

# Global Investment Banking; Challenges Surrounding the Design of Information Systems for the 21<sup>st</sup> Century

by

**Oded Weiss**

M.Sc., Chemical Engineering (1996)  
The Technion - Israel Institute of Technology

Submitted to the System Design and Management Program  
in Partial Fulfillment of  
the Requirements of the Degree of  
**Master of Science in Engineering and Management**

at the

**Massachusetts Institute of Technology**  
**January 1998**

[5000 1.87]

© Massachusetts Institute of Technology (1998)

ALL RIGHTS RESERVED

Signature of Author \_\_\_\_\_

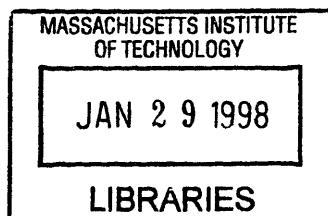
MIT Sloan School of Management  
MIT School of Engineering  
January 16, 1998

Certified by \_\_\_\_\_

Prof. Michael Stewart Scott Morton  
Jay W. Forrester Professor of Management  
Thesis Supervisor

Accepted by \_\_\_\_\_

Dr. Dan Frey  
Assistant Director  
System Design and Management Program



**ARCHIVES**

# **Global Investment Banking; Challenges Surrounding the Design of Information Systems for the 21<sup>st</sup> Century**

by

**Oded Weiss**

Submitted to the System Design and Management Program  
in Partial Fulfillment of  
the Requirements of the Degree of  
**Master of Science in Engineering and Management**

## **ABSTRACT**

The investment banking industry is experiencing major strategic and organizational changes. Information technology (IT) is playing a major role in these changes and, if utilized properly, IT can provide investment banks with a competitive advantage. However, technology experts are voicing a degree of uncertainty as to whether the existing systems will be able to provide the sophisticated requirements necessary to address the evolving needs of the industry in the 21<sup>st</sup> century

Thanks to new technologies and the availability of information, entry barriers to the investment banking industry have become lower. New entrants and the suppliers can offer the same services in a cost-effective way due to their effective use of new information systems and the Internet. In order to stay competitive in the marketplace, investment banks must use new technologies to leverage parts of their existing infrastructure in the front office and to replace inefficient legacy systems in the back office.

In the first part of this thesis, I examine the services that investment banks provide and describe the current information technology infrastructure that they currently use. The second part analyzes the ways in which the environment is putting pressure on investment banks to change their methods of doing business. The third part describes the requirements from information systems that will enable investment banks to compete efficiently in the 21<sup>st</sup> century. Finally, this thesis attempts to answer the question whether the current infrastructure is capable of supporting the 21<sup>st</sup> century needs.

Thesis Supervisor Michael Stewart Scott Morton  
Title: Jay W. Forrester Professor of Management

## Acknowledgments

I am grateful to Professor Michael Scott Morton for presenting me with an interesting challenge and for supervising this thesis. I found his genuine comments of great value.

I acknowledge and express my appreciation to my parents in recognition of their patience, devotion, and sacrifice in helping me to attain my educational goals.

## TABLE OF CONTENTS

INTRODUCTION _____	7
INVESTMENT BANKS _____	9
The Industry _____	9
General Structure of a Full Service Investment Bank _____	9
Investment Banking Services _____	10
Sales and Trading _____	10
Research _____	11
The Equity Analyst's Role _____	12
Credit Suisse Group _____	15
Credit Suisse First Boston (CSFB) _____	18
INFORMATION TECHNOLOGY FOR GLOBAL INVESTMENT BANKS _____	19
IT Organizational Structure _____	20
Technical Infrastructure _____	22
Shift from Back Office to Front Office _____	24
Technical Tools for the Equity Analyst _____	27
Global Research Library at CSFB _____	28
PRESSURES PROMOTING CHANGE FOR INVESTMENT BANKS _____	30
Buyers _____	32
Globalization _____	33
Smarter and More Demanding Customers _____	37
Rivalry _____	38
Consolidation _____	38
Decreasing Margins _____	39
Global Risk Assessment Demands _____	39
New Entrants _____	40
Technology-Driven Change _____	41
Suppliers _____	44

ISSUES TO CONSIDER WHEN DESIGNING INFORMATION SYSTEMS FOR INVESTMENT BANKS IN THE 21 <sup>ST</sup> CENTURY _____	45
Standardization _____	45
Real-time Risk Measurement _____	47
High-Volume Information Management _____	47
Use of Web-Based Technologies _____	48
Vendor Compatibility _____	51
Security _____	52
Customized Information _____	53
Global and Scaleable Systems _____	55
IS THE CURRENT IT INFRASTRUCTURE CAPABLE OF MEETING 21 <sup>ST</sup> CENTURY NEEDS _____	57
Legacy Systems _____	58
Open Systems _____	61
Year 2000 Problem _____	62
CONCLUSION _____	65
APPENDIX A - INDUSTRY DEFINITIONS _____	68
APPENDIX B - ACRONYM KEY _____	70
APPENDIX C - EQUITY ANALYSTS IN THE MAJOR INVESTMENT BANKS	71
APPENDIX D - AN EXAMPLE OF EQUITY ANALYST REPORT _____	73
BIBLIOGRAPHY _____	77

## TABLE OF FIGURES

<i>Figure 1 - Professionals with Whom the Equity Analyst Must Communicate.</i>	13
<i>Figure 2 - Schematic Presentation of Time Allocation For Equity Analyst.</i>	15
<i>Figure 3- The Structure and The Components of the Credit Suisse Group</i>	17
<i>Figure 4- Organizational Chart of Credit Suisse First Boston</i>	18
<i>Figure 5- Organizational Chart of the Information Technology Division at CSFB</i>	21
<i>Figure 6- Schematic of the Investment Banks Systems</i>	22
<i>Figure 7- Typical staffing strategies in the last decade</i>	24
<i>Figure 8: Porter Five Forces Framework with the Oster's Modification.<sup>8</sup></i>	30
<i>Figure 9: Schematic for the Forces That Affect the Investment Banks</i>	32
<i>Figure 10 - Old Organizational Structure of Equity Research Division</i>	34
<i>Figure 11 - New Organizational Structure of Equity Research Division</i>	35
<i>Figure 12: Dynamic tension between External and Internal Dimensions of the Organization</i>	41
<i>Figure 13: The Need for Standards</i>	46

## INTRODUCTION

As we approach the 21<sup>st</sup> century, the investment banking industry is going through major strategic and organizational changes. Information technology (IT) is playing a major role in supporting these changes and, if utilized properly, IT can provide investment banks with a competitive advantage. However, there is high level of uncertainty from technology experts as to whether the existing systems will be able to provide the sophisticated requirements necessary to address the evolving needs of the industry in the next century

In the first part of this thesis, I examine the services that investment banks provide and describe the current information technology infrastructure currently used by major investment banks. The second part analyzes the ways in which the environment is putting pressure on investment banks to change their methods of doing business. The third part describes the requirements from information systems that will enable investment banks to compete efficiently in the 21<sup>st</sup> century. Finally, this thesis attempts to answer the question whether the current infrastructure is capable of supporting the 21<sup>st</sup> century needs.

Equity research is one of the services that investment banks offer to their clients. This thesis describes the various tasks and the unique skills of equity analysts within the investment banks. I believe that because of the large number of professionals that the financial analysts need to interact with and due to the variety of services that analysts

provide, information technology has, and will continue to have, a significant effect on equity analysts' performance. Therefore, I chose to give special attention to their role and to the technology that they need to survive and thrive in the next century.

During my research, I spoke with several people from the information technology divisions of several investment banks. Credit Suisse First Boston has gone through two mergers in 1997 and many people from the various divisions including the IT division are reviewing the bank's strategy for the next century. Moreover, new initiatives of Credit Suisse First Boston's IT division made significant contributors to my research and I frequently used their systems as an example. However, the strategic conclusions from my research are not limited to CSFB.

Finally, many of the technical and organizational issues that I present in the thesis are highly controversial. This thesis summarizes my personal view and the different opinions of the IT professionals in the various investment banks with whom I spoke. Any other view may be viable and equally correct.



# **INVESTMENT BANKS**

## **The Industry**

The investment banking industry can be divided roughly into two major groups:

- Full service investment banks.
- Specialty boutiques

Among the full service investment banks there is an increasing number of banks that are expanding operations to other countries and becoming global investment banks. The increasing number of global transactions, the communication needs and the collaborative efforts among different departments in banks are posing significant challenges for information technology designers.

## **General Structure of a Full Service Investment Bank**

An investment bank provides a range of services to companies and institutions using the financial markets. In this capacity, an investment bank can be an advisor to corporations, an issuer of financial products and a distribution organization for financial products, an investor, or a research organization.

Not all investment banks provide all these services and each investment bank has its own structure and own strengths. However, we can simplify the structure of most investment banks to three major divisions:

- Investment banking services
- Sales and trading
- Research

These divisions are closely linked and most of the transactions involve all of the three divisions.

### **Investment Banking Services**

The investment banking division provides a full range of financial and strategic advisory services to corporations, financial institutions and governments. They are responsible for advising clients on important strategic issues such as mergers and acquisitions (M&A), disposals and restructuring as well as arranging fixed income, equity and equity-linked issues.

### **Sales and Trading**

The sales group is responsible for selling financial products (stock, bonds, etc.) developed by the investment-banking department. As such, they serve as the link between the sellers (corporations and government entities) and the buyers (investors) of those products. Sales professionals meet the varied needs of portfolio managers, research analysts and traders at pension funds, insurance companies, mutual funds, hedge funds, banks, money management firms, investment advisors, endowments and foundations.

Traders make markets in various securities and provide liquidity to facilitate customers' transactions. Equity derivatives specialists also develop strategies to allow portfolio hedging and restructuring, asset allocation, equity index swaps and the construction of synthetic instruments.

## **Research**

Research departments generally incorporate several different types of research efforts:

- Quantitative research, which deals mostly in fixed income securities
- General economics and markets research
- Equity research

The researchers are responsible to provide analysis and quantitative support to the other parts of the bank. The research departments are usually divided into small teams for different products groups that work closely with the appropriate division in the bank. However, most of their work is considered "rocket scientists" work because it requires the development of quantitative models of financial phenomena and it is performed in the corporation's computer labs using sophisticated analytical tools.

## **The Equity Analyst's Role**

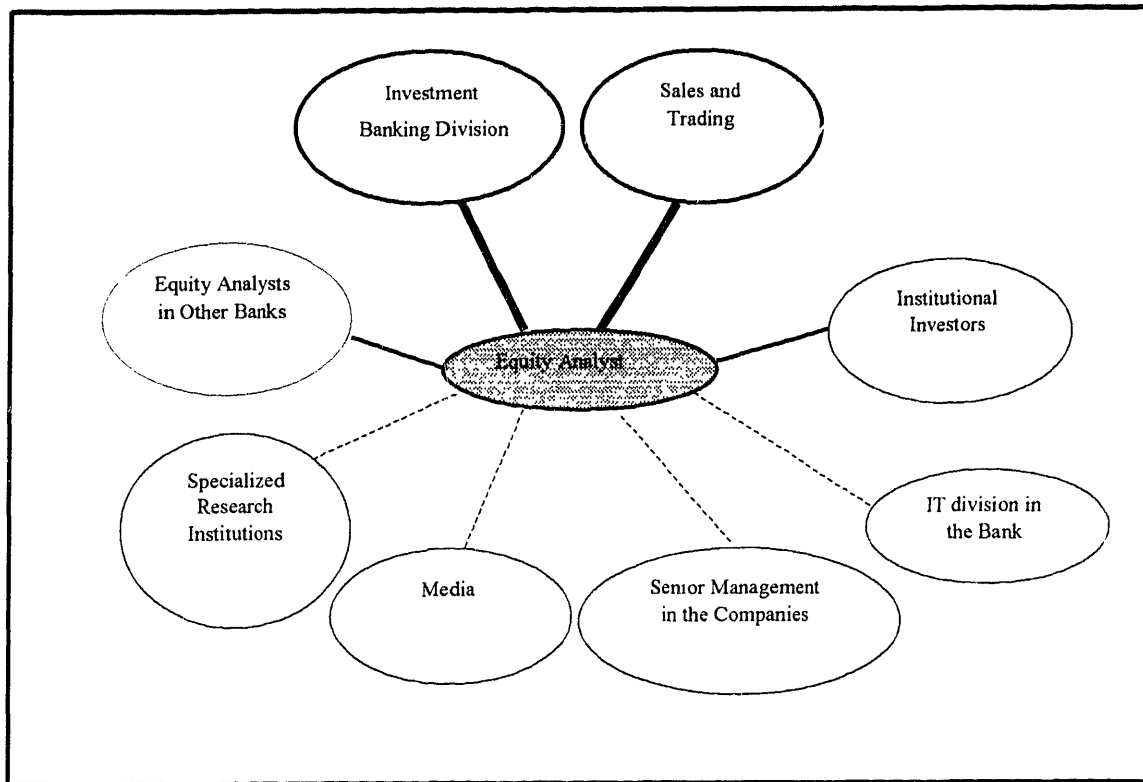
Equity analysts are somewhat different from the rest of the research department in the sense that they collaborate and communicate with many different professionals; internally and externally with the different types of clients (institutional investors, corporations, etc.) Another important aspect of their work is that each analyst concentrates on a specific industry sector and in companies within that sector. Consequently, they are experts in the trends within that industry and receive all the related information.

Equity analysts perform various tasks:<sup>1</sup>

- Provide earnings estimates
- Select stocks
- Publish reports for each company that they cover
- Publish industry reports
- Identify new mergers and acquisitions opportunities
- Support Initial Public Offerings (IPOs)
- Meet with institutional investors
- Meet with senior management of the companies they cover
- Participate in "road shows"
- Answer queries from sales and trading specialists regarding their stocks
- Support company evaluations and comparable analysis for the investment banking division

---

<sup>1</sup> Author notes during interviews



**Figure 1 - Professionals with Whom the Equity Analyst Must Communicate.**

It is important to understand that the metrics that are being used in evaluating the analysts performance are:

- Accuracy of earnings estimates
- Stocks portfolio performance
- Number and quality of reports
- Reputation

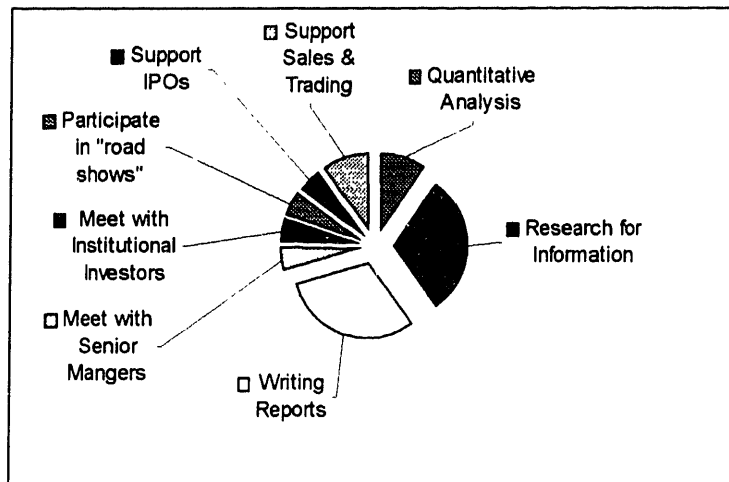
*The Wall Street Journal* and the *Institutional Investor* magazine publish annual surveys of the best equity analysts in the industry. The *Wall Street Journal* uses only the first two

matrices (accuracy of earnings estimates and stock portfolio performance) because they are easier to measure and are objective, while *Institutional Investor* presents a qualitative ranking based on an analyst's reputation and number and quality of the publications. In each one of the major investment banks there are several hundreds equity analysts (Appendix C lists the number of equity analysts in the major investment banks.)

The analysts' reports, which analysts spend a significant amount of their time producing, are the only tangible products of the analysts' work. Only recently, have analysts' compensations been tied also to the volume of deals generated by their recommendations; more and more analysts are dedicating their time and efforts initiating mergers and acquisitions deals. Consequently, the compensation packages of equity analysts have been increased significantly over the last few years. Nicolas Crispi an executive recruiter working mainly with equity analysts for 25 years says, "Searches that began at \$150,000 are now being closed at \$300,000." And the leading "franchise players" - recognized names in such deal-intensive fields as technology and healthcare - can, says Crispi, easily command in excess of \$1.5 million and a contract for as long as three years, along with a payout scheme tied to the analyst's participation in investment banking transactions.<sup>2</sup>

---

<sup>2</sup> *Institutional Investor*, "The 1997 All-America Research Team", cover story, October 1997.



**Figure 2 - Schematic Presentation of Time Allocation For Equity Analyst.**

I believe that because of the various tasks and the specific characteristics of the analysts' position, information technology has, and will continue have, a significant effect on equity analysts performance. Therefore, I chose to give special attention to their role and to the technology that they need to compete successfully in the next century.

## **Credit Suisse Group**

Credit Suisse Group is comprised of four business units, Credit Suisse, Credit Suisse Private Banking (CSPB), Credit Suisse First Boston (CSFB) and Credit Suisse Asset Management (Figure 3). Each unit serves the needs of specific customer groups and markets. In 1990, Credit Suisse purchased the American investment bank First Boston and the latter became CS First Boston.<sup>3</sup> Since then CS First Boston has continued to

---

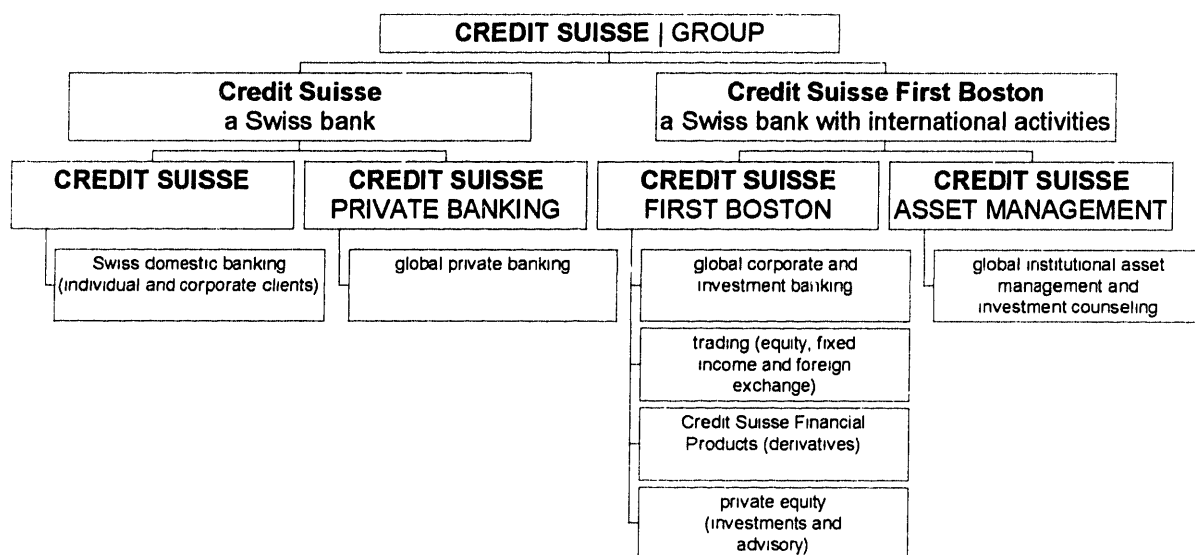
<sup>3</sup> Credit Suisse pumped \$725 million into First Boston, mostly to cover crumbling bridge loans.

operate as an independent investment bank in North America with some collaboration with the corporate and investment banking unit of Credit Swiss. On 1 January 1997 CS First Boston was merged with the international wholesale business and the trading units of Credit Suisse to form the new Credit Suisse First Boston (CSFB).<sup>4</sup>

---

<sup>4</sup> Linda Grant, "Will CS First Boston Ever Win?" *Fortune*, August 19, 1996.





Pro forma results (Indicative) in CHF million (except staff) in 1996

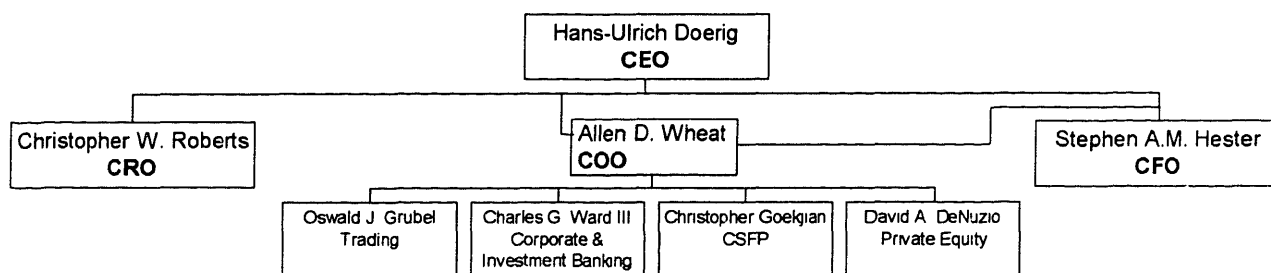
	<b>CREDIT SUISSE</b>	<b>CREDIT SUISSE</b>	<b>CREDIT SUISSE</b>	<b>CREDIT SUISSE</b>
		PRIVATE BANKING	FIRST BOSTON	ASSET MANAGEMENT
Net operating income	2,700	3,040	6,475	660
Staff expense	1,720	810	3,265	220
Valuation adjustments, provisions and losses	990	60	170	30
Pre-tax operating profit (loss)	(950)	1,360	1,875	195
Equity	3,950	1,950	9,600	400
Staff	15,800	6,150	11,000	1,200

**Figure 3- The Structure and The Components of the Credit Suisse Group<sup>5</sup>**

<sup>5</sup> 1996/1997 Credit Suisse Annual Report.

## Credit Suisse First Boston (CSFB)

Credit Suisse First Boston is an international investment bank serving both borrowers and lenders of capital around the world. The firm provides comprehensive financial advisory and capital-raising services, and develops and offers financial products and services to a broad range of clients. CSFB has \$8.5 billion of equity capital, and it provides all securities, derivatives, advisory and wholesale commercial banking activities of the Credit Suisse Group to a wide ranging customer base.



**Figure 4- Organizational Chart of Credit Suisse First Boston<sup>6</sup>**

---

<sup>6</sup> Credit Suisse First Boston Web Site ([http://www.corp.csfb.com/corp/about/about\\_05.htm](http://www.corp.csfb.com/corp/about/about_05.htm).)

# **INFORMATION TECHNOLOGY FOR GLOBAL INVESTMENT BANKS**

The information technology division in an investment bank is mainly responsible for the following services to all of the business units of the bank:

- Management and support of desktop application
- Management and support to business division applications development (architectural policy and consultancy support)
- Consultancy and advisory services

Other responsibilities includes:

- Management, maintenance and support of all large-scale computer processing and data management hardware
- The development and operation of the enterprise-wide communications network

Information technology divisions differ from one investment bank to another in their organizational structure and technical infrastructure. However, all of the global investment banks are facing similar challenges.

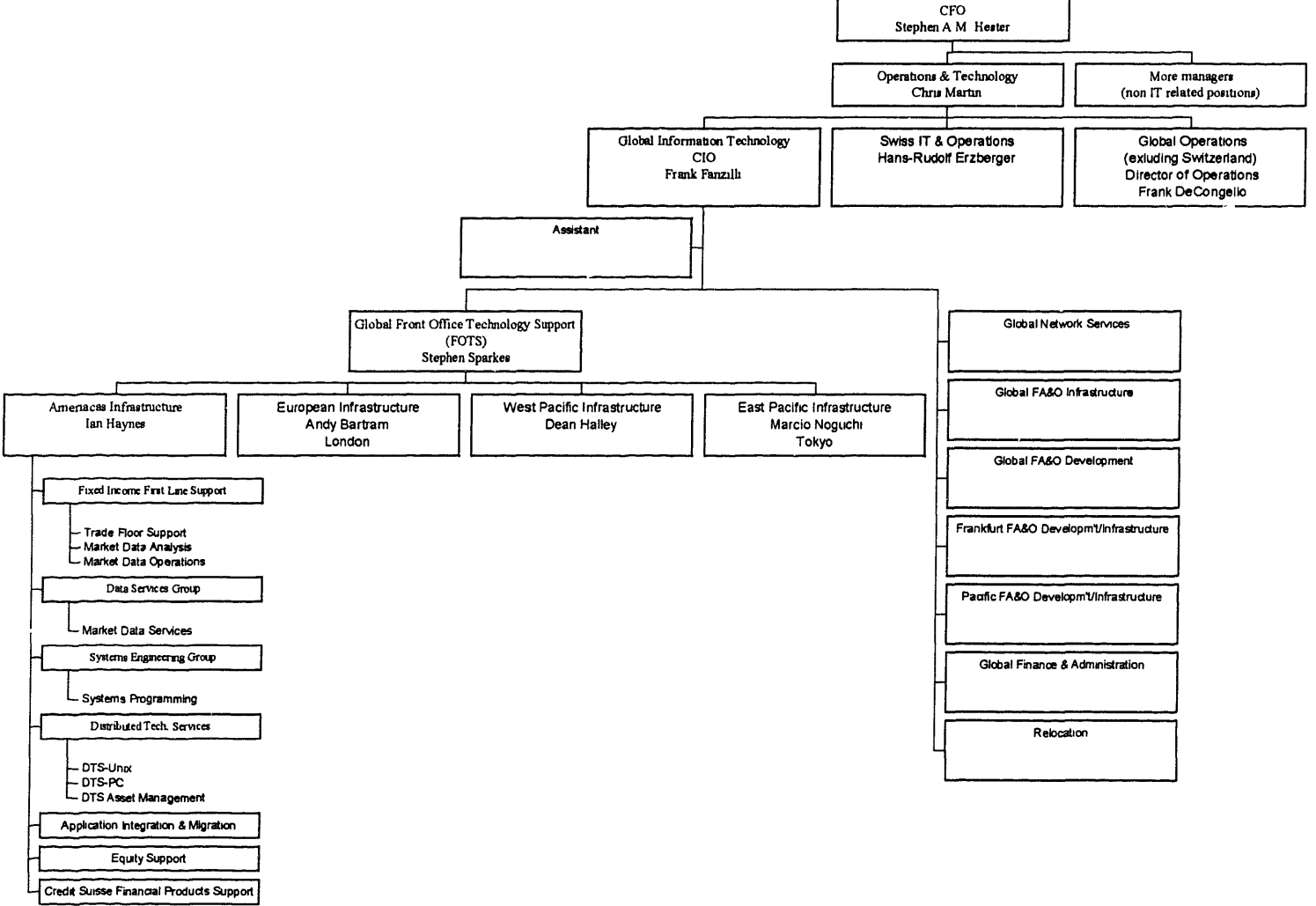
## **IT Organizational Structure**

Most investment banks operate with an integrated group level IT in major market areas. The group has responsibility for back office systems and infrastructure services and for decentralized front office systems support for applications development for the business divisions.

Global priorities for budget and staffing allocation are set by central user management (at the group level); divisional application priorities are set by user divisions; and divisional IT budgets are the responsibility of each user division. Each IT group responsible for maintaining systems architecture and avoiding duplication, for telecommunications, information services (for example, external information sources), office systems, applications development standards and policies, and data centers.

While this type of organizational structure is common, some organizations are highly centralized (Salomon Brothers before the merger with Travelers Group) and highly decentralized (Goldman Sachs & Company). Credit Suisse First Boston's organizational structure has gone through many changes in the last year. Figure 5 described the organizational structure at CSFB.

**Figure 5- Organizational Chart of the Information Technology Division at CSFB<sup>7</sup>**



<sup>7</sup> Author notes during interviews

## Technical Infrastructure

The information technology infrastructure is usually divided into the front and the back office operations (figure 6). While there are many different configurations for back office infrastructure most include mainframes from IBM, DEC or SUN that run database software such as DB/2 and Sybase. Data center development, maintenance, and the communication links to business units are the responsibilities of the back office team. In some cases, the mainframes are located in a remote site (Princeton, New Jersey in CSFB) and most of the back office staff is isolated from the rest of the bank staff

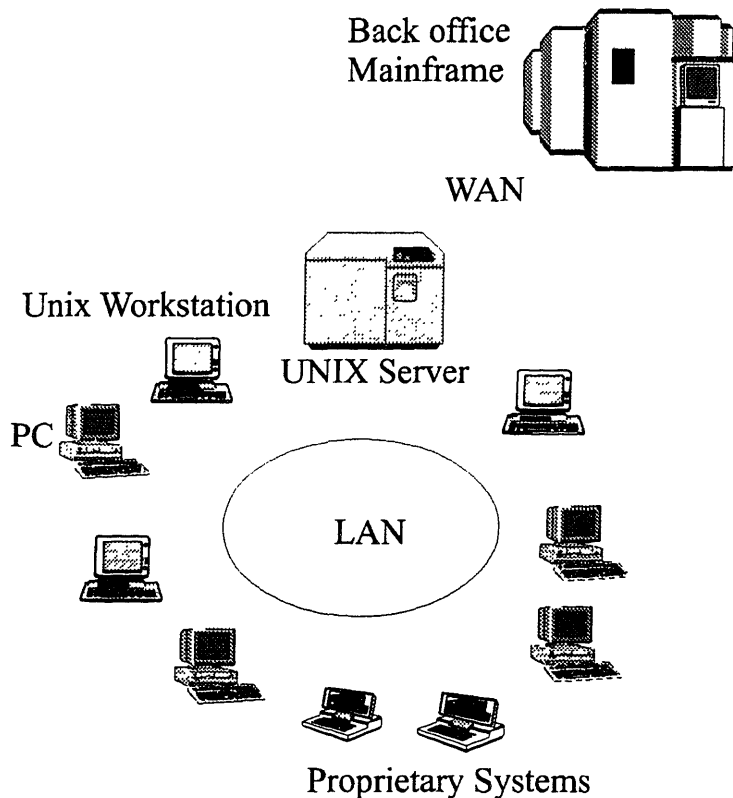


Figure 6- Schematic of the Investment Banks Systems

The front office infrastructure consists of dozens of different platforms and applications and in most investment banks, different components and applications have been upgraded to address specific and temporary departmental needs. The desire to quickly response to the user requests led to less planing and more improvising. Not surprisingly, the situation in the front office infrastructure is even less organized than in the back office.

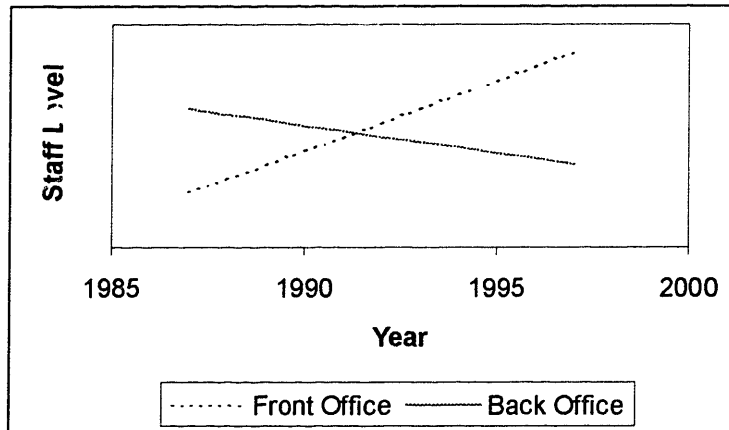
When distributed client/server systems emerged as the foundation of next generation computing, many Wall Street firms, in order to leverage previous infrastructure investments, connected client/server systems to the existing mainframes. Individual managers added hardware and software from different vendors as needed. Unfortunately, these pieces often did not fit together as easily as the vendor's marketing materials promised. The complexity of financial databases also increased exponentially, as new financial products continuously arrived on the scene<sup>8</sup>. The new applications and the customized solutions in several investment banks led to blurred lines between the front and back office. When the responsibilities where not clear, IT professionals from one office often blamed the professionals from the other office for the problems.

---

<sup>8</sup> Mehl B., " First Boston profits from IT upgrade; CS First Boston; Company Operations", *Wall Street & Technology*, Vol. 14, No. 9, Pg. 50, 1996.

## Shift from Back Office to Front Office

New technologies and the increasing power of front office applications increased the importance of the front office infrastructure. In the same time, the handling of the back office mainframe became easier as many specialized vendors made it possible to outsource the data centers maintenance. Consequently, in recent years staffing rapidly shifted from back office systems to the front office for application development. Figure 7 illustrates typical staffing strategies in the last decade.



**Figure 7- Typical staffing strategies in the last decade**

An important example of a new technology that increases the power of the front office infrastructure and minimizes the need in the back office infrastructure is NUMA-Q by Sequent.

**NUMA-Q** - Four-processor boards, or quads, are connected within a single server by Sequent's innovative IQ-Link. IQ-Link transfers data between quads at the rate of one



gigabyte per second, so quickly that many processors can be linked together yet still appear to database applications as a single, shared-memory system. This makes NUMA-Q to one of the most scalable open systems platforms in the world, with up to 252 Intel® Pentium® Pro CPU's, 32 GB of memory, and 100 terabytes of disk storage. From an interconnect perspective, NUMA-Q has a wide I/O bandwidth, which can be utilized to power-through massive multi-terabyte decision support queries.<sup>9</sup>

IQ-Link,<sup>TM</sup> the Sequent-designed connection technology for linking multiple quads, is the reason why NUMA-Q can overcome the limitations of today's backplane-based big-bus SMP computers to truly achieve mainframe status in scalability and overall performance. This unique high-speed interconnect uses intelligent caching techniques and a Gallium Arsenide data pump to deliver extremely effective throughput.

NUMA-Q also solves the "data skew" problem—the error-prone distribution of data across nodes—that afflicts many Massively Parallel Processing (MPP) systems and limits the configuration to a few handcrafted queries. With NUMA-Q, CPUs are not tied to disks, so processing power from any node can be directed to any disk.

From a technical point of view, NUMA-Q's extreme performance makes Relational On-Line Analytical Processing (ROLAP), automated data mining and advanced graphical visualization practical and cost effective.

---

<sup>9</sup> Sequent Web site (<http://www.sequent.com/news/releases/1997/nr-1195.html>.)

**Digital and Sequent Initiative** - Digital Equipment Corporation and Sequent Computer Systems, Inc. recently announced they will collaborate on a 64-bit UNIX initiative to establish the leading UNIX on the IA-64 enterprise computing architecture, and the most interoperable UNIX with Windows NT. The 64-bit UNIX initiative is based on Digital UNIX, will add key Sequent technologies, and be augmented with joint development by the two companies.<sup>10</sup>

The IA-64 microprocessors will extend the reach of the Intel Architecture into the high-end of workstations and servers. The first IA-64 microprocessor is Merced™ that will be in production in 1999.<sup>11</sup>

Casey Powell, chairman and CEO of Sequent Computer Systems, Inc. said, “This 64-bit UNIX initiative will deliver the only complete 64-bit UNIX on Intel IA-64. The initiative is uniquely positioned to achieve broad acceptance among enterprise-focused customers, independent software vendors (ISV) and OEMs who require a risk-free migration path, partnership, and product integration for IA-64.”

The implications of that initiative are tremendous; investment banks could use number of high power servers connected together and eliminate the need in the back office mainframes.

---

<sup>10</sup> Digital Web site ([http://www.digital.com/info/PRW03B/.](http://www.digital.com/info/PRW03B/))

<sup>11</sup> Intel Web site (<http://www.intel.com/pressroom/archive/speeches/MPF1097D.HTM.>)

## **Technical Tools for the Equity Analyst**

Each investment bank equips its equity analysts with different sets of tools. However, there are four main groups of tools that all analysts need:

**Market data providers** - The equity analysts should have access to real-time stock quotes and news, leading economic indicators, currency exchange rates, bonds prices, etc. Several companies can provide this valuable data such as Bloomberg and Reuters. Until recently, analysts could not easily link the market data with other applications. However, applications like the open versions of Bloomberg that was introduced in 1996, enables an easy link between various applications.

**Analysis tools** - In order to evaluate a company, financial models are necessary. Most analysts use spreadsheet applications, usually Microsoft Excel, to do this, but there are also dozens of specialized tools like Wilshire and BARRA systems, etc. The increased use of Microsoft Excel helped drive the shift from back office to front office applications and to the increased use of Windows operating systems. Frank Fanzilli, CSFB's CIO says that since CSFB is a big user of Excel--and since the product "can't run on a Unix workstation"--it makes a lot of sense to roll out NT, at least on the front-end.

**Reports and presentations generators** - in order to produce written reports, overhead slide presentations, etc. word processors and slides tools like MS PowerPoint are necessary.

**Communication tools** - electronic mail (email).

### **Global Research Library at CSFB**

The primary motive for the CS First Boston merger with the European investment bank part of Credit Suisse was to become a global player in the global market. The IT division of the new organization has an essential role in implementing that change.

To accomplish its goal, the IT division has initiated several programs.

In general, CSFB has built an advanced Web page that includes corporate information and research documents. However, certain groups within the bank have already moved beyond this step. The equity group is using its Web site to advise institutional buy-side investors of its inventory level, while the equity research arm has deployed earnings models in spreadsheet form that clients can use to test the impact of changing model assumptions. The CSFB's Global Research Library, which is presented in this section, is one of the most important initiatives within CSFB.

The Global Research Library application takes CSFB to a new level in electronic distribution of research, a unique component among trading companies. Analyst reports and updates are being distributed today in near real-time on a worldwide basis, via

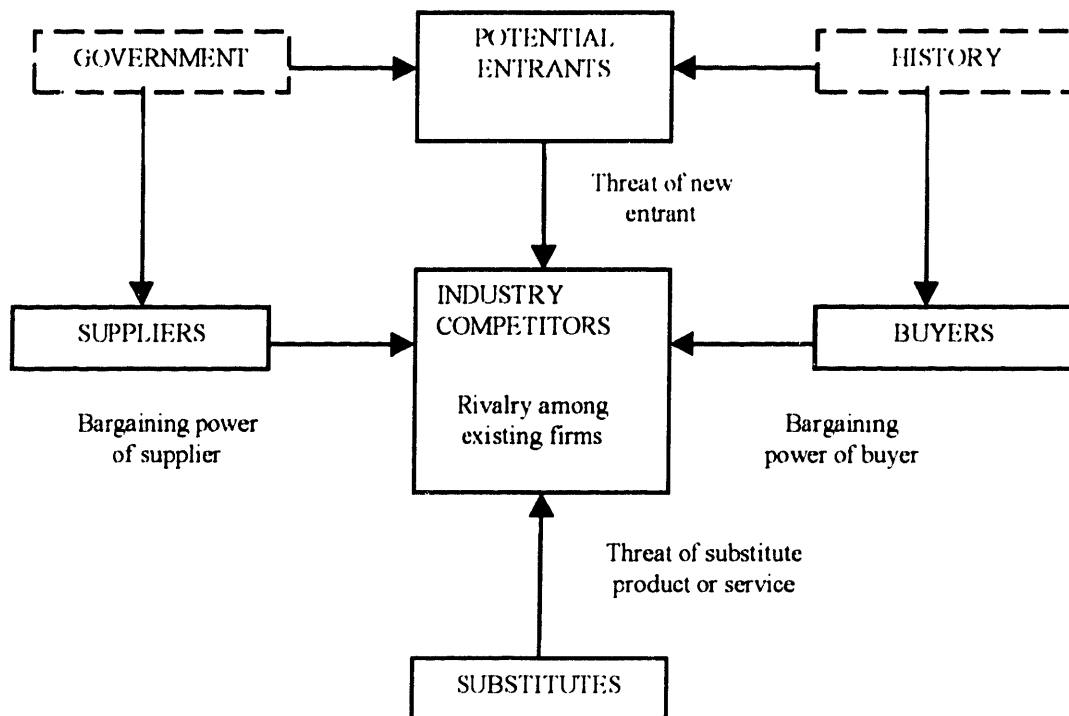
Intranet to traders, and in the future, it will be distributed via the Internet to selected investors. The system makes it possible to store non-text data like graphics, audio, and video on the server. The content could be transmitted across the global computer network. One of the interesting features of the Global Research Library is its automated notification system that enables users to create a personal profile with specific topics (industry, company, country); and when a new article is uploaded to the system, users automatically receive notification (either by email or via pop-up window.)

Thee CSFB's front office staff together with Informix professionals developed this intranet/internet application using the Informix Illustra Object-Relational Database Management System (ORDBMS) for extensibility to handle complex data; Informix's Web DataBlade module for generation of dynamic web content; and the PLS Text DataBlade module for rapid, indexed, full-text searches within the database.

The Global Research Library application runs on the Informix's Universal Server (an object/relational database server). The system operates on Sun Microsystems hardware and supports several thousand users throughout its worldwide operations, including four major installations in London, New York, Tokyo, and Zurich.

## PRESSURES PROMOTING CHANGE FOR INVESTMENT BANKS

In his book "Competitive Strategy",<sup>12</sup> Michael Porter suggests that there are five major forces that affect all industries: buyer power, supplier power, rivalry, new entrants (barriers to exit and barriers to entry) and threat of substitution. Oster, took Porter's framework and add the government and history factors.<sup>13</sup>



**Figure 8: Porter Five Forces Framework with the Oster's Modification.<sup>8</sup>**

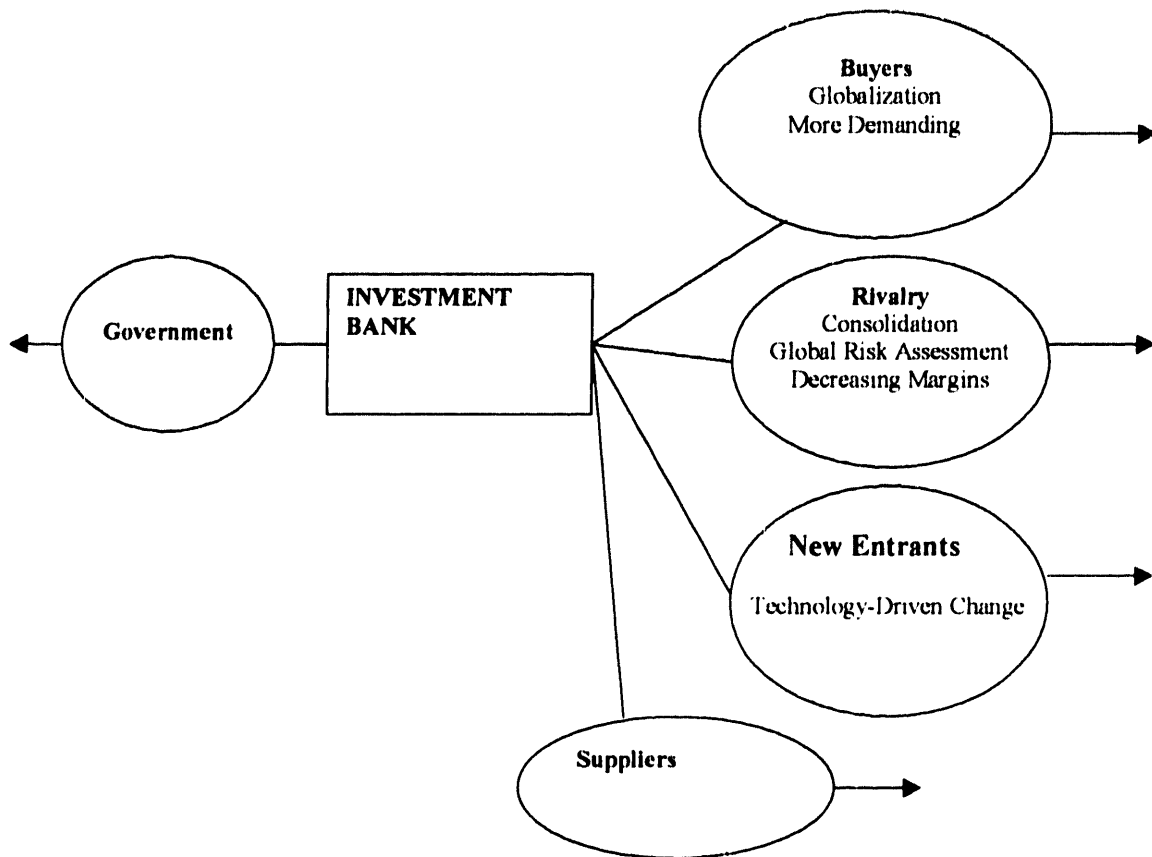
---

<sup>12</sup> Michael E. Porter, "Competitive Strategy- Techniques for Analyzing Industries and Competitors", Free Press, 1980.

<sup>13</sup> Oster, Sharon M., "Modern Competitive Analysis," New York: Oxford University Press, 1994.

Today, the five forces, especially rivalry, buyer power and new entrants are placing enormous pressures on the investment banks forcing them to change their strategy and the way they operate.

The government on the other hand, is slowing the pace of changes. For instance, the Securities and Exchange Commission and other overseers have accommodated on-line experiments, but they cannot keep up with the new application and uses of the Internet. Investment firms have had to delay the most basic Internet functions, like e-mail communication between brokers and clients, because of regulatory uncertainty. Federal regulators decry firms using the Internet and thus bypass their jurisdiction, and most foreign regulators are not doing any work either to support the new technologies.



**Figure 9: Schematic for the Forces That Affect the Investment Banks**

## **Buyers**

Today, investment banks provide a wide range of services to companies and institutional investors. The globalization of conglomerates and the companies that they are serving forces the investment banks to gain expertise in new financial markets and in global transactions. Moreover, due to an easier access to information, the institutional investors learn about investment opportunities in emerging markets and they demand a global service from the investment banks.

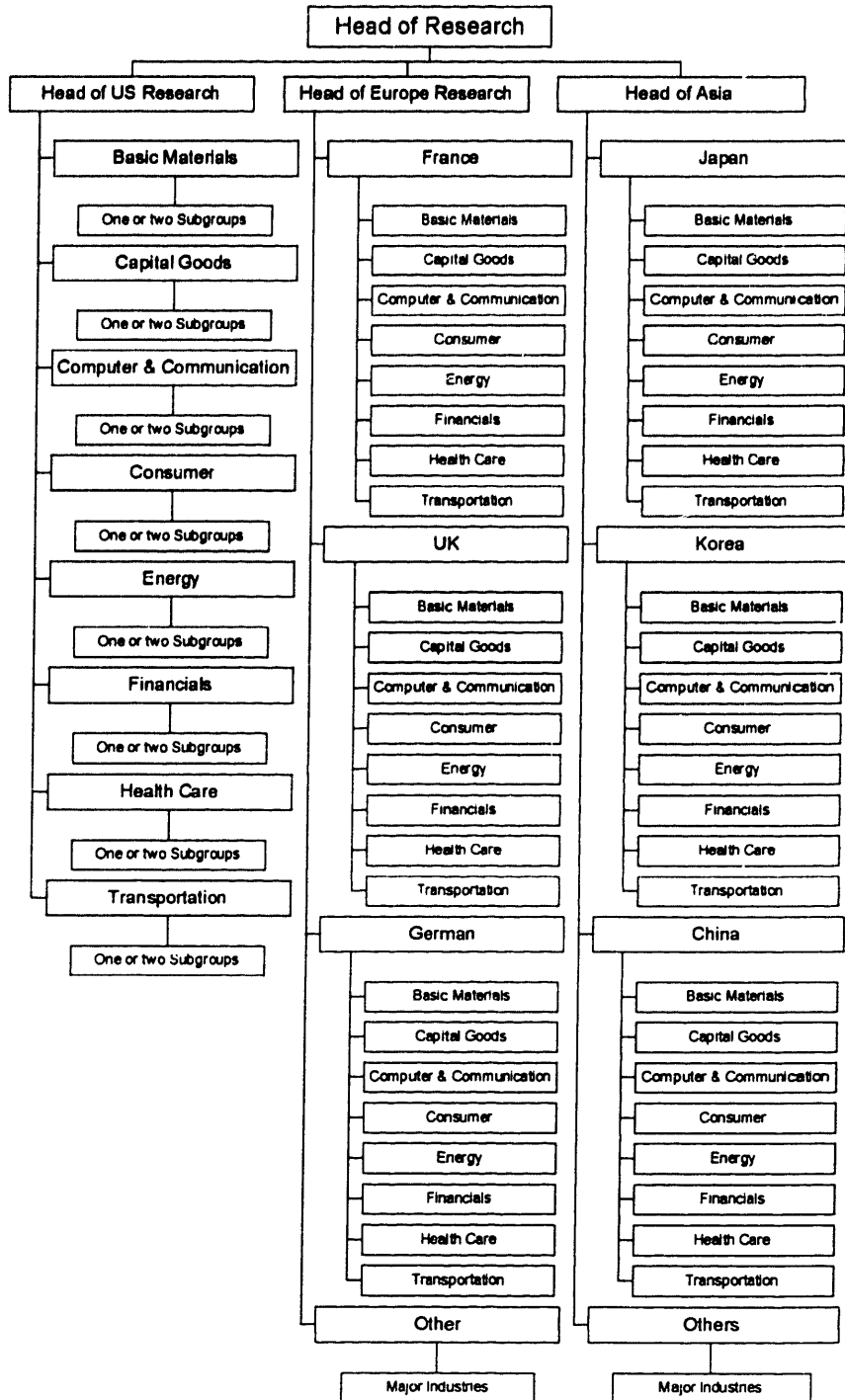


## **Globalization**

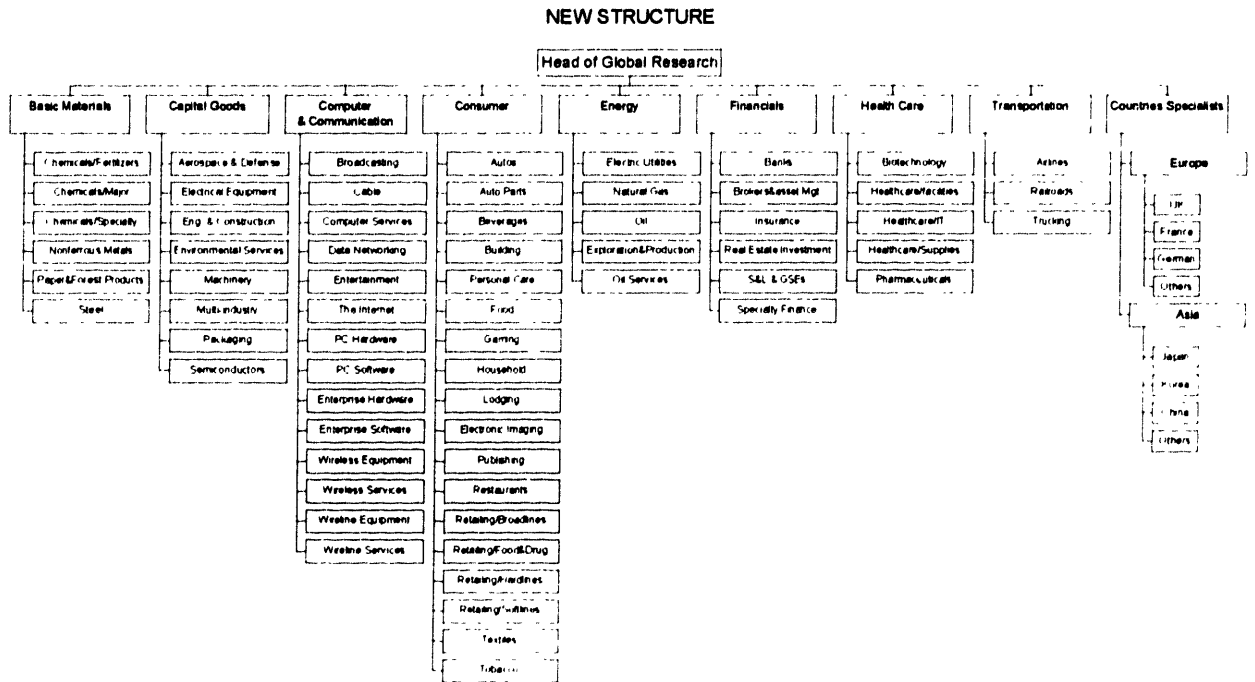
Globalization is the one of the major forces that has changed the investment banking industry in the past decade. An increasing number of the major players are discovering that global economy is no longer a flashy buzzword but reality. In fact, the consolidation trend is partially fueled by the need for corporation to become global players. For equity analysts in particular, the ability to perform global research has become the most important challenge. What good is a report on General Motors Corp that fails to include the competitive threat posed by Toyota Motor Corp. or how useful is a forecast for British Telecommunications that misunderstands AT&T Corp. or a study of Switzerland Novartis that doesn't include Merck & Co. or Germany's Hoechst?

The need for global research influences the organizational structure of the equity research divisions in many investment banks. In the old structure most analysts concentrated in domestic industries research and some analysts covered specific geographic regions. In the new organizational structure, the analysts are covering their industries globally (See figures 10-11).

## OLD STRUCTURE



**Figure 10 - Old Organizational Structure of Equity Research Division**



**Figure 11 - New Organizational Structure of Equity Research Division**

Nevertheless, big investment banks such as Merrill Lynch are still in the early stages of implementing global research strategies. The major firms still confront a variety of challenges as they tackle global research:

**Language** - While English is the generally accepted common language, the fact that several languages are spoken in the global market has created a communication barriers. However, the combination of the growth needs of many companies and the increasing number of cross border deals, has forced companies around the world to increasingly use English.

**Different Accounting Rules** - This issue complicates the companies' evaluation tasks.

Although an increasing number of analysts are starting to understand different accounting methods, "there will always be quirks and twists [in each region]. We do [global research] with discipline, but we do it with humility."<sup>14</sup> However, more companies around the world want to be listed on U.S. stock exchanges, which force them to restate accounts in accordance with U.S. generally accepted accounting principals (GAAP). In addition, the European Common Markets move towards economic and monetary unity is reducing the number of accounting methods and standardizing practices.

**Accessibility to information sources** - Due to the different technological formats and standards obtaining needed information for global research can be difficult. According to Steven Einhorn, global research director at Goldman Sachs, one challenge to restructuring a global research department is: "how to use your technology platform to create data, manipulate files and globalize reports."

**More time on the road** - The moment the analyst is in charge of an industry on a global basis. She/he needs to travel to the different companies she/he is covering around the world. That approach puts increasing stress on analysts in terms of time she/he spent in travel.

---

<sup>14</sup> A quote from Patrick O'Donnell, chief of global equity research at Putnam Investments, in *Institutional Investor*, December 1997.

## **Smarter and More Demanding Customers**

Fund-management firms used to be excellent customers; they relied on investment banks to buy and sell the stocks and bonds they invested in, and supply research on their investments. However, today's fund managers are huge firms such as AXA of France and Fidelity Investments that manage more than \$ 500 billion worth of assets each. Many have invested in their own analysts and traders. For instance, Fidelity's Boston office contains a huge trading floor that would not look out of place on Wall Street. Not surprisingly, fund managers are demanding more and more from investment bankers for less and less money.<sup>15</sup>

Some important clients have begun to insist on electronic services. Fidelity Investments last year asked many investment banks and research institutions to provide electronic delivery of analytic models and research updates. The purchasing power of this investment giant forces investment bankers to send hundreds of models and reports each night to Fidelity; the brokerage firms that do not participate lose their business. Indeed, Internet and electronic data interchange (EDI) opens the door for buy-side firms like Fidelity to demand more direct access to the analytic brains of the brokerage firms. And fidelity is not the only one to pushing for Internet services, in fact, the percentage of institutional investors with Internet connections on their desktops has jumped from about 5 percent to 75 percent in the past 18 months.<sup>16</sup>

---

<sup>15</sup> *The Economist*, "Fools' gold", December 13, 1997.

<sup>16</sup> Hal L.. " The Search For The Killer App'," *Institutional Investor*, April, 1997

## **Rivalry**

"Technology, globalization and deregulation are the things that are driving the marketplace," says Goldman Sachs's CEO Jon Corzine. "And it all leads to consolidation." And although no one knows the exact shape of things to come, the general consensus is that decreasing margins and consolidation will deepen over time.

## **Consolidation**

1997 was an extraordinary year of restructuring for the investment-banking industry worldwide. There has been an enormous effort to join a handful of houses to create large multinational investment banks with vast expertise and global reach that can make a fortune selling investment-banking services. It is clear that only a small number of investment banks can survive in this increasingly competitive business.<sup>17</sup>

Merrill Lynch, Goldman Sachs, and Lehman Brothers, are the only major brokerage firms that were not involved in the consolidation trend. Salomon brothers recently merged with Smith Barney and Morgan Stanley merged with Dean Witter Discover. Credit Suisse First Boston bought the European equity division of BZW and in April, Bankers Trust bought Alex Brown. Finally, the last merger of 1997, the merger between

---

<sup>17</sup> *The Economist*, "Fools' gold", December 13, 1997

Union Bank of Switzerland with Swiss Bank Corporation created the United Bank of Switzerland, Europe's biggest bank and the world's second-biggest.

### **Decreasing Margins**

Increasing competition within the industry and from new entrants has forced the investment banks to reduce their fees. Technology is also responsible for decreasing margins - web sites are giving away so much free financial data and research to attract traffic that they are making once-valuable information virtually worthless.

Salaries (include bonuses) comprise typically more than half of the costs of an investment bank. As new entrants compete aggressively to hire the best talent, operational cost at many investment firms are souring. The best stock analysts are routinely paid more than \$1 million a year and the best traders are paid many millions more.

### **Global Risk Assessment Demands**

Shrinking profit margins have forced investment banks to take bigger risks. This has taken two distinct forms. One has been to increase the risks of their existing businesses. Equity dealers, for instance, routinely take on "block trades" for their customers. In this type of service, investment banks buy huge chunks of shares from investors, exposing themselves to the risk that markets might move against them before they can resell their shares. In the equity-underwriting business, "bought deals" are more common. In these, instead of parceling out the underwriting risk among a syndicate of investment banks, one bank underwrites the lot.

At the same time, banks are investing more of their own money in the markets.

"Proprietary trading" desks operate like in-house hedge funds. They take some of a bank's capital, borrow huge amounts against it, and invest the lot in the markets. This leverage turns small price movements into big gains--and losses. Goldman Sachs, Salomon, and Bear Stearns are the three best-known proprietary traders on Wall Street. But most modern investment banks are involved in the business to some extent.

Investment banks have not found it easy to manage the bigger risks they are running. Bankers consider technology as a major tool to control the increasing risks. However, while the technology enables better information that can improve the risk management, the designers of the information system have to cope with bigger and more complicated investment houses and the results are not clear.

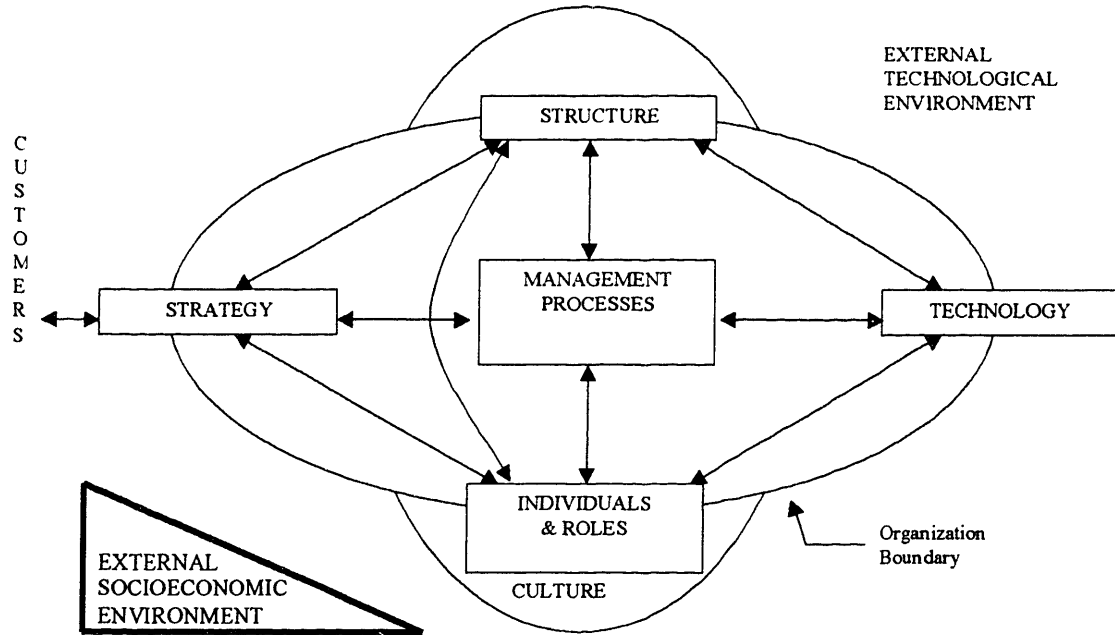
## **New Entrants**

Traditional investment banks are facing two types of new entrants to their industry. The first group is the commercial banks that have tried to muscle into investment banking. These new competitors range from the British and American firms that bought Britain's brokerage houses and merchant banks in the 1980s, to the continental European and American banks that are buying or building investment-banking divisions today. The second group, and most interesting, comes from industries that have traditionally had little to do with finance but are leveraging their technology knowledge or infrastructure to compete with the investment banks.



## Technology-Driven Change

Many forces, internally and externally, could force organization to change. Researchers in the '1990s' program at MIT developed a framework that concludes all the socio-economic, political, and technical forces. The research recognized the importance of the external technological environment. However, in the last few years, with the extraordinary growth of Internet use, this force became even more significant.



**Figure 12: Dynamic tension between External and Internal Dimensions of the Organization<sup>18</sup>**

---

<sup>18</sup> Scott Morton, M. S., "The Corporation of the 1990s: Information Technology and Organizational Transformation," New York: Oxford University Press, 1991.

Investment banks once made easy money as middlemen: they matched buyers with sellers and charged a big fee for their efforts. That service was useful in a world of poor communications, scarce information and inefficient capital markets. Today, information about the demand, supply and price of capital moves freely around the world, increasingly over networked computers. Computers themselves are becoming ever better at bringing together buyers and sellers and matching their trades automatically. Now that the London Stock Exchange has introduced electronic trading, every major stock market in Europe uses computers for a task that was once handled by traders.

No wonder that the commissions that investment banks earn by organizing share trades have fallen swiftly, by about 40% in the US and Britain over the past ten years.

Depending on the currency, bond-trading commissions have fallen by 25-50%. If fund managers want to channel their orders through most of the big stock exchanges, they must still use the investment banks and brokers, which consider themselves as member firms. Increasingly, however, big investors are finding ways of avoiding investment bankers' commissions altogether. Electronic brokers match up investors' sales and purchases off-exchange, then report their transactions to an exchange once completed.

Salomon Direct, an Internet-based service developed by Salomon Brothers' fixed-income group, is a good example of how technology is changing the business. Not only is the firm's published research available, the firm is also posting spot market commentaries from its traders and salesmen, complete with an e-mail link back to the bank officials. The reaction from the corporate clients and the institutional investors, and the

possibilities created by the technology, has the firm's fixed-income department upgrading its impact and its equity department as a result, initiated a similar project. "In the past year [the Internet] has gone from something that is going to cut mailing costs to something that is really going to affect business," says Leo Schlinkert, Salomon's managing director for fixed-income electronic commerce.<sup>19</sup>

One of the striking examples of the new entrants use of technology is Wit Capital, a digital investment bank, which in 1996, completed one of the first-ever initial public offerings on the Internet's World Wide Web. That event demonstrated to the financial establishment how easily an obscure entrepreneur could bypass Wall Street and reach investors directly through the Internet. For good measure, Andrew Klein, the founder of Wit Capital, also announced that investors could trade those shares free on the Web.

Another example is *USA Today*, a traditional media company, which is using the Web to break into the investment business. Late last year the on-line version of *USA Today* launched Financial Marketplace, a section that allows its readers to jump directly to co-branded Internet trading sites offered in conjunction with brokerage firms. Small electronic brokerages like E\*Trade, eBroker, Ceres, Aufhauser and Accutrade have signed up with the *USA Today*, and the latter gets a cut of the brokerage action.

---

<sup>19</sup> Hal L., " The Search For The Killer App", *Institutional Investor*, April 1997.

The new nonbank financial institutions, large multinational corporations and several technology providers can choose to join the most lucrative businesses, and avoid the legacy systems and regulatory burdens of traditional investment banks.

## **Suppliers**

Investment banks provide various services to their clients and most of their deals and transactions are a result of client requests. In some cases, management consulting companies and accounting firms that usually serve the same client base of investment banks, used to recommend their clients to use investment bank services. For example, if management consulting company identified that an unprofitable unit in the client's organization should be divested, they recommended that their client use an investment bank to sell it.

One of the sources of investment banks' competitive advantage is their access to the information in the markets. When information become available to the other service providers mentioned above, they can offer some of the services of investment bank to their clients. In fact, most of the "Big Six" accounting firms have financial advisory divisions that provide some of the advisory services, and although it is still somewhat limited, the activity volume of these divisions is constantly growing. The pressure from the suppliers is another driver of the decreasing margins of investment banks and this pressure forces the banks to become more efficient.

## **ISSUES TO CONSIDER WHEN DESIGNING INFORMATION SYSTEMS FOR INVESTMENT BANKS IN THE 21<sup>ST</sup> CENTURY**

Designing an information system is a complex and sophisticated task; many books and articles have been published on this subject. This section is meant to highlight the most important issues that must be considered in designing an information technology system for the 21<sup>st</sup> century. Although this section provides examples for information systems for equity analysts, most of the issues are relevant for other types of information systems.

### **Standardization**

One of the most important tasks in designing new systems is choosing the standards. The IT professionals and business management should agree on the nature and role of the technology standards.

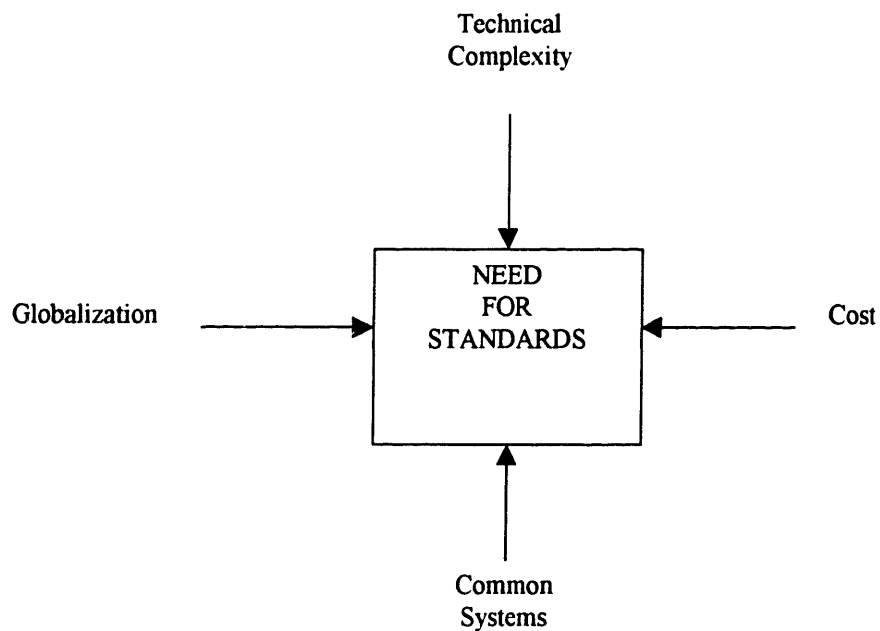
Standards are a mechanism by which the firm achieves its technological architectural vision<sup>20</sup>. They limit the range of technologies that IT staff must support, enabling them to provide faster, more cost-effective support.<sup>21</sup> The globalization trend that was mentioned earlier is also an important driver for adopting technical standards. Many investment

---

<sup>20</sup> Ross, Jeanne W., Beath, Cynthia Mathis, Goodhue, Dale L., "Develop long-term competitiveness through IT assets; information technology", *Sloan Management Review*, No. 1, Vol. 38; Pg. 31, 1996.

<sup>21</sup>J.C. Henderson and N. Venkatraman, "Strategic Alignment: Leveraging Information Technology for Transforming Organizations," *IBM Systems Journal*, Vol. 32, number 1, pp. 4-16, 1993.

bank clients have complained that the investment banks have tried to achieve globalization by "stapling" or assembling, in one bulky package, research reports of analysts around the world, with no cross-border view or any attempt to single out the most important issues. This problem is due mainly to the lack of technological standards among the analysts around the world. The analysts cannot integrate the information in one coherent document; they take all the reports and bundle them into one. There is no doubt that the standardization of the systems will allow a quick method of assembling one global report. The need for standards is summarized in figure 13.



**Figure 13: The Need for Standards<sup>22</sup>**

---

<sup>22</sup> Source: John F. Rockart, CSIR/MIT, class lecture

## **Real-time Risk Measurement**

The demand from the IT infrastructure for global risk assessment that was mentioned earlier leads to an important IT characteristic for the 21<sup>st</sup> century systems. The information technology infrastructure should enable investment banks to continuously control their risk exposure.

Today investment banks perform risk analysis using several different tools to analyze market movements, assess company-wide risk, manage portfolios, track customer tendencies, and calculate customer profitability. However, those islands of information have made it nearly impossible for companies to assess risk on a macro level. The exposure information must be collected manually and cannot be integrated in real time.

Since the equity analysts in the various investment banks are involved with many of the bank's activities, better information on risk exposure will enable them to adjust their activities to maintain the desired risk exposure level. One of the ways to achieve better control is by integrating distributed computing with data warehousing systems.

## **High-Volume Information Management**

The exploding amounts of information and the difficulties in managing information has led to the development of data warehousing. Data warehousing takes operational data from disparate mainframe computers and client/server systems and repackages it in a centralized, relational format. It is also a method of sharing costly information that may

be stored in as many as two dozen locations. The data can be used by equity analysts to discover new merger and acquisitions opportunities and to enhancing client relationships; other users in the banks can use the data for evaluating institutionwide risk, cross-selling and marketing, determining products profitability, and more<sup>23</sup>.

Building a data warehouse is not an easy process because it requires contracting with several vendors for different functions, and it is a relatively new technology. However, many technology experts view it as the only way to master access the massive amounts of information in banks in general, and in investment banks, in particular.<sup>24</sup>

### **Use of Web-Based Technologies**

In the last decade, vast sums of money have been spent on building information systems that have been locked in data centers surrounded by customer service personnel. These personnel then respond to client requests for that information. What the Internet enables to do is on the one hand to push that information directly to the clients and on the other hand let them pull it in by themselves.

The equity analysts' reports are usually prepared individually by the analyst or with the assistance of local analysts and associates. However, Internet applications allow the analysts to cooperate efficiently with their colleagues around the world.

---

<sup>23</sup> Bers, Joanna Smith; Prince, Cheryl J; Sraeel, Holly, " Five major trends in banking ", *Bank Systems & Technology*, Vol. 33, No. 1 Pg. 8-16, 1996.



Internet/Intranet applications are becoming increasingly important to the investment banking industry. Financial web sites are no longer simply electronic advertisements. Investment banks now offer their clients a broad range of services including pricing models, account-management tools, and in the future perhaps even real-time trading.

For instance, BZW made their equity research reports available to clients on their web site this year and they plan to add client-specific real-time data and transactional information in the near future.<sup>25</sup>

At J.P. Morgan, the 2,000 fixed-income clients with access to its Internet-based delivery service are also now gaining access to hundreds of internal reports that could not practically be delivered before, according to Jeanne Feldhusen, Morgan's head of global fixed-income research. J.P. Morgan's next step is to provide a menu of interactive analytics that will allow clients to perform various on-line calculations; the bank also vows to develop more customized client interfaces.

Donaldson, Lufkin & Jenrette, an investment bank, established DLJ-direct, an on-line brokerage that is considered one of the best today. The service offers direct access to various sources of research and information. Moreover, the system enables users to optimize their portfolio and to perform advanced calculations.

---

<sup>24</sup> Barney L., "Data warehousing tames a cyclone of information," *Wall Street & Technology*, Vol. 12, No. 14, Pg. 68, 1995.

An increasing number of investment banks are already involved in projects using Internet technology. The Internet's value is well recognize by the IT managers. "If we did nothing to address the Internet, I think we would be substantially eliminated in terms of being competitive," says David Marshall, chief information officer for Bankers Trust.<sup>26</sup>

Some banks are still trying to limit the access to their research, and while Lehman Brothers, for example, offers free access for everyone to all of their recent reports: equity, economic and fixed income; others like Deutsche Morgan Grenfell offer their research reports on the Web for their clients only. Finally, Goldman Sachs is in the process of thinking about what to do with the Internet, "It potentially changes the world dramatically, but we have to deal with market segmentation issues. Do we want to have 1 million customers?" says Goldman's CEO Corzine. "Our questions are going to be more basic. Some of them don't get answered because of the Internet."

---

<sup>25</sup> Webb A., "Towards the plug 'n' play bank," *Euromoney*, No. 339 Pg. 120-122, 1997.

<sup>26</sup> Hal L., "The Search for the Killer App'," *Institutional Investor*, April 1997.

## Vendor Compatibility

Outsourcing some IT responsibilities to computing firms can compensate for skill shortages in IT units and relieve management of the need to oversee technical tasks that outside of their domain; are not competitive strengths or core competencies.<sup>27</sup> As a result of their economies of scale, many vendors in principle can provide more reliable, cost-effective support than in-house units, while allowing top IT management to focus on strategic priorities. However, making outsourcing work is a different proposition from deciding to outsource<sup>28</sup>. IT managers must be at least as skilled as the outsourcer in each area, in order to better to be able to use the system efficiently after the outsourcing contract is over. Even if the vendor has a long-term maintenance contract, the managers should be ready for the possibility that in the future the vendor will not be able to provide its services. IT managers must also be informed buyers and excellent negotiators.

Frank Fanzilli, CSFB's Chief Information Officer, says that technology managers should employ a "buy over build" mentality--but only as long as they know how to choose "best of breed" technologies.<sup>29</sup> Indeed, outsourcing is on the mind of every senior executive who wants to cut costs or shrink the IT organization.<sup>30</sup> When technology officers decide

---

<sup>27</sup> Rockart, John F., Earl, Michael J., Ross, Jeanne W, " Eight imperatives for the new IT organization", *Sloan Management Review*, No. 1, Vol. 38, P.43, 1996.

<sup>28</sup> Earl, Michael J., "Limits to IT Outsourcing," *Sloan Management Review*, Vol. 37, pp. 26-32, 1993.

<sup>29</sup> *Wall Street & Technology* "New CS First Boston CIO speaks out", Vol. 14; No. 8; P.32, August 1996.

<sup>30</sup> Rockart, John F., Earl, Michael J., Ross, Jeanne W, " Eight imperatives for the new IT organization", *Sloan Management Review*, No. 1, Vol. 38, Pg.43, 1996.

to outsource a project, they usually benchmark the various vendors in the market, check the performance history of the companies and compare the ways the companies develop their products. However, as the number of vendors involved in a project increase, compatibility problems arise and often, in the search for the best vendor, compatibility is neglected.

As we move into the next century, we find specialized vendors that offer state-of-art technology that can provide the investment banks with competitive advantage. However, in order to succeed in the global technological realm compatibility issues must not be sacrificed.

## **Security**

Security and confidentiality issues are common problems in implementing on-line information systems via the Internet for financial services. However, the security issue is turning a technological concern to a psychological concern because there are many technical solutions to these concerns. Encryption solutions and advanced solutions like the IBM's private network called Global Network make security a negligible problem.<sup>31</sup> By taking advantage of the computer company's extensive network pipes and firewalls, banks can securely expand their reach around the globe, connecting with employees as well as corporate and individual customers.

---

<sup>31</sup> Bers, Joanna Smith; Prince, Cheryl J; Sraeel, Holly, " Five major trends in banking ", *Bank Systems & Technology*, Vol. 33, No. 1 Pg. 8-16, 1996.

Equity analyst reports are very valuable but there is no need for sophisticated encryption systems to protect them because after all, most of the information is eventually published and in reality, analysts are interested in gaining exposure. However, when dealing with information related to mergers and acquisitions activities or other transaction-related information, many users still find it hard to trust the Internet. Technology leaders are convinced that with the development of digital certificates and better encryption mechanisms, that users' trust in Internet security will be strengthened. That is probably a reasonable assumption, however, a new problem arises- the liability problem, The industry has not yet agreed upon a liability framework for when things break down.<sup>32</sup>

## **Customized Information**

The competitive situation and new information technology have made once-valuable information virtually worthless- web sites are giving away free data and research to attract customers and "standard" information quickly becomes free. For example, two years ago 15-minute delayed stock quotes ensured millions of hits each day. Now free quotes are as widespread as pornography on the Web. Indeed, Playboy offers them on its site. So does the Wine Spectator site and scores of others.<sup>33</sup> Charting also used to be expensive, and today everybody is giving it away. The same will happen to the research reports, and many companies are already giving out some of their analysts' reports on their web sites.

---

<sup>32</sup> Webb A., " Towards the plug 'n' play bank", *Euromoney*, No. 339 Pg. 120-122, 1997.

<sup>33</sup> Hal L., " The Search For The Killer App", *Institutional Investor*, April 1997.

The next step for the investment banks is to tailor research to individual clients; 21<sup>st</sup> century systems should allow the analyst to quickly customize its products for clients. Kevin McCaffrey, Smith Barney's deputy research director, is looking forward to "jumping beyond" mass e-mail to more selective systems. "There's a way to communicate faster, target customers, make everything accessible and share the screen on a precisely pin-pointed basis versus a broad-based broadcasting basis," says McCaffrey. "This wouldn't preclude but would rather supplement First Call [FIRST CALL Corp. is source of real-time research, earnings estimates and corporate information. The information distributed by FIRST CALL originates from leading brokerage firms, investment research firms and global corporations], which goes to all our institutional clients." Moreover, as was mentioned before, equity analysts interact with internal users in the investment bank and with external clients. There are probably many parts in the reports that the analysts would like to emphasize or omit hence the next generation information systems should enable analysts to do that without rewriting the reports or using "cut and paste" techniques.

## Global and Scaleable Systems

The globalization trend forces the equity analysts to take responsibility for new companies in different parts of the world. The major investment banks that used to be concentrated in New York, London and Tokyo have been forced to open new offices around the world in order to give their global clients local presence in the countries that the clients want to invest in. Any new system that will be implemented should be scalable, in other words it should be expandable. That will allow the expandable of the system to new locations so that when equity analysts travel to different countries, they can use the same systems. CSFB's global research library that was described earlier, is an excellent example of expandability.

While Merrill Lynch has expressed a desire to communicate as a global firm, as the biggest investment bank on the street, the company is moving very slowly. "With the acquisition of Smith New Court [in the U.K.], we have 28 offices for research, and each requires a certain minimum level of technology that enables it to communicate with brokers and investors all over the world," says global equity research head Melnick.<sup>34</sup> "We've added voice mail and e-mail, and now we're talking about using the Web to communicate internally and externally." And "as we move forward," he adds, "we will have to be able to deliver research products over audio and video media." However,

---

<sup>34</sup> *Institutional Investor*, "The 1997 All-Europe Research Team", cover story, February 1997.

Melnick notes that certain electronic technologies are almost obsolete but that "we have to maintain these so-called legacy systems until no client uses them anymore."<sup>35</sup>

---

<sup>35</sup>*Institutional Investor*, "The 1997 All-Europe Research Team", cover story, February 1997.



## **IS THE CURRENT IT INFRASTRUCTURE CAPABLE OF MEETING 21<sup>ST</sup> CENTURY NEEDS**

The current information technology infrastructure is mainly based on mainframes and proprietary systems. Each investment bank has a different mix of systems; unfortunately, few common standards exist. Moreover, since many investment banks are the products of multiple mergers, their IT departments typically have the problem of trying to develop, run and maintain applications across a multiplicity of hardware, network and operating system configurations.<sup>36</sup> However, although it is complicated and expensive, the infrastructure manages to support, in most cases, the business needs successfully.

Today, competition, customers and new entrants are putting an enormous pressure on investment banks to change their way of doing business. The technology, mostly the Internet, is also driving investment banks to change, and the million-dollar question is, whether the current infrastructure which includes many legacy systems, is capable of supporting 21<sup>st</sup> century needs.

---

<sup>36</sup> Webb Andy, "Transcending Cross Platform Conflicts," *Wall Street & Technology*, Vol. 15, No. 09, 1997.

## Legacy Systems

The previous section describes the issues that must be considered when designing information systems that will enable the investment banks to compete efficiently in the 21<sup>st</sup> century. Unfortunately, most of those concerns and issues can not be addressed by the existing legacy systems. The mainframe essentially fails in dealing with four of the most important issues.

**Real-time information** - No one doubts the fact that Wall Street's is heavily reliance on real-time information. While Unix has been shoehorned into the role of a server-based, real-time operating system, it was never intended to be used that way.<sup>37</sup> Although some of the legacy systems are running several applications on a real-time basis, it is unclear how they can handle a total shift of all the applications to real-time basis. On the other hand, new operating systems such as Microsoft Windows<sup>®</sup> NT<sup>®</sup> were developed as a server systems that could handle real-time data feeds easily. Lehman Brothers installed a Microsoft Windows NT client/server system in their equity trading division where the spreadsheets incorporate live feeds and proprietary analytic models developed by the firm's quantitative and equity analysts.<sup>38</sup>

---

<sup>37</sup> Tomasula, Dean, "NT's momentum nudges at Unix; Windows NT operating system; Product Information", *Wall Street & Technology*, Vol. 14, No.3, Pg. 46, 1996.

<sup>38</sup> Microsoft's Web site (<http://www.microsoft.com/industry/finserv/Case/lehman.htm>.)

**Linkage to the Internet** - Applications using Internet technology can be virtually run on any platform. And although some may argue that Internet applications should only be an extension of the internal infrastructure, we see an increasing number of client/server architectures combined successfully with Intranet/Internet applications.

In 1996, Charles Schwab & Co. completely migrated from Unix mainframes to a client/server system. That process included the installation of Windows NT on more than 5,000 workstations. When their IT specialists wanted to link their system to the Internet, "We talked to a number of vendors and virtually everyone was supporting Windows," said Robert Duste, vice president and chief technologist at Schwab.<sup>39</sup> Other notable advantages were the ease at which the installation was completed (Schwab's first branch was up and running on NT in less than a month), the fact that Schwab's customers already are familiar with Windows software because they use the same applications in their offices and on their home PCs, and finally the relative availability of programmers versed in Visual Basic, Power Builder and Paradox.

**Customized Information** - Unlike applications that were programmed by using object-oriented language, the applications for the legacy systems, which were programmed in languages such as COBOL, can not be easily modified. Moreover, the users can not change the structure or the formulas in the database. The result is that it is impossible to create an easy way to provide, for example, customized companies' reports.

---

<sup>39</sup> Tomasula, Dean, "NT's momentum nudges at Unix; Windows NT operating system; Product Information", *Wall Street & Technology*, Vol. 14, No.3, Pg. 46, 1996.

Morgan Stanley has been publishing equity and fixed-income research for clients on its web site for the last year. Their next step is the creation of a firm-wide vehicle called Client Link, which enables the company to deliver an integrated range of services (both product- and application-based) to their clients on a customized basis. Morgan Stanley has rolled this out on a selective basis over the last year and plans to expand it dramatically this year. A key advantage is that clients can specify exactly what they receive, so the whole process is client-centric, rather than Morgan Stanley-centric<sup>40</sup>. Morgan Stanley's customized service, when completed, will go well beyond providing straightforward data and research. A range of tools, from portfolio accounting to more sophisticated risk and basket portfolio analyses, will be released in the next few months. Although the bank has offered clients these applications for some time, they have previously only been available to run on specific platforms, such as Unix. By migrating the legacy applications into a common browser-type front end and making them platform independent, the bank will do more than make them readily accessible. Clients will be able to run the applications of their choice remotely while these remain resident on a Morgan Stanley server. As with any processing is done remotely from the client's machine, the amount of data transferred across the Internet is kept to a minimum.

---

<sup>40</sup> Webb A., "Towards the plug 'n' play bank". *Euromoney*, No. 339 Pg. 120-122. 1997.

**Scalability** - The rapid increase in the 1990s of the information volume in the investment banks caught many technology managers unprepared. It is very difficult to increase the capacity of a mainframe computer and in most cases, impossible.

Technology changes so fast that it is hard to anticipate how the systems in the next century will look like and who will be the dominant players. However, most information technology specialists agree that in order to succeed where the mainframes fail, the new systems should be open systems.

## **Open Systems**

In many financial applications, the term "open systems" is frequently being used and thousands of applications advertise their openness. The greatest advantage of the open system is that software with open architectures extends a system's life by accepting add-on products when new requirements surface. Additionally, with an open system, there are many of third-party software products available off-the-shelf to leverage the initial investment.

Many client/server systems claim that they provide an open system but many don't, so it is important to determine if the system really is open. Applications that run on a client/server environment must follow a set of rigid guidelines to be considered open; the most important guidelines are:

- The database server should be queried directly from third-party desktop applications (for example, Lotus, EXCEL, Microsoft Access, etc.) and those applications should be able to read or update the database directly.
- The system should accommodate customized tables and additions of columns and procedures to the supplied tables.
- The calculations and formulas stored in the system can be modified without affecting the client application. For example, if analysts find a better way to calculate swap values they can put their own formula in the system.

Bloomberg, a provider of proprietary market data systems, recognized that the industry wants to minimize the use of closed and proprietary systems, so introduced in 1996 an open version of its product that is gaining market share rapidly.

## **Year 2000 Problem**

Historically, computer memory and storage space was quite limited, causing programmers to express dates in various types of "shorthand." Virtually all the schemes implied a century rather than making it explicit so the century digits were assumed to be "19". Few programmers anticipated that their software would be running 10, 20, or even 30 years later thus there was a little concern about the century change. On January 1<sup>st</sup>, 2000 all software and hardware that have this shorthand date convention will potentially malfunction. Many managers characterize the year 2000 as a mainframe problem

primarily involving old COBOL software. This is not the case - many PC and UNIX based software share the same problem.

IT managers at CSFB decided to outsource the handling with the year 2000 problem. After benchmarking the various solutions the IT managers chose Viasoft. "We chose Viasoft because of the reliability, integration and quality of their Year 2000 technology and service offering,"<sup>41</sup> said Michael B. Tiernan, vice president of information systems for Credit Suisse First Boston. "We completed a thorough evaluation of the major offerings on the market, and came to the conclusion that Viasoft's solution for solving the Year 2000 was the most valuable to our environment. Viasoft's Year 2000 strategy emphasizes several key characteristics that are critical to the success of our Year 2000 project, particularly speed, quality, reliability, choice and long-term value."

Viasoft's Existing Systems Workbench (ESW) is an integrated suite of software re-engineering tools that controls the productivity of development conversion teams and minimizes the risk associated with large-scale maintenance projects.<sup>42</sup>

The cost of correcting the problem globally may reach \$600 billion.<sup>43</sup> Not surprisingly, dozens of papers have been published on this issue and the technology community is well

---

<sup>41</sup> *Business Wire*, "Credit Suisse First Boston Corp. partners with Viasoft to solve Year 2000 problem", April 7, 1997.

<sup>42</sup> Viasoft Web site

<sup>43</sup> Gartner Group.

occupied in trying to solve this problem. I believe that the fact that huge amounts of money are going to be spent anyway to solve this problem can be used as an excuse to help IT managers to convince management to decide to invest in a whole new information technology infrastructure.



## CONCLUSION

In this thesis I have researched the investment banking industry's IT needs and the forces that are influencing them to change their way of doing business. I focused on equity analysts, their IT needs, and their position within that industry. In addition, I demonstrated why I believe a major shift in the way they perform is expected in the next few years. The technological changes offer them new ways to contribute to the investment banks and their previously main product, the written reports, are becoming less valuable. In fact, there is much evidence that their role has already changed and industry specialists believe that equity analysts' contribution to the revenues of the investment bank is expected to grow.

In financial services, as in many others industries, new technology is considered a cost center. IT professionals who want to deliver costly leading-edge systems are in constant conflict with the management who is concerned about the bottom line. In this thesis, I showed that IT can be a source of competitive advantage. The next-generation IT systems are enabling the equity analysts to help the investment banks to increase revenues. In this era of soaring costs and dwindling margins on the one hand and more powerful clients on the other, every contribution to banks' bottom lines can make the difference between success and failure. And although 1997 was a remarkably good year for the investment banks, many bankers noted that they think tougher times are ahead.

As always, the technology itself cannot provide the magic cure for some of the problems of the investment banks. Moreover, as was mentioned earlier, there are many technological problems involved with new technologies. However, many investment banks are forced to make strategic changes to the way they are doing business, and in order for IT to support those changes, strong commitment is required from the management. IT should not be treated as a cost center only but as a tool to help investment banks become market leaders.

The thesis demonstrated that most of the current infrastructure is not sufficient for the 21<sup>st</sup> century needs. It is clear though, that most investment banks are still trying to leverage their former investments in the technical infrastructure and a decision to scrap their legacy systems and build totally new systems is not an easy one.

In my opinion, a dramatic change is needed since the industry has gone through so many changes in the last thirty years, it is facing many more in the near future, hence the legacy system could not be stretched anymore to fit the future needs and will have to be replaced, and sooner the better. Gary A. Curtis, who is responsible for Boston Consulting Group's worldwide information technology practice, estimates that the major brokerage houses currently invest a sizeable percentage (5 percent to 20 percent) of their earnings--in a good year--in technology. The problem is, Curtis says, the planning focus for many American businesses, finance in particular, is extremely short-term.

Thanks to new technologies and the availability of once-specialized, difficult-to-access information, entry barriers to the investment banking industry have become lower. New entrants and the suppliers can offer the same services in a cost-effective way due to their effective use of new information systems and the Internet. In order to stay competitive in the marketplace, investment banks must use new technologies to leverage parts of their existing infrastructure in the front office and to replace inefficient legacy systems in the back office.

Finally, I hope that readers will find this subject interesting and will be encouraged to do further research on the subject.

## APPENDIX A - INDUSTRY DEFINITIONS<sup>44</sup>

**Client/Server Architecture** - An arrangement used on local area networks that makes use of distributed intelligence to treat both the server and the individual workstations as intelligent, programmable devices, thus exploiting the full computing power of each. This is done by splitting the processing of an application between two distinct components: a "front-end" client and a "back-end" server. The client component is a complete, stand-alone personal computer (not a "dumb" terminal), and it offers the user its full range of power and features for running applications.

**Data Warehousing** - Data warehousing system takes operational data from disparate mainframe computers and client/server systems and repackages it in a centralized, relational format.

**Data Mining** - The process of discovering meaningful new correlations, patterns and trends by sifting through large amounts of data stored in repositories, using pattern recognition technologies as well as statistical and mathematical techniques.<sup>45</sup>

**Electronic Data Interchange** - A set of standards for controlling the transfer of business documents, such as purchase orders and invoices, between computers. The goal of EDI is the elimination of paperwork and increased response time. For EDI to be effective, users must agree on certain standards for formatting and exchanging information, such as the X.400 protocol.

---

<sup>44</sup> Computer Dictionary, Microsoft Press, Third Edition, 1997.

<sup>45</sup> Gartner Group

**MPP** -A computer architecture in which each of a large number of processors has its own RAM, which contains a copy of the operating system, a copy of the application code, and its own part of the data, on which that processor works independently of the others.

**NUMA** - A system architecture designed for Sequent's Non-Uniform Access Memory, a type of distributed shared memory using a number of shared memory segments instead of a single centralized physical memory.

**RDBMS** - A database or database management system that stores information in tables - rows and columns of data -and conducts searches by using data in specified columns of one table to find additional data in another table.

**SMP** - Acronym for Symmetric MultiProcessing. A computer architecture in which multiple processors share the same memory, which contains one copy of the operating system, one copy of any applications that are in use, and one copy of the data. Because the operating system divides the workload into tasks and assigns those tasks to whatever processors are free, SMP speeds transaction time.

**SMP Server** - Short for symmetric multiprocessing server. A computer that is designed with the SMP architecture to improve its performance as a server in client/server applications.

## **APPENDIX B - ACRONYM KEY<sup>46</sup>**

**COBOL** - Common Business-Oriented Language

**CPU** - Central Processing Unit

**EDI** - Electronic Data Interchange

**IS** - Information System

**ISV** - Independent Software Vendors

**IT** - Information Technology

**LAN** - Local Area Network

**MPP** - Massively Parallel Processing

**NUMA** - NonUniform Memory Architecture

**ORDBMS** - Object Relational Database Management System

**RDBMS** - Relational Database Management System

**ROLAP** - Relational On-Line Analytical Processing

**SMP** - Symmetric MultiProcessing

**WAN** - Wide Area Network

---

<sup>46</sup> Computer Dictionary, Microsoft Press, Third Edition, 1997.

## APPENDIX C - EQUITY ANALYSTS IN THE MAJOR INVESTMENT BANKS<sup>47</sup>

NELSON'S TOP 25 GLOBAL RESEARCH FIRMS - 1996																
RANKED BY TOTAL NUMBER OF EQUITY ANALYSTS EMPLOYED WORLDWIDE																
Rank		Firm				Number of Analysts					% Chg # Anal. 96 vs 95	Average No. of Companies Covered Per Analyst				
96	95	94	93	92		96	95	94	93	92		96	95	94	93	92
1	2	4	3	4	Merrill Lynch <sup>(1)</sup>	383	261	184	NA	NA	46.74	9.2	11.6	9.3	10.5	10.8
2	1	1	1	1	SBC Warburg <sup>(2)</sup>	328	278	244	203	190	17.99	12.1	11.8	12.1	12.5	11.9
3	4	11	18	21	Robert Fleming <sup>(3)</sup>	240	232	121	NA	NA	3.46	17.2	17.7	10.9	14.9	11.6
4	5	6	6	9	UBS	238	200	142	130	107	19.00	11.4	9.7	10.0	8.1	13.0
5	3	2	5	3	HSBC James Capel	232	224	208	138	149	3.57	9.7	9.6	9.6	12.8	12.1
6	7	3	2	2	BZW Ltd	201	193	188	168	172	4.16	11.7	12.4	11.5	12.7	11.4
7	7	3	16	16	ABN AMRO Hoare Govett <sup>(4)</sup>	163	157	130	92	34	5.36	12.7	12.3	12.7	10.9	14.1
8	8	7	7	12	Credit Lyonnais	194	164	139	123	30	16.23	11.8	12.7	11.4	9.9	7.6
9	9	5	5	9	NatWest Securities	184	164	136	122	117	25.97	8.3	8.4	10.5	7.2	11.5
10	13	10	10	10	Goldman Sachs	167	128	126	111	98	30.47	12.7	14.0	14.2	13.8	15.1
11	12	25	36	NA	Deutsche Morgan Grenfell <sup>(5)</sup>	166	131	51	NA	NA	25.95	9.3	8.1	7.2	8.8	NA
12	10	12	9	10	ING Barings	168	163	114	121	96	3.27	11.3	9.6	9.0	9.3	17.5
13	11	16	16	14	Kleinwort Benson	155	140	105	89	87	10.71	12.4	13.7	14.4	16.1	16.5
14	16	17	13	13	Morgan Stanley	145	106	103	97	88	36.79	13.1	14.9	14.3	12.1	12.0
15	15	12	14	16	Credit Suisse First Boston	129	113	114	94	77	14.16	12.1	12.9	11.5	13.2	14.9
16	14	15	17	17	Salomon Brothers	129	115	108	83	76	12.17	19.7	26.7	16.0	19.0	14.4
17	17	21	26	30	Schroder Securities <sup>(6)</sup>	117	101	61	67	69	16.94	16.2	13.8	17.1	20.0	17.3

<sup>47</sup> Nelson Information, Inc.

21	21	22	22	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31
21	26	34	31	28	Paribas Capital Markets	69	51	40	35	34	35.29	10.7	17.6	15.4	13.6	18.2					
22	21	22	20	20	Prudential Securities	68	70	60	64	58	-2.86	13.7	12.6	12.9	13.8	11.8					
23	22	23	NA	NA	J.P. Morgan	65	63	52	NA	NA	3.17	10.9	9.4	5.8	NA	NA					
24	24	29	26	28	Oppenheimer	63	55	44	40	34	14.55	14.9	13.9	13.4	15.8	16.5					
25	23	23	24	25	Bear, Stearns	62	60	52	46	39	3.33	23.8	19.1	17.5	16.3	15.8					

Not 1) reflects merger of Merrill and Smith New

es: Court

2) includes Bunting Warburg

3) includes Jardine Fleming, Ord Minnett and Fleming Martin

4) includes HG Asia

5) reflects merger of Deutsche Bank with

Morgan Grenfell and CJ Lawrence

6) includes Schroder Wertheim



## APPENDIX D - AN EXAMPLE OF EQUITY ANALYST REPORT<sup>48</sup>

Headline: Xerox: Names IBM CFO President & COO;

Gives Company A Strong No. 2 Man

Author: Ted Kundtz 1(212)526-5322/Jim Ricchiuti

Company: XRX

Industry: COMPUT

Ticker : XRX Rank(Prev): 2-Outperform Rank(Curr): 2-Outperform

Price : \$71 3/4 52wk Range: \$72-45 Price Target: \$75-\$80

Today's Date : 06/13/97

Fiscal Year : DEC

---

EPS	1996	1997	1997	1998	1998	1999	1999
QTR.	Actual	Prev.	Curr.	Prev.	Curr.	Prev.	Curr.
1st:	0.65A	0.75A	0.75A	0.83E	0.83E	-E	-E
2nd:	0.81A	0.89E	0.89E	1.09E	1.09E	-E	-E
3rd:	0.68A	0.88E	0.88E	1.03E	1.03E	-E	-E
4th:	1.17A	1.43E	1.43E	1.66E	1.66E	-E	-E

---

Year:	3.31A	3.95E	3.95E	4.61E	4.61E	--E	--E
Est.:		3.88E	3.94E	4.44E	4.56E	4.80E	5.00E

---

<sup>48</sup> Lehman Brothers Web Site

-----  
Price (As of 6/12) : \$71 3/4 Revenue (1997) : 18.1 Bil.

Return On Equity (97): 26% Proj. 5yr EPS Grth : 18.0 %

Shares Outstanding : 361.7 Mil. Dividend Yield : 1.7 %

Mkt Capitalization : 25.95 Bil. P/E 1997; 1998 : 18.2 X; 15.6 X

Current Book Value : \$17.56 /sh Convertible : None

Debt-to-Capital : 33 %\* Disclosure(s) : A

\* Excludes debt associated with Xerox credit.

-----  
\* Xerox names IBM CFO Richard Thoman, 52 years old, as president and COO, putting in place a strong No. 2 to eventually succeed Paul Allaire, chairman and CEO.

\* Thoman, who joined IBM in 1995, carries an impressive rsum, including overseeing the turnaround of IBM's PC business, along with executive positions at both American Express and RJR Nabisco. He also was a senior associate with McKinsey.

\* Thoman will report directly to Allaire and oversee Xerox's day-to-day operations. Allaire will assume more of a traditional chairman/CEO role, with finance and strategy continuing to report directly to him.

\* Thoman's exposure to the treacherous competitive waters of the PC business should prove valuable as the traditional copier and networked computer printer businesses converge and given the heightened competition Xerox faces with the Japanese and H-P.

\* Continue 2-Outperform rating. We believe Xerox is poised for a period of accelerating growth, driven by a major replacement cycle to digital B&W copiers, rapid growth of color copiers/printers, production publishing and outsourcing.

---

#### Xerox Names IBM CFO As New President And Chief Operating Officer

Shares of Xerox rallied yesterday on news that the company named Richard Thoman, the chief financial officer of IBM, to the post of president and chief Operating Officer. Xerox, which has not had a president since the early 1990s, appears to have put in place a strong candidate to eventually succeed Paul Allaire, its current chairman and CEO, who turns 60 next month.

Thoman carries an impressive portfolio. He has worked alongside IBM Chairman and CEO Lou Gerstner for 25 years, with prior tours as a senior executive at RJR Nabisco (as president and CEO of Nabisco International) and American Express (as president and CEO of American Express International and chairman and co-CEO of the American Express Travel Related Services Company), as well as earlier at McKinsey & Co.

Thoman joined IBM in 1994 as head of IBM's personal computer business, which at the time was in disarray. Thoman, along with Jerome York, then CFO of IBM, played a key role in improving the internal operations of the company's PC business. During that period of time, IBM made significant improvement in bringing new PC products to market quickly and reestablished a market presence. We believe Thoman's exposure to the rapid product cycles and

intense competition of the personal computer business will prove particularly valuable given the competitive pressures Xerox faces in its core copier business with the Japanese and as the company increasingly butts heads with H-P as the traditional copier and networked printer businesses converge.

Thoman's appointment to the president's post at Xerox should dispel any concern investors may have had about a potential successor to Allaire in what clearly will be a pivotal period for the company as digital copier technology replaces traditional light lens office copiers, color copiers/printers increasingly supplant black and white systems and as Xerox targets new markets for growth, including further expansion in the commercial printing business.

**BUSINESS DESCRIPTION:** Xerox manufactures and markets analog and digital black and white and color copiers and printers worldwide.

-----

Disclosure Legend: A-Lehman Brothers Inc. managed or co-managed within the past three years a public offering of securities for this company. B-An employee of Lehman Brothers Inc. is a director of this company. C-Lehman Brothers Inc. makes a market in the securities of this company. G-The Lehman Brothers analyst who covers this company also has position in its securities.

## BIBLIOGRAPHY

---

- 1 - *Institutional Investor*, "The 1997 All-America Research Team", cover story, October 1997.
- 2 - Linda Grant, "Will CS First Boston Ever Win?", *Fortune*, August 19, 1996.
- 3 - 1996/1997 Credit Suisse Annual Report.
- 4 - Credit Suisse First Boston Web Site ([http://www.corp.csfb.com/corp/about/about\\_05.htm](http://www.corp.csfb.com/corp/about/about_05.htm).)
- 5 - Mehl B., "First Boston profits from IT upgrade; CS First Boston; Company Operations", *Wall Street & Technology*, Vol. 14, No. 9, Pg. 50, 1996.
- 6 - Sequent Web site (<http://www.sequent.com/news/releases/1997/nr-1195.html>.)
- 7 - Digital Web site (<http://www.digital.com/info/PRW03B/>.)
- 8 - Intel Web site (<http://www.intel.com/pressroom/archive/speeches/MPF1097D.HTM>.)
- 9 - Michael E. Porter, "Competitive Strategy- Techniques for Analyzing Industries and Competitors", Free Press, 1980.
- 10 - Oster, Sharon M., "Modern Competitive Analysis," New York: Oxford University Press, 1994.
- 11 - *The Economist*, "Fools' gold", December 13, 1997.
- 12 - Hal L., "The Search For The Killer App'", *Institutional Investor*, April, 1997
- 13 - Scott Morton, M. S. , "The Corporation of the 1990s: Information Technology and Organizational Transformation," New York: Oxford University Press, 1991.
- 14 - Ross, Jeanne W., Beath, Cynthia Mathis, Goodhue, Dale L., "Develop long-term competitiveness through IT assets; information technology", *Sloan Management Review*, No. 1, Vol. 38; Pg. 31, 1996.
- 15 - J.C. Henderson and N. Venkatraman, "Strategic Alignment: Leveraging Information Technology for Transforming Organizations," *IBM Systems Journal*, Vol. 32, number 1, pp. 4-16, 1993.
- 16 - Bers, Joanna Smith; Prince, Cheryl J; Sraeei, Holly, "Five major trends in banking ", *Bank Systems & Technology*, Vol. 33, No. 1 Pg. 8-16, 1996.
- 17 - Barney L., "Data warehousing tames a cyclone of information," *Wall Street & Technology*, Vol. 12, No. 14, Pg. 68, 1995.

- 
- 18 - Webb A., "Towards the plug 'n' play bank," *Euromoney*, No. 339 Pg. 120-122, 1997.
- 19 - Rockart, John F., Earl, Michael J., Ross, Jeanne W, " Eight imperatives for the new IT organization", *Sloan Management Review*, No. 1, Vol. 38, P.43, 1996.
- 20 - Earl, Michael J. "Limits to IT Outsourcing," *Sloan Management Review*, Vol. 37, pp. 26-32, 1993.
- 21 - *Wall Street & Technology* "New CS First Boston CIO speaks out", Vol. 14 ; No. 8 ; P.32, August, 1996.
- 22 - *Institutional Investor*, "The 1997 All-Europe Research Team", cover story, February 1997.
- 23 - Webb Andy, "Transcending Cross Platform Conflicts," *Wall Street & Technology*, Vol. 15; No. 09,1997.
- 24 - Tomasula, Dean, "NT's momentum nudges at Unix; Windows NT operating system; Product Information", *Wall Street & Technology*, Vol. 14, No.3, Pg. 46, 1996.
- 25 - Microsoft's Web site (<http://www.microsoft.com/industry/finserv/Case/lehman.htm>.)
- 26 - Webb A., "Towards the plug 'n' play bank", *Euromoney*, No. 339 Pg. 120-122, 1997.
- 27 - *Business Wire*, "Credit Suisse First Boston Corp. partners with Viasoft to solve Year 2000 problem", April 7, 1997.
- 28 - Computer Dictionary, Microsoft Press, Third Edition, 1997.

# THESIS PROCESSING SLIP

FIXED FIELD: ill. \_\_\_\_\_ name \_\_\_\_\_

index \_\_\_\_\_ biblio \_\_\_\_\_

► COPIES: Archives Aero Dewey Eng Hum  
Lindgren Music Rotch Science

TITLE VARIES: ►  \_\_\_\_\_

NAME VARIES: ►  \_\_\_\_\_

IMPRINT: (COPYRIGHT) \_\_\_\_\_

► COLLATION: 782.

► ADD: DEGREE: \_\_\_\_\_ ► DEPT.: \_\_\_\_\_

SUPERVISORS: \_\_\_\_\_

NOTES:

cat'r:

date:

► DEPT: SOM

page:

► 5159

► YEAR: 1998 ► DEGREE: ~~Ph.D.~~ S.M.

► NAME: WHEISS, David