may have on these tasks, comes the third part of the interview.

The emphasis is placed on the importance of traditional "real" face to face interaction versus virtual interaction through as e-mail or videoconferencing. Years ago visionaries and technology providers painted an image of the future where travel would not be necessary anymore as every-day tasks could be done remotely using computers and interaction would be done through video screens. Today, thanks in essence to the Internet and faster computing, the technological capabilities to match these predictions have been met. The question remains as to how executives adopt these new means of communicating when dealing in their business environment, and to what extent can virtual communication replace face to face meetings?
The following issues are relevant in the third part of the interview:

- How important is it to meet face to face with peers during meetings or conferences, versus interacting virtually?
- Are there certain issues that simply can not be treated other than face to face, or does information technology offer a new revolutionary way of conducting business?
- Should information technology as a mean of communicating be left at the operational level?
- Are these issues particular to this industry?

The three areas of concern outlined here wrap up the interview process. This gives us an image of how information technology has changed the business world for the executive in the engineering and construction industry, and more important what the changes will be in the years to come.

### 3.2.3 Interview process

A detailed description of the profiles and positions of the people interviewed, as well as the profiles of their respective companies will be given in chapter 4. Hereafter is a brief description of how the interview process was carried through.

As mentioned before, the advantages of the interview method over a general questionnaire method is that it enabled me to gather more in-dept information about the issues of concern. However, the interview process is time consuming and it is not possible to reach as many people as through a questionnaire. Nevertheless, I tried to get in touch with as many executives as possible, and from a broad spectrum of companies within the E/C industry. I felt that this was important in order to analyze later on if there is a common feedback throughout the industry.

I have conducted a total of 21 interviews. 19 with CEOs and Executives from companies within the E/C industry, and 2 with executives from information technology companies. Although my primary focus is the E/C industry, I have decided to include these two executives from information technology companies to see how their views compare, and
also to learn from them what they think the opportunities for the E/C industry are, basically having an outsider's perspective.

To gather information during the discussions I used hand notes and/or a cassette recorder. Interview duration ranged anywhere from 10 minutes (brief discussions) to an hour. The average is around 25-30 minutes. I conducted approximately a third of the interviews in the United States with executives close to the Department of Civil and Environmental Engineering at MIT, or located within the Boston area and on the East Coast. The remaining interviews were conducted at the Annual Meeting of the World Economic Forum (WEF) held in Davos Switzerland in January. Among the members of the WEF are CEOs and executives of over 60 engineering and construction companies with offices worldwide who gather each year in Davos for a week to network and interact with their peers. This was an ideal opportunity to get in touch.

The executives I approached come from companies varying in size, geographic span and range of services. The concerns for a CEO from a large multinational may not be the same as for one from a smaller, more local company. Their opinion with regards to how information technology affects them can diverge substantially. I have also discovered that there is not necessarily a correlation between the size of a company and the geographic markets in which it does business, more about this issue in chapter 4 and 5.

The executives of the smallest companies I interviewed have less than a 100 employees, while the largest ones have up-to 200,000 employees world-wide and generate over $30,000 million in annual revenue. The services provided by these companies include contracting, general contracting, waste management, utility services, architecture and design, supply and specialty contracting. I thus covered most of the industry except for smaller suppliers, sub-contractors and owners.

3.3 SURVEY

3.3.1 Approach

As I mentioned earlier, the primary purpose of the survey was to act as a follow-up to the interviews. However, I also wanted to take the opportunity of exploring certain issues that
came up during the interview discussions, namely issues regarding the possibilities created by the Internet and by the web in particular.

While the interview questions were more targeted towards the ways of interacting and communicating for the executive, the goal of the survey was to paint a picture of the future and emphasize on opportunities not yet fully exploited. The detailed analysis of what I learned from the interviews is provided in chapter 4, but at this time I would like to stress the following points brought forth by the interview discussions:

- Most executives are starting to use e-mail as a mean of communicating, primarily with their colleagues and peers
- The use of internal networks (Intranets) has enables executives to manage internal daily activities more efficiently
- Information technology has enabled companies to become truly global as activities can be monitored from anywhere, anytime

However there is no indication about the use of the web as either a new platform of performing traditional tasks related to the E/C industry, or an enabler of new business opportunities. In particular with respect to accessing content and providing e-commerce solutions.

The survey focuses on the web as a more efficient channel of providing information to the executive, as well as a platform to create new business opportunities for the E/C industry. The use of the web for the executive was not directly brought-up during the interviews, because the focus was based more on personal interaction and networking. It was also important to get an understanding of how familiar executives are with the use of information technology and the Internet beforehand.

After the interview phase of my research, I thought it was relevant to extend the subject to the web via the survey. I also decided to send the survey primarily to the executives that I had interviewed because I felt that the interview and the survey process complemented each other within the scope of my research.
3.3.2 Survey outline

The survey focuses on five types of services relevant to the E/C industry that can be made available over the web. In other words, the web could serve as the platform for these services as well as provide added value and content. I have identified these services as follows:

i) Electronic commerce

ii) Providing Economic and Financial Information that are relevant to the E/C Sector

iii) Providing specific financial information with regards to entering new markets and regions

iv) Seeking and identifying partnerships and alliances

v) Routine services

My interest is in learning how attractive a web-based version of each of these services is for the executive in the E/C industry. I asked the executives I contacted to express their opinions from a scale of 1 to 5 (appendix 2).

Note that some of these web-enabled services are not exclusive to the E/C industry. Note also that some of these services do not only affect the executive in the company. However, my research focuses primarily on the impact at the executive level.

Hereafter I merely intend to express some general ideas behind each of these services. I do not propose any solutions of how these services should be developed using the web, the goal at this time is to raise questions about how interesting these services would be.

A) Electronic commerce

As we have seen in chapter 2, in recent years the web develop from a new way of providing information to a whole new way of doing business. The amount of goods traded over the web between businesses reached $43 billion in 1998 and this number is predicted to grow to $1.3 trillion by 2003 (Standard & Poor’s, 1999). The business to business e-commerce market offers by far the largest portion of online trading.
In chapter 2 I gave an example of how the E/C industry could benefit from the web through online auctioning of used construction equipment. How this will have an impact on engineering and construction companies is beyond the scope of this research, however it is clear that the selling and buying of goods and services over the web will grow to the level of having a significant impact on the business. Therefore it is key in my opinion that executives identify the potential opportunities relevant to their industry.

B) Providing economic and financial information relevant to the E&C sector

During the interview discussions, one issue which often came up with regards to the use of information technology was that with so much information available, how does one get the right “piece” of information to the right person. This issue was raised mostly in relation to the internal networks of the company, Intranets, but it is even more so applicable to the world-wide-web.

Today every major media channel and publication has an elaborate web page that provides news and basically offers a substitute to getting the information we need in addition to the more traditional television and newspaper. However if the web remains merely a different way of conveying information, I believe that it's potential is heavily underutilized. One of the primary added values of the web is to be able to offer information in quasi real time, as well as to organize this information. One relevant example is the fast access to (almost) real time stock market information.

In relation to my research, the question is how can executives in the E/C industry utilize the potentials of the web to directly access financial and economic information that is relevant to their sector. At this point I am not making suggestions on how this information should be provided, I am merely interested on receiving feedback about how attractive this service would be over the web.

C) Providing specific financial information with regards to entering new markets and regions

This service is more targeted towards having easy access to all the information needed when starting a project in a new region. For example: economic information about the region and financing and insurance opportunities.
Again, there are numerous publications and web-sites that provide economic information about countries for example, but this is insufficient to make the use of the web attractive for the executive in the E/C industry. It would be interesting to have all the necessary information contained in a manner to make it easy to access, and valuable. The web offers this opportunity, but it has to be determined how this information has to be organized, and what is the specific content that one needs.

An example would be to know how an infrastructure project in Brazil is affected after an economic slowdown in the region. In short, what are all the issues an executive of a construction company needs to know in order to take immediate action. Would it help to make this information available over the web?

D) Seeking and identifying alliances and partnerships

Perhaps one of the most important tasks when targeting a large construction project is to find partners. From my discussions I have learned that companies tend to partner with each other based primarily on previous collaboration experiences as well as job-specific expertise. In order to enter a new market however, identifying companies with job-specific or region-specific expertise to form an alliance can be a difficult and risky endeavor.

The idea is to be able to identify easily what type of company to approach for a particular project in a particular region of the world. The web could add value to this task in providing for example a community of companies seeking alliances and partnerships.

E) Routine services

Along the same line of identifying partnerships and alliances, the procurement of routine services over the web is the next step for a project preparation. Finding sub-contractors over the web among a list of pre-qualified companies for a specific job is an example of application that could be beneficial.

Most of the services discussed require an involvement beyond just providing information through a web-site, which most companies have today. In order for these services to be successful on the web, building an industry-wide online community is necessary. For this
reason I think that it is key for the executive level in a company to explore the potentials of the web.

3.3.3 Survey process

The survey was sent out to all executives from the E/C industry I interviewed plus a few more I did not have the opportunity to meet for an interview, but who expressed their interest in the research. I sent out a total of 24 surveys and obtained 17 responses, which corresponds to a 70% response rate. This high response rate is due to the fact that I had met most of the people before and they were familiar with my research and willing to give me feedback.

3.4 SUMMARY

We have discussed the methodology that I used to gather information, which consists in two parts: a series of interviews of about 20 executives from the E/C industry followed by a survey.

I have presented the development of the interview and survey questions, and the ideas that motivate each of these questions in relation to the impact of information technology on the executive in the E/C industry.
Chapter 4

ANALYSIS

4.1 METHODOLOGY

The analysis consists of extracting relevant facts from the interviews and the survey. Based on the questions I developed for the interviews (see appendix 1), I first propose to examine in section 4.3 the general trends that emerged from the discussions with 19 executives from the E/C industry along the following pattern:

i) Networking and peer to peer interaction

ii) The impact of information technology

iii) Virtual versus face to face interaction

Section 4.4 examines the opinion of 2 executives from the IT industry with respect to the evolution of information technology, and their views on the E/C industry. Finally, I propose to analyze the feedback from the survey in section 4.5.

Chapter 5 will summarize the elements learned from the interviews and the survey, and analyze the implications in relation to the research conducted in chapter 2.
4.2 INTERVIEW PROFILES

The goal of the thesis was to target a large number of executives from different companies for the interviews in order to cover the industry as a whole. The interviews were conducted with executives in different positions from different companies. While certain issues that are critical to a CEO for example are not necessarily as important for a chairman, the interviews showed that within the scope of this thesis, there are issues common across the members of the board, and across companies within the industry. For information purposes however, I intent to briefly outline the types of individuals, and types of companies targeted.

As previously mentioned, I originally contacted a number of executives in the Boston area near MIT, as well about 60 executives from the industry who participate at the Annual Meeting of the World Economic Forum in Davos. Between the interviews and the survey, I received feedback from a total of 24 executives from the E/C industry, 19 of which I had the opportunity to interview.

Titles of executives interviewed and surveyed vary. The large majority carry the title of CEO, President, Director or Chairman; or a combination of these respective titles (i.e. President and CEO for example). Other executives interviewed have positions as vice-presidents, members of the board or high level managers. The average age of executives interviewed is 53.5 years (note that I only have a record for the ages of 19 out of 24 individuals).

Companies represented vary in size, geographic span and range of services offered. Because some of the larger companies offer a wide range of services related to the industry, it is difficult to make a clear classification. However for information purposes and to get a general ideas of the companies represented I have made the following distinction:

- 17 contractors or general contractors (providing primarily design and construction services)
- 2 service providers (utilities and waste management)
- 2 suppliers to the industry
- 2 specialty contractors (for example mechanical and electrical engineering)
- 1 architecture, planning and design firm

Countries where companies are headquartered are also very diverse. 11 United States based companies, 2 from Switzerland, France, Canada and the United Kingdom; and 1 from Germany, Portugal, Turkey, Liechtenstein and India respectively.

The largest companies represented have an annual revenue of over $30 billion and employ more than 200,000 people, while the smallest ones have revenue lower than $100 million and employ less than 100 people. Most companies operate globally except for some of the smaller ones who focus more strongly on regional markets.

4.3 GENERAL TRENDS

The general trends are issues that I extracted from the interviews as being the opinion of the majority, or issues that arose most often during the course of the discussions. There are of course differences in the interview feedback related to the actual positions of the executives I interviewed (Chairman, CEO...) and the types of companies they represent. However I was able to identify certain issues critical to most, if not all, of the executives interviewed.

4.3.1 Networking and peer to peer interaction

In order to analyze the impact information technology may have on the activities of executives in the E/C industry, the first step is to define these activities. As described in chapter 3, I made the assumption that networking and interaction are critical parts of the job of an executive. Based on the interview discussions I confirmed this assumption, and was able to identify three areas of focus that executives in the E/C industry are confronted to on a daily basis. These areas of focus can be defined as follows:

i) Outside focus: interaction and networking with people outside the company, primarily shareholders and clients, as well as peers from the industry
ii) Activity focus: supervising and monitoring projects worldwide
iii) *Corporate focus:* mentoring and motivating employees, and developing the corporate strategy

Again, involvement in each area of focus vary for executives depending on their specific role and the size, type and strategy of the company. Nevertheless common traits in terms of motivations and responsibilities inherent to each area of focus throughout the industry were identified hereafter:

**A) Outside focus**

There are two reasons for investing time into outside focus for the executive:

- Get counseling and information about the trends in the industry
- Create business opportunities for the company

Interaction with clients, shareholders and peers is described as being the most important and time-consuming task at the executive level. This is particularly true as executives stress the importance for companies in this industry to become more service oriented and relationship driven to accommodate today's customers needs.

Note that for executives from smaller companies, interaction with peers from potential competing companies is not considered necessary and only done occasionally if at all. Because they operate in smaller markets, these executives rely on their clients for business opportunities, as well as understanding industry trends.

For larger companies (annual revenue > $1,000 million) such as the ones represented at the Annual Meeting in Davos, networking with competitors can on occasion lead to partnering and joint venture opportunities, and is a primary source of sensing global industry trends.

**B) Activity focus**

Activity focus is also a highly time intensive task for executives from large companies that operate worldwide. Note that for a Vice President responsible for operations for example, this task can be even more time consuming than the task of outside focus. On the other
hand a Chairman will be more involved in outside focus because his role is not to supervise projects directly.

Note also that activity focus like outside focus involves interaction with customers, but on a local basis where projects are being developed. Even if the executive is not in charge of project management, he/she is responsible for client satisfaction at this level.

Activity focus requires a lot of time spent in traveling for some executives as companies become global in their operations and project all over the world have to be managed on a local basis.

C) Corporate focus

Corporate focus consists of time spent inside the company. Interaction takes place between executives, employees and internal project teams. Executives also consider corporate focus as the link between outside focus and activity focus that will enable them to determine corporate directions and strategy.

Executives have stressed that lessons learned from outside focus and activity focus are brought into the corporate focus activities to develop the guidelines for action the board must take, and also convey this information to employees and make sure everyone understands the positioning of the company.

As I have mentioned, executives from different companies put more or less emphasis on one or the other area of focus depending on their role in the board, the size and strategy of the company. However, based on the feedback from the interviews, time spent in each area of focus can be split as follows:

- Outside focus and activity focus: 60% - 80%
- Corporate focus: 20% - 40%

For most executives, outside focus is the main area of concern in terms of time spent, except for a few that I interviewed who are directly involved in operations. In this particular case, activity focus can take up to most of the 60% - 80% of their total time.
It was mentioned that one of the challenges for an executive in this industry, regardless the position or type of company, is to resist the tendency to get too much involved in corporate focus. Particularly with respect to becoming a global, and/or more relationship driven company, these strategies being driven primarily by outside focus.

4.3.2 The Impact of Information Technology

Hereafter I have outlined aspects from the discussions that describe how executives in the E/C industry have turned toward information technology with respect to the tasks of outside focus, activity focus and corporate focus.

From the interviews I learned that most executives look at the term “information technology” from the perspective of what elements of technology can be useful for their activities. This point of view leads to distinguish between the following:

- Intranets and E-mail
- The world wide web
- Wireless communication
- Other tools

A) Electronic Networks and The E-mail Revolution

Two key elements were pointed out as having brought significant changed to executives daily activities, primarily in the fields of corporate focus and activity focus:

- Network computing, mainly in the form of internal company networks or Intranets
- The exponential growth of e-mail users

Intranets enable the executive to have real time access to internal information and on-site (activity specific) information. This enables him/her to monitor directly the tasks of corporate focus and activity focus. The combination of the Intranet for the sharing of information within the company, and E-mail to communicate has given the executive a powerful tool to:

- Access critical information in real time in order to be able to act/react immediately

50
- Coordinate and manage local teams in real time following the global strategy of the company
- Personally supervise and monitor internal project development online

E-mail is an integral part of using the electronic networks to share information, but it has also created a whole new and different way of interacting for the executive. We have discussed the attractive features of e-mail over traditional means of communicating in chapter 2. Note that the simplicity and ease of use of a system are absolutely critical factors for executives, most pointing out that with today's technology, technical support is sometimes still necessary.

I surveyed the executives in the E/C industry about their habits of using e-mail as a mean of communication. Seventeen out of the nineteen, or roughly 90%, of the executives interviewed have a personal e-mail address either through their company network or through a third party Internet Service Provider (ISP).

At this point, the incentives of using electronic networks and e-mail for the executive are to a large extent corporate focus and activity focus. It enables up-to-date information about internal performance and real time assessment of projects run in a remote location. Closer attention can be given to a larger number of projects, and this was not possible five years ago. But e-mail is also used by some executives for outside focus to interact with one's personal network of peers which is a critical element of doing business.

In addition to more efficient operation on the field, a few executives stressed that showing an understanding of information technology trends and using the tools can be a critical sales factor in the eyes of certain clients, particularly the information technology intensive ones.

**B) The World Wide Web**

As discussed, most executives interviewed use internal networks and e-mail as tools that support the tasks of corporate focus and activity focus. We have also analyzed the potentials of the World Wide Web (the web) as a tool that is changing businesses in
different industries throughout the world, and how this will have an impact at the
executive level.

Based on the feedback from the interviews, the web is used by a minority of executives in
this industry today. The primary use at this stage is accessing general information such as
daily news, stock quotes, and information about client companies and competitors. Only a
few executives I talked to “surf” the web on a regular basis. The survey places more in-
depth focus on the opportunities of the web for executives in the E/C industry in section
4.5.

C) Wireless Communication

Aside from interconnecting computers, high emphasis was put on the revolution in
networking and interaction enabled by wireless communication technologies. I would like
to share two visions that were given to me by executives during the interviews with
respect to the use of wireless communication in the areas of activity focus, and outside
focus respectively, and which they consider as a tremendous added value to how they
currently do business.

Vision #1: The possibility to dictate into one's mobile phone observations made on the
field or after a meeting. These observations are directly transmitted into a text document
on the computer at headquarters using voice recognition software, and ready to be used
immediately.

Vision #2: During an informal discussion on a golf course with a client, one calls the
office headquarters and asks for a project proposal from his/her team. By the time the golf
course is completed, the office sends and e-mail into a wireless portable device with
complete project specifications and plans to present to the potential client.

D) Other Tools

In relation to the first developments of Welcom, I was curious on the opinions of
executives interviewed about their views with regards to using videoconferencing as a tool
to communicate electronically.
The feedback is that at this stage outside of occasional group meetings between different locations (room-based videoconferencing), the tool itself is not very attractive. Reasons mentioned were primarily the disadvantages discussed in chapter 2. Executives stress that today for their use, videoconference sessions still have to be “set-up” or organized beforehand over the phone or via e-mail. This has the effect of adding a level of complication to the use of the system which is undesirable for the time constraint executive. It is considered by most executives interviewed as another tool, but it does not yet have the simplicity and convenience of e-mail.

4.3.3 Virtual versus face to face interaction

One of the first comments from executives is that with the use of information technology as a tool to communicate, the physical ability to meet with clients and peers has become more important than ever before.

This statement might seem contradictory but almost all executives interviewed stressed that face to face interaction is still a critical aspect of doing business, in particular with respect to outside focus, but also for the tasks of activity focus, and corporate focus. There are mainly three reasons that were given to support this fact:

i) The need to build a network

ii) The general need for face to face contact

iii) Reasons inherent to this industry

A) The need to build a network

What drives the activities of outside focus for the executive is primarily the network of people he/she deals with. Interaction with this network is not necessarily business related, and can be informal (former business colleagues, club members…) It was stressed that building this network can only be done through human interaction. Using e-mail is a tool just like the phone that helps busy executives keep in touch with their network between meetings, but ultimately to build this network and maintain a sustainable relationship, face to face contact is considered to be necessary. The idea I was given is that one can “bump into people” or be “introduced to someone” during meetings and gatherings, creating one’s network of contacts.
B) The general need for face to face contact

Most executives stress that by nature, doing business in their position requires face to face contact no matter the type of industry. The physical contact on the field is critical to get a sense of the culture and people one is dealing with. This can not be done if there is a technological barrier between the parties. A number of CEOs stressed that they view their role as being “the number one salesman of the company,” and that this implies a level of subjectivity when dealing with people that can only be assessed in face to face contact.

Also, for the tasks of outside focus the driver of the business is described as being the personal relationship with the customer or shareholder. Some executives question how much their position is actually dependent on the use of information technology and the use of computers by definition.

C) Reasons inherent to this industry

It was mentioned that there are two factors that make the need for face to face interaction particularly important in the E/C industry: the heavy monetary investments and the long-term involvement inherent to most projects. This is very different from businesses where goods and services are sold on a one-time transaction basis.

It was mentioned that only in certain areas of the industry such as procurement of materials for example, face to face contact will eventually be eliminated as goods can be bought and sold directly over the web. However when it comes to discussing an investment in a project, the opinion is that the mutual feeling of trust between the parties can hardly be conveyed through technology.

Almost all executives interviewed stress that face to face communication can actually never be, and should not be replaced, even when a new generation that is more familiar with the use of computers reaches the executive level. One CEO stressed that it will actually be a challenge for the new generation of managers and executives to “learn to build networking and relationship skills in a world of technology.”
4.4 OPINIONS FROM THE IT INDUSTRY

In order to have an outside opinion about the opportunities created by information technology for the executive in the E/C industry, I contacted and interviewed two executives from information technology services companies. These companies develop corporate IT solutions such as Internet and e-commerce strategies, and provide IT consulting for their clients.

The goal is to learn how they perceive the impact of IT on the E/C industry at the executive level, what differs from other industries, and what are the future opportunities the IT industry will bring to the construction world.

The first observation that was made is that people at the executive level are not primary targets for technology providers in market terms. One of these two interviews was conducted in July 1998, and it was stressed that the personal computer (PC) unattractive for most executives simply because they are not familiar with the use of computers and considered that there was no need to in their position.

We have seen that the more recent interviews with executives from the E/C industry conducted in February 1999 contradict this statement. This is an indication of how fast information technology is affecting the industry. Nevertheless, it was stressed that people at the executive level of a company are among the slower adopters of information technology for the following reasons:

- By nature, their job is not very technology intensive (compared to tasks performed at the operational level) so they are not necessarily aware of new elements they could benefit from
- The newest technology is often not very reliable at first and/or cumbersome to use, which offsets the potential advantages at this level

One executive from the IT world I talked to also makes the following distinction when using the term information technology.

- The use of the personal computer
- Wireless integrated technology
His opinion is that the latter technology has a higher potential in terms of use at an executive level. Note this was also mentioned by some executives from the E/C industry.

Executives from the IT industry agree however that today the trust and personality aspects conveyed during face to face interaction can not be replaced by technology. But there will most certainly be an evolution which will affect the ways executives in the E/C and in other industries interact and communicate.

4.5 SURVEY ANALYSIS

4.5.1 Introduction

As a follow-up to the interviews, and to research the opportunities created by the web I have sent out a survey to a total of 24 executives from the E/C industry. The survey was sent to the executives I had interviewed, plus to an additional group of executives who I did not have the chance to interview but who were contacted and expressed their interest in my research. I received feedback from 17 out of 24 surveys sent, or a 70% response rate.

Executives were asked to rate on a scale of 1 to 5 the importance and relevance of the web in the following categories:

i) Electronic commerce, for example online of construction equipment and materials

ii) Providing economic and financial information that are important to the E/C sector

iii) Providing specific financial information executives need with regards to entering new markets and regions

iv) Seeking and identifying partnerships and alliances for penetrating new markets and regions

v) Routine services such as seeking sub-contractors and suppliers, and identifying contractual conditions

I have reported on different charts the average for all respondents, the average for contractors and general contractors (the majority of companies surveyed), and the responses of one design firm, one specialty contractor, and one supplier. The reasoning is
that a particular service might be important for an executive of a construction company, but might not be so important for an executive from a design company.

Note that it is delicate to draw overall statistics from a small sample of responses, but it may give us an idea of the directions the web should take to serve this industry in different sectors.

4.5.2 The presence of the web so far

We have discussed that executives start to use e-mail, Intranets, and occasionally surf the web to find information. Out of interest I have analyzed how the companies they represent have set-up web-pages to convey information about their services and signify their presence.

Out of 24 executives interviewed and/or surveyed from the E/C industry representing different firms, I have found that 21 companies have a web-site dedicated to providing information about their services. Some of these sites are relatively simple with general company information, description of relevant projects and press releases. Some of the larger companies have different web-sites for each country, and detailed financial information with company performance and investing opportunities.

It is interesting to note that 2 of these companies did not have a web-site at the time of the latest interviews in early February three months ago. It has to be understood that creating a company web-site does not directly influence the tasks of the executive, but it shows to a certain extent how web savvy individuals at this level are. Also, because within a few months two companies newly appeared on the web shows how fast the industry is moving.

The advantages of having a web site at this point are not limited to signalizing presence. The most complete sites offer financial information for investors, potential partners and clients; showcase their projects, and offer online recruiting.
4.5.3 Analyzing the responses

A) General average

Table 1 represents the average importance given to each service from the total of 17 responses I received which include all the following types of companies: 14 contractors and general contractors, 1 design firm, 1 specialty contractors and 1 suppliers.

The primary trend that we see is the importance of the web in providing executives with information. Most importantly service 1 and 2, general information about the E/C industry, and market specific information.

Some of the surveys came back to me with additional comments, and it was mentioned that particularly relevant for the executive are press releases and economic data about clients and competitors (service #2). It was mentioned that this information is to some extent already available on the web on sites such as Yahoo! (www.yahoo.com) or PointCast (www.pointcast.com). It was also mentioned that most important for the executive with regards to specific market information (service #3) is project-financing information, which does currently not exist over the web.

In terms of e-commerce (service #1), it was noted that this service is not highly important in general for the executive because it is more related to the tasks of purchasing and procurement, which is not one of the primary focus we identified in earlier. Nevertheless, the average response of 3 out of 5 points indicates that there is an interest in exploring the field of e-commerce at executive level.

Another service noted to be important is the seeking of routine services such as subcontractors and suppliers (service #5). It was however mentioned that this is more of a concern at operations management level than at the executive level.

Seeking partnerships and alliances (service #4) can be categorized as part of the outside focus tasks of the executive. As we have seen, most underline the necessity of face to face interaction to perform this task, which might explain that the level of interest for having such a service on the web is not as high, 3.2 out of 5 average.
The key observation at this point is to realize that all 5 services are considered to be above average important, weather they already exist under limited form or don’t exist at all.

B) Contractors and general contractors

In my opinion it is relevant to separate the contractor and general contractor companies from other companies like designers and suppliers who are also part of the E/C industry as defined for the scope of this research. Table 2 gives the average opinion for 14 executives from contracting and general contracting companies.

We can see that the table 2 average for each service is very close to the general averages from table 1 previously discussed. Again there is strong emphasis on accessing economic and financial information (service #2), and accessing market specific information (service #3).

We can also see a slighter greater interest in e-commerce (service #1) as contractors and GC firms could typically benefit from this service to trade the huge amount of equipment and materials they have to deal with for every project.
Figure 1: Survey responses, general average

<table>
<thead>
<tr>
<th>Types of Services</th>
<th>Level of Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-com</td>
<td>3.0</td>
</tr>
<tr>
<td>finance</td>
<td>4.1</td>
</tr>
<tr>
<td>specific</td>
<td>4.2</td>
</tr>
<tr>
<td>partner</td>
<td>3.2</td>
</tr>
<tr>
<td>routine</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Figure 2: Survey responses, contractors and general-contractors average

<table>
<thead>
<tr>
<th>Types of Services</th>
<th>Level of Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-com</td>
<td>3.2</td>
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<td>specific</td>
<td>4.2</td>
</tr>
<tr>
<td>partner</td>
<td>3.3</td>
</tr>
<tr>
<td>routine</td>
<td>3.6</td>
</tr>
</tbody>
</table>
C) Designers, specialty contractor, and suppliers

Tables 3, 4 and 5 reflect the opinions of executives from a design firm, a specialty contractor, and a supplier respectively. I had feedback from one of each of these companies, and it may be interesting to see how they compare with the average, and with the feedback from contractors and general contractors.

The first trend that we see is that electronic commerce (service #1) is not as relevant for these executives, except for the supplier who can use the web to buy and sell equipment. Note however that in this case the specialty contractor represented does not deal with equipment. This is not necessarily the case for firms in that category.

Note also that the selling and buying of services could conceivably also be done over the web and fall into the e-commerce category. In this case one could imagine online bidding for a design project for example. It seems however that at this stage e-commerce is thought about more in terms of trading material goods.

Other relevant services for all individuals surveyed is the access to economic and financial information relevant to the E/C sector (services #2 and #3). Having access to this information seems to be an inherent part of the tasks of the executive throughout the industry.

We also notice that for the design firm, seeking partners and alliances (service #4) is of primary importance. I would assume that this in view of securing business opportunities from construction firms for potential design-build projects for example. Also note that identifying routine services (service #5) is being rated as more important by all three parties compared to the average for contractors and general contractors. I will assume that the reason is because all three of these companies need to deal with specialized sub-contractors inherent to their specific role within the E/C industry.
Figure 3: Survey response, design firm

![Design Firm Average Graph](image)

Figure 4: Survey responses, specialty contractor

![Specialty Contractor Average Graph](image)

Figure 5: Survey responses, supplier

![Supplier Average Graph](image)
4.6 SUMMARY

Based on about 20 interviews with executives of different companies from the E/C sector, we have determined that executive's responsibilities can be separated into 3 categories:

- Outside focus
- Activity focus
- Corporate focus

Outside focus together with activity focus are the most time consuming tasks at the executive level in this industry.

The general level of adoption of information technology is relatively high as almost all executives have a personal e-mail address, some use the company Intranet to monitor activities and the web to access information.

The perceived added value at this time is primarily the possibility to get in touch with anyone at anytime which enables critical decisions to be made based on real time information. Nevertheless, face to face interaction is still a key part of doing business at the executive level for the reasons of heavy monetary and long-term investment inherent to this industry.

In terms of opportunities offered by the web, most interesting for the executive are the access to economic and financial information relevant to the E/C industry and also market specific information necessary for smooth project development. Other services such as identifying partners and associated services, as well as the opportunities of e-commerce have also generated interest.
Chapter 5

Summary and Conclusions

5.1 RESEARCH SUMMARY

This thesis is concerned with how, through the course of the past decades, information technology has started to have an impact on our personal and professional lives. Since the commercialization of the first personal computers, through the growth of the Internet and the web, information technology has had an effect on different levels within corporations. Today, almost every company has appointed a Chief Information Officer and is looking into ways of incorporating information technology elements into the overall company strategy.

In the midst of this revolution I decided to focus on a particular group of individuals, namely executives in the engineering and construction industry. In this research, I examined their needs with respect to the possibilities brought about by information technology and investigated how IT is changing the way they communicate, interact and do business.
The research has revealed the following key elements related to the use of information technology at the executive level:

- Today, most executives have identified potential opportunities created by information technology for the E/C industry and for themselves.
- Executives are rapidly learning to use e-mail and the Internet as efficient tools to communicate and share information.
- Today e-mail and the Internet have enabled executives to access critical information and coordinate activities directly and in real-time, in particular when away from the office.
- The interviews have pointed out that the most time consuming tasks for executives today are outside focus and activity focus, both involving networking and interaction primarily with clients and peers. The use of IT should therefore address these needs more specifically.
- Most of the executives interviewed agree that we are only at the beginning of the IT revolution, and that the way people communicate will further be affected in the future.
- The survey and research show that there is a high level of interest in exploiting the opportunities of the web to gain access to industry-specific content relevant to executives, but these opportunities have not been exploited yet.
- Despite advanced technology, face to face interaction will always remain a critical aspect of doing business at the executive level because of the nature of this position, the need to build a network, and reasons inherent to this industry.

It is important in my opinion to point out that even if early projects such as Welcom generated curiosity among executives, the actual use of information technology on a daily basis, in particular for interaction and communication, is relatively new for this group, but growing rapidly. An example that supports this statement is that among the executives I interviewed in Davos, the number who have a personal e-mail address doubled between 1998 and 1999 (based on the WEF Annual Meeting participant booklet).
As I underlined with the example of the “kiosk” system at the Annual Meeting in Davos (section 3.2.2) there are in my opinion two reasons why the daily use of information technology is growing at the executive level. First the technology is becoming more user friendly (an important element for executives who are not necessarily computer literate). Second and more important, there is growing recognition that information technology can provide an added value to the tasks inherent to the executive position.

5.2 IMPLICATIONS

As I have mentioned, a number of executives stressed that we are only in the early stages of the incredibly fast changes brought by information technology and that at this point, capabilities are heavily underutilized. In particular the opportunities offered by the web still have to be explored.

Based on the interviews, I have identified some of the implications of these changes beyond the simple “interconnection” of executives

A) Company culture

One of the most visible changes brought about by information technology is the interdependence created by connecting everyone in the company. Competitive advantage can be created from sharing information between employees as well as between the members of the board, but according to some executives this is a new philosophy people are not used to. The interviews pointed out that training and education at all levels are key to be able to extract the advantages of this information flow within the company.

Some executives told me they are taking time to learn how to use their computer along with other employees, something they would not have judged necessary in their position even a year ago.

Another issue is what is the next step beyond connecting people? Most believe that the critical factor is to be able to organize all the information at hand and “deliver the right piece of information to the right person.” This holds true at all levels of the company, but is particularly important for the executives because of their responsibilities. The new
concepts of “knowledge management” partially address this issue. These concepts go beyond the scope of this research, but in the future, with respect to the use of information technology, they might be equally important to the executive as interacting and communicating.

B) A global corporation

How have early adopters of information trends been able to differentiate themselves and create a competitive advantage in this industry? The true benefit of interconnecting people and being able to manage more efficiently a greater number of projects independently from their location has allowed companies to seek opportunities beyond their traditional geographic boundaries.

For smaller companies, these geographic boundaries were imposed by default because the cost of doing business far away offset the potential benefits of gaining access to new markets. Today, with real time information and communication made possible by information technology, even small companies can become truly global and do business anywhere in the world.

C) Implications for the executive

For the executive, as mentioned above, face to face interaction is still important, but because projects can be monitored much more closely independent of the location through virtual communication, the critical elements to meeting face to face are being redefined.

The interviewed executives stressed that virtual interaction enables to more clearly “set the agenda” between meetings, allowing for a more productive face to face encounter. In the executives minds, virtual communication and face to face interaction act as complements to increase efficiency, be it with clients, peers or other board members. Today, this is primarily where the added value of information technology lies in terms of communication between executives.
5.3 CONCLUSIONS

Based on the interviews and the survey, we can infer that for executives in the E/C industry, there is strong potential today for:

- Virtual community building
- Developing specific content

Initiatives like Welcom have generated a great deal of interest but did not reach the desired momentum. It could be argued that in addition to the reasons we have analyzed, the concept might have been premature.

With regards to the web, no specific content solutions are being proposed to executives in the E/C industry today. One reason might be that executives define their needs for content and communication on an individual basis, and it is therefore difficult to define a general “content” solution. However I think that there is potential for example, to develop a web-site that identifies and addresses these needs, and would act as a portal to the Internet and a community builder for executives.

I believe that community-building opportunities similar to Welcom and content specific web-sites for executives to fully benefit from the opportunities created by information technology will become a reality in the future. With executives becoming more familiar with e-mail and the Internet, virtual interaction and information technology will redefine the way in which business is done at the executive level in the E/C industry in the years to come.
References


Information found on the web strongly contributed to this research. The following are the primary web-sites that I have consulted:

Blue-line/On-line: www.bluelineonline.com

Business Week e.biz online: ebiz.businessweek.com

Dell Computers: www.dell.com

Engineering News Record: www.enr.com

Industry To Industry, Inc: www.i2i.com

PC Webopaedia: www.webopaedia.com

Red Herring online: www.redherring.com

Wired Magazine online: www.wired.com
Appendix 1

INTERVIEW QUESTIONS

Opportunities created by information technology for the executive in the engineering and construction industry.

Scope:

- What is the importance of networking and peer to peer interaction at CEO/executive level in the industry today?

- How can information technology & the web add value to the tasks of networking and interaction?

- What are the aspects of face to face versus virtual interaction and networking?

1. Networking and Interaction

1.1 I made the assumption that peer to peer interaction and networking is one of the most important tasks for the CEO/Executive. How do you perceive your job? What do you think your job should be?
1.2 Do you have a specific network of people that you regularly are in touch with? Who is part of this network (*clients, shareholders, competitors/potential partners, colleagues from outside the industry*)?

1.3 Do you consider your company to be relationship driven?

1.4 What are the topics of concern most often addressed with the people you interact with?

1.5 Would you consider that the need for interacting with your network has taken more importance in the past 5 years or has it always been important?

1.6 Do you perceive a radical change in the way people communicate? Do you communicate differently?

2. **Use of information technology for interaction**

2.1 In your interaction as we have discussed, do you use information technology to exchange information and communicate?

2.2 What kind of tools do you use that you feel add value to the tasks of interaction and networking?

2.3 Do you use e-mail, videoconferencing? Do you «surf» the web regularly? For what purposes? Are you comfortable with the use of computers, e-mail and the web?

2.4 What do you consider are some of the barriers of using information technology in your position (*there is no added value, no interest, no need, not user-friendly, none of my colleagues use IT, I prefer to communicate via the phone or face to face*)?

2.5 What would encourage you to use more information technology to interact with your peers? What improvements are necessary in the technology?

2.6 Are you concerned about security issues?

2.7 Comment on: «The value of interaction lies in the network of people you are in contact with» how do you imagine IT help create this network and support interaction?
2.8 Looking at the evolution of information technology, we can see that 15 years ago primary uses were word and data processing. Today companies have tremendously improved the way they do business at operational level (Intranet, exchanging of files over the web...) Do you feel that IT is «creeping» it's way into the boardroom, and what will be its use?

3. **Face to face versus virtual interaction at the executive level in the E/C industry**

3.1 How important is it to meet face to face with your peers (*meetings, conferences, etc.*), versus interacting over distance (via the e-mail, video or even the phone)?

3.2 Will there always be a necessity for face to face interaction?

3.3 Are there certain issues that simply can not be done other than face to face?

3.4 Is this particular to this industry?

3.5 What are some aspects of doing business at your level that could definitely be using more information technology

3.6 What are your views of the future? Should information Technology be left at the operational level in the E&C Industry? Will IT inevitably creep into the human aspects of interaction and doing business at the executive level?

* * *
Appendix 2

SURVEY QUESTIONS

This appendix shows the documents sent for the survey. It contains:

- A letter that outlines the content of the research
- An executive summary that relates the critical factors learned during the interviews with respect to the impact of information technology on executives in the E/C industry
- A questionnaire on the importance of Internet services for executives in the E/C industry
Olivier Schwab  
Department of Civil and Environmental Engineering  
Massachusetts Institute of Technology  
77 Massachusetts Avenue, Rm. 1-175  
Cambridge, MA 02139  

Recipient address  
Cambridge, 1999

Dear Sir or Madam,

We have recently met to discuss my thesis research at the department of Civil and Environmental Engineering at the Massachusetts Institute of Technology under the advisory of Professor Fred Moavenzadeh.

The focus of my research is to evaluate the potential of information technology and the possible impact that it may have on the ways that CEOs and Executives in the engineering and construction industry interact, network, and conduct business.

I have conducted a total of 20 interviews with CEOs and Executives from engineering and construction companies varying in size, geographic span, and range of services. I have enclosed a brief summary about what I learned from the conversations I have had with you and some of your colleagues.

I would also like to take this opportunity to have your opinion about certain specific services that can be provided over the Internet, but are not fully exploited by the industry.

Please take a moment to answer the questions on Pages 3 and 4 as this will contribute to the next step of my research. I thank you for your input.

Sincerely,

Olivier Schwab
Executive Summary

1) Tasks of a CEO/Executive

In order to evaluate the impact that information technology may have on the activities of CEOs/Executives, I have summarized these activities in three broad categories:

- **Outside focus**: networking with clients and stakeholders (investors/shareholders)
- **Activity focus**: monitoring project teams and clients on a local basis
- **Corporate focus**: strategic decision making, training and mentoring of employees

Depending on the size of the company, strategic focus, and positioning in the value chain, one task can take more or less importance over others. However, most of the CEOs and executives I interviewed stressed the increasing importance of outside interaction and networking to understand and form strong ties with customers.

2) Means of interaction and networking

Most agree today that e-mail and wireless communication have transformed to some degree the way people interact. However, these tools offer merely a complement to traditional face to face interaction. Meeting face to face is a key component of doing business in the E&C industry for the following reasons:

- To initiate contact in order to build a high trust and sustainable network
- The long term commitment and heavy investments inherent to this industry
- The need for physical contact with the local culture where the company operates

3) The added value of Information Technology for the Executive today

- Strengthening relationships with clients and peers through the use of the Internet
- Providing and developing relevant information on markets of interest
- Providing and developing economic and financial information relevant to the E&C industry

Technology has enabled CEOs/Executives to manage day to day activities more effectively, especially when it comes to real time information about on-site job progress and company performance. This has allowed for companies to become truly global, as these activities can be monitored at anytime from anywhere.

However, it seems that information technology and in particular the use of the Internet if fully exploited could assist the CEO/Executive in the E&C industry to enhance the quality of the communication.
Internet Services for the Engineering and Construction Industry

What type of information would be truly beneficial to a CEO/Executive, given that this information was made available over the Internet? In what context and under what form should this information be presented?

Please express your views on a scale from 1 to 5 about the relevance, importance and use of the Internet in the following areas related to the engineering and construction industry.

1) Electronic Commerce

The trading, leasing and renting of new and used construction equipment on-line.

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2) Providing Economic and Financial Information that are Important to the E&C Sector

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3) Providing Specific Financial Information

With regards to entering new markets and regions

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4) **Partnerships and Alliances**

Seeking and identifying partners for penetrating into new markets and regions

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5) **Routine Services**

Such as seeking sub-contractors and suppliers, and identifying contractual conditions

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