# Management Information Systems Cases

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Contents

# Appendix Case Studies

## Overview

This appendix presents seven case studies that illustrate various problems that arise in MIS. Remember that most problems can affect many areas of a company. Any realistic situation will have many different problems or symptoms. It is important to search for the causes of the symptoms. Chapter 3 presented some hints and techniques that can be used to approach case problems and look for causes. One useful step is to try to classify the level of the problem: operations, tactical, or strategic. Although many problems will affect all three areas, the fundamental causes often focus at one level.

When you are searching for solutions to business problems and cases, it is often helpful to examine what other companies have done in similar situations. The previous chapters had several examples of cases and applications that might prove useful. Also, business and MIS publications continually provide examples of problems faced by existing firms and of innovative solutions.

Remember that business problems rarely have a single correct *answer*. There is always room for creativity and innovation. Just make sure that your solution will actually solve the main problems. Also, think about the implications of any solutions. Will it cause more problems than it solves?

Virtually any MIS case could be *solved* with the simple statement that the firm needs more computers. However, a one-line statement is not a very useful plan. In any business setting, you not only have to find an *answer*, you must also persuade others (executives) that your answer is the best alternative. Additionally, a good solution will contain an implementation plan—perhaps with a timetable that delineates each step of the process.

## Amazon.com

In 1994, with a handful of programmers and a few thousand dollars in workstations and servers, Jeff Bezos set out to change the retail world when he created Amazon.com (ticker: AMZN). Shel Kaphan, Amazon's first programmer, assisted by others, including Paul Barton-Davis, used a collection of tools to create Web pages based on a database of 1 million book titles compiled from the Library of Congress and Books in Print databases. Kaphan notes that "Amazon was dependent on commercial and free database systems, as well as HTTP server software from commercial and free sources. Many of the programming tools were free software" [Collett 2002]. In July 1995, Amazon opened its website for sales. Using heavily discounted book prices (20 to 30 percent below common retail prices); Amazon advertised heavily and became the leading celebrity of the Internet and e-commerce.

### Sales and Relationships

Amazon made its initial mark selling books, and many people still think of the company in terms of books. However, almost from the start, the company has worked to expand into additional areas—striving to become a global retailer of almost anything. Some of the main events include: 1995 books, 1998 music and DVD/video, 1999 auctions, electronics, toys, zShops, home improvement, software, and video games [1999 annual report].

By the end of 1999, the company had forged partnerships with several other online stores, including Ashford.com, Audible, Della.com, drugstore.com, Gear.com, Greenlight.com, HomeGrocer.com, Kozmo.com, living.com, NextCard.com, Pets.com, and Sothebys. Of course, most of those firms and websites later died in the dot-com crash of 2000/2001.

Amazon also established partnerships with several large retailers, including Target, Toys 'R' Us, Babies 'R' Us, and Circuit City. Effectively, Amazon became a service organization to manage the online presence of these large retailers. However, it also uses its distribution system to deliver the products. The Circuit City arrangement is slightly different from the others—customers can pick up their items directly from their local stores [Heun August 2001].

By mid-2003, the Web sales and fulfillment services amounted to 20 percent of Amazon's sales. Bezos points out that most companies realize that only a small fraction of their total sales (5 to 10 percent) will come from online systems, so it makes sense to have Amazon run those portions [Murphy 2003].

In 2001, Amazon took over the website run by its bricks-and-mortar rival Borders. In 2000, Borders lost $18.4 million on total online sales of $27.4 million [Heun April 2001]. Also in 2001, Amazon partnered with Expedia to offer travel services directly from the Amazon site. However, in this case, the Amazon portion consists of little more than an advertising link to the Expedia services [Kontzer 2001]. The deals in 2001 continued with a twist when Amazon licensed its search technology to AOL. AOL invested $100 million in Amazon and pays an undisclosed license fee to use the search-and-personalization service on Shop@AOL [Heun July 2001]. In 2003, Amazon launched a subsidiary just to sell its Web-sales and fulfillment technology to other firms. Bezos noted that Amazon spends about $200 million a year on information technology (a total of $900 million to mid-2003). The purpose of the subsidiary is to help recover some of those costs—although Bezos believes they were critically necessary expenditures [Murphy 2003].

With so many diverse products, and relationships, it might be tempting to keep everything separate. However, Amazon perceives advantages from showing the entire site to customers as a single, broad entity. Yes, customers click to the various stores to find individual items. But, run a search and you will quickly see that it identifies products from any division. Additionally, the company is experimenting with cross sales. In 2002, the Project Ruby test site began selling name-brand clothing and accessories. Customers who spend $50 or more on apparel received a $30 gift certificate for use anywhere else on Amazon [Hayes 2002].

By 2004, 25 percent of Amazon's sales were for its partners. But, one of Amazon's major relationships took a really bad turn in 2004 when Toys 'R' Us sued Amazon and Amazon countersued. The complaint by Toys 'R' Us alleges that it had signed a ten-year exclusivity contract with Amazon and has so far paid Amazon $200 million for the right to be the exclusive supplier of toys at Amazon.com. David Schwartz, senior VP and general counsel for Toys 'R' Us stated that "We don't intend to pay for exclusivity we're not getting" [Claburn May 2004]. Amazon's initial response was that "We believe we can have multiple sellers in the toy category, increase selection, and offer products that (Toys 'R' Us) doesn't have" [Claburn May 2004]. The lawsuit counters that at least one product (a Monopoly game) appears to be for sale by third-party suppliers as well as Toys 'R' Us. A month later, Amazon countersued, alleging that Toys 'R' Us experienced "chronic failure" to maintain sufficient stock to meet demand. The court documents noted that Toys 'R' Us had been out of stock on 20 percent of its most popular products [Claburn June 2004]. Although the dispute sounds damaging, it is conceivable that both parties are using the courts as a means to renegotiate the base contract.

Small merchants accelerated a shift to Amazon's marketplace technology. By 2007, Amazon was simply the largest marketplace on the Web. For example, John Wieber was selling $1 million a year in refurbished computers through eBay. But increased competition and eBay's rising prices convinced him to switch to direct sales through Amazon. Similar small merchants noted that although the fees on Amazon are hefty, they do not have to pay a listing fee. Plus, eBay shoppers only want to buy things at bargain-basement prices (Mangalindan 2005).

## Information Technology

In the first years, Amazon intentionally kept its website systems separate from its order-fulfillment system. The separation was partly due to the fact that they did not have the technical ability to connect them, and partly because the company wanted to improve security by keeping the order systems off the Web.

By 1997, Amazon's sales had reached $148 million for the year. The big book database was being run on Digital Alpha servers. Applications were still custom written in house. By early 2000, the company had over 100 separate database instances running on a variety of servers—handling terabytes of data.

In 2000, Amazon decided to overhaul its entire system. The company spent $200 million on new applications, including analysis software from E.piphany, logistics from Manugistics, and a new DBMS from Oracle. The company also signed deals with SAS for data mining and analysis [Collett 2002]. But, one of its biggest deals was with Excelon for business-to-business integration systems. The system enables suppliers to communicate in real time, even if they do not have sophisticated IT departments. It provides a direct con-

nection to Amazon's ERP system either through programming connections or through a Web browser [Konicki 2000].

About the same time (May 2000), Amazon inked a deal with HP to supply new servers and IT services [Goodridge and Nelson 2000]. The new systems ran the open-source Linux operating system. Already by the third quarter of 2001, Amazon was able to reduce its IT costs by 24 percent from the same quarter in 2000 [Collett 2002].

By 2004, the supply chain system at Amazon was a critical factor in its success. Jeffrey Wilke, Senior VP of worldwide operations, observed that "When we think about how we're going to grow our company, we focus on price, selection, and availability. All three depend critically on the supply chain" [Bacheldor 2004]. Almost the entire system was built from scratch, customized to Amazon's needs. When a customer places an order, the system immediately connects to the distribution centers, determines the best way to ship the product, and provides the details to the customer in under two minutes. The entire process is automatic.

Dr. Russell Allgor has moved from Bayer Chemical and has built an 800,000-equation computer model of the company's sprawling operation. When implemented, the model is to help accomplish almost everything from scheduling Christmas overtime to rerouting trucks in a snowstorm. Allgor's preliminary work is focused on one of Amazon's most vexing problems. This is how to keep inventory at a minimum, while ensuring that when someone orders several products, they can be shipped in a single box, preferably from the warehouse — the company has six — that is nearest the customer [Hansell, 2001]. Dr. Allgor's analysis is simple, but heretical to Amazon veterans. Amazon should increase its holdings of best sellers and stop holding slow-selling titles. It would still sell these titles but order them after the customer does. Lyn Blake, a vice president who previously ran Amazon's book department and now oversees company relations with manufacturers, disagrees with this perspective. "I worry about the customer's perspective if we suddenly have a lot of items that are not available for quick delivery."

Amazon's merchant and zShop systems are powerful tools that enable smaller stores to sell their products through Amazon's system. Amazon continually works to improve the connections on those systems. This system caused problems in 2001—the main issue is that the data on the merchant websites was being updated only once every eight hours. The merchant's link to Amazon's main database servers, and internal applications transfer the data onto the displayed page as requested. As customers purchased items, the inventory quantities were altered in the main servers, but the current totals were not transferred to the display pages until several hours later. Consequently, customers would be told that an item was in stock, even it had sold out several hours ago. To solve the problem, Amazon installed Excelon's ObjectStore database in 2002. The system functions as a cache management server, reducing the update times from eight hours down to two minutes. Paul Kotas, engineering director for the Merchants@Group noted that "with the growth of this business, we needed a zero-latency solution" [Whiting 2002].

In 2003, Amazon added a simple object access protocol (SOAP) gateway so that retailers could easily build automated connections to the system. Data is passed as XML documents and automatically converted to Amazon's format [Babcock 2003].

One of the most successful technologies introduced by Amazon is the affinity list. When someone purchases an item, system makes recommendations based on similar items purchased by other customers. The system uses basic data mining and statistical tools to quickly run correlations and display the suggested products. Kaphan notes that "There was

always a vision to make the service as useful as possible to each user and to take advantage of the ability of the computer to help analyze a lot of data to show people things they were most likely to be interested in" [Collett 2002]. The system also remembers every purchase made by a customer. So, the Amazon programmers created the Instant Order Update feature, that reminds customers if they have already purchased an item in their cart. Bezo notes that "Customers lead busy lives and cannot always remember if they've already purchased a particular item." He also observed that "When we launched Instant Order Update, we were able to measure with statistical significance that the feature slightly reduced sales. Good for customers? Definitely. Good for shareowners? Yes, in the long run" [2003 annual report].

## New Services

Amazon requires huge data centers and high-speed Internet connections to run its systems. Through vast economies of scale, Amazon is able to achieve incredibly low prices for data storage and bandwidth. Around 2005, the company decided that it could leverage those low costs into a new business selling Internet-based services. The company offers an online data storage service called S3. For a monthly fee of 15 cents per gigabyte stored plus 20 cents per gigabyte of data transferred, any person or company can transfer and store data on Amazon servers [Markoff 2006]. Through a similar service (EC2), any company can use the company's Web servers to deliver digital content to customers. Microsoft reportedly uses the system to handle some large files for downloads. The company essentially serves as a Web host, but instead of paying fixed costs, you pay 10 cents per virtual server per hour plus bandwidth costs. Amazon's network can handle bursts up to 1 gigabit per second. The system creates virtual servers, running the Linux kernel, and you can run any software you want [Gralla 2006].

Amazon also runs the A9 search engine, so it began selling keyword advertising. Similar to Google, A9 provides advertising links to other Web sites and shares the revenue. The company also provides mapping and other services that can be integrated into your Web site.

Perhaps the most unusual service is Mturk. The name derives from an 18-century joke where a "mechanical" chess-playing machine surprised European leaders and royalty by beating many expert players. The trick was that a human was hidden under the board and moved the pieces with magnets. Amazon's trick is to use human power to solve problems. Companies post projects on the Mturk site and offer to pay a price for piecemeal work. Any individual can sign up and perform a task and get paid based on the amount of work completed. Amazon takes a 10 percent commission above the fee. For example, the company Casting Words places audio files on the site and pays people 42 cents to transcribe one minute of audio files into text [Markoff 2006].

Adam Selipsky, vice president of product management and developer relations at Amazon Web Services observed that ""Amazon is fundamentally a technology company; we've spent more than one and a half billion dollars investing in technology and content. We began by retailing books, but it was never in our business plan to stay with that" [Gralla 2006].

## Financial Performance

If you read the many press statements and glowing tributes to Amazon, and look at the technology the company has created, you might walk away with the perception that the

company is a star. You might even be tempted to buy stock in the company. Before you do that, take a close look at Amazon's financial performance. In 2003, the company did finally show a profit—of $35 million. But, add up all of its losses (and singular profit) over time, and you will see that the company has lost almost $3 billion! Take a look at the financial statements in more detail, and you will see that it paid for these losses by borrowing money—it currently has $1.9 in long-term debt. The lack of corresponding assets shows the stockholder's are short over $1 billion [annual reports].

| Year | Net Sales | Net Income | Debt (LT) | Equity | Employees |
|---|---|---|---|---|---|
| 2006 | 10,711 | 190 | 1,247 | 431 | 13,900 |
| 2005 | 8,490 | 359 | 1,480 | 246 | 12,000 |
| 2004 | 6,921 | 588 | 1,835 | (227) | 9,000 |
| 2003 | 5,264 | 35 | 1,919 | (1,036) | 7,800 |
| 2002 | 3,933 | (149) | 2,277 | (1,353) | 7,500 |
| 2001 | 3,122 | (567) | 2,156 | (1,440) | 7,800 |
| 2000 | 2,762 | (1,411) | 2,127 | (967) | 9,000 |
| 1999 | 1,640 | (720) | 1,466 | 266 | 7,600 |
| 1998 | 610 | (125) | 348 | 139 | 2,100 |
| 1997 | 148 | (31) | 77 | 29 | 614 |
| 1996 | 16 | (6) | 0 | 3 | |
| 1995 | 0.5 | (0.3) | 0 | 1 | |

($Million. Source: Annual Reports.)

The company's financial position has improved somewhat since 2000. Most of the improvement is due to increases in sales—which is good. But, those sales increased largely by selling products for other firms, and from one more twist. Amazon no longer discounts most of the books that it sells. In fact, it is generally more expensive to purchase books from Amazon than to buy them from your local bookstore. For competitive online pricing, check www.campusi.com, which searches multiple websites for the best price, but the selection might not be as large.

You might argue that Amazon is finally beginning to exhibit the capabilities that were promised a decade ago. And that with increasing sales, and better attention to costs, the company has the ability to pay off that huge debt and maintain its stature. Or, you might want to think about what will happen to costs as interest rates rise—remember that the economy experienced the lowest rates in history in the early 2000s. An increase of a mere two percentage points will wipe out the 2003 profit. You also might want to keep in mind that the CFO once remarked that he did not understand the emphasis on financial data—the company never intended to make a profit.

Out of curiosity, where did all of that money go? In 2003, Bezos noted that $900 million went to business technology; $300 million was spent on the fulfillment centers; and $700 million on marketing and customer acquisition [Murphy 2003]. That last part largely represents selling books at a loss or offering free shipping while trying to attract customers. Those numbers add up to the $1.9 billion debt, but what happened to the other $1 billion in net losses?

## Case Questions

1. Who are Amazon's competitors?

2. Why would customers shop at Amazon if they can find better prices elsewhere?

3. Why did Amazon create most of its own technology from scratch?

4. If Amazon buys products from other firms and simply ships them to customers, why does it need so many of its own distribution centers?

5. Will other retailers buy or lease the Web software and services from Amazon? Can Amazon make enough money from selling these services?

6. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

## Additional Reading


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## Tennessee Valley Authority (TVA)

The Tennessee Valley Authority (TVA) is a quasi-public federal organization headquartered in Knoxville, Tennessee, that was founded in 1933. It provides electric power; flood control; navigation; and agricultural, economic, and industrial development through the Southeastern United States. It is the nation's largest electric utility. It makes most of its money ($6.9 billion in 2003) by selling electric power to regional power associations. It provides power to more than 160 municipal and cooperative power distributors who service more than 7 million consumers. In addition, special projects are funded by Congress (amounting to $135 million in 1992). The 13,000 employees (down from 19,000 in 1992) are divided into several business units, including finance, power generation, marketing, and navigation. The IS department consists of 683 employees (down from 925 in 1992) and has an annual budget of $100 million [Garvey 2003]. However, the company employs 4,000 union trade workers (such as electricians) on a seasonal basis to handle maintenance [Hoffman 2004].

| Year | Revenue | Net Income |
|---|---|---|
| 2006 | 9,185 | 329 |
| 2005 | 7,794 | 85 |
| 2004 | 7,533 | 386 |
| 2003 | 6,953 | 444 |
| 2002 | 6,796 | 73 |
| 2001 | 6,999 | (3,311) |
| 2000 | 6,762 | 24 |
| 1999 | 6,595 | 119 |

$ Million. Source: Annual Reports.

Like other businesses, the TVA faces a changing environment with deregulation. For years, it was the only supplier of electricity in its region—cooperatives and municipalities signed agreements to purchase power solely from TVA. Many of these contracts had extended time frames of 35 to 50 years. Many of these contracts were due for renegotiation in the 1990s, and other utilities are eager to expand their markets. Additionally, the federal government is encouraging competition in the production of electricity. As a result, TVA has to become more cost conscious. As of 1994, the Energy Policy Act of 1992 effectively frees customers to choose the electric company they wish to use. Wholesale corporate utility customers can already buy their electricity from a variety of sources. It is unclear at this time whether individual households will have the option of selecting power providers. The act is primarily designed to provide multiple choices to large factories, power distributors/resellers, and municipal utilities.

### Management and Employees

The TVA is governed by a three-person board of directors, with one of them appointed as the head of the board. The three members are appointed by the U.S. President, and the spots are often given to financial backers as political patronage. The day-to-day activities are governed by the general manager, the comptroller, the general counsel, the chief budget officer and the director of information. The separate business units are largely independent

of each other. They have separate divisional leaders, separate budgets, and different objectives that occasionally conflict. Also, many of the offices are located in different cities.

The TVA has an interesting history in terms of management and labor relations. Although it is technically an agency within the federal government, its employees are not subject to Civil Service regulations. Congress decided that because of the technical nature of the agency, it required highly trained employees, so it should be free to hire employees from the national job market without the political considerations involved in the Civil Service system. In 1940, TVA became the first U.S. federal agency to adopt collective bargaining. By 1977, 99 percent of eligible trade and labor employees were members of a union. Even management level and "white-collar" employees are members, with 87 percent of eligible salaried workers belonging to an employee union.

At the TVA, membership in unions is encouraged by personnel rules and practices. Employee promotions and raises are based on merit evaluations. As part of the employee merit evaluation system, membership in a union is considered a sign of professional competency, merit, and efficiency. Hence, membership in a union virtually guarantees job tenure and merit raises.

Because TVA is a federal agency, an unusual problem has arisen. The TVA Act of 1933 that established the agency set a maximum salary of $10,000 for members of the board of directors. More importantly, it stipulated that no employee could receive a higher salary than the amount paid to the directors. Because this value was fixed by Congress, it could only be changed by Congress by passing new legislation. Consequently, the value is not changed often and the TVA has had trouble hiring and keeping professional employees. As a result, the agency has a history of relying on outside consultants who are not directly affected by the salary cap because they are paid for individual tasks.

## TVA in the 1970s

The GAO reports that the TVA was experiencing a huge growth in the use of electricity in the late 1960s and early 1970s,

> *when power sales were growing at a steady rate and were expected to double every 10 years. In the Tennessee Valley, the number of electricity customers rose to over 2 million in the 1960s and about 30 percent of all the homes were heated with electricity.*
>
> *By 1970, TVA customers used nearly twice as much electricity as the national average. At that time, TVA was experiencing an annual growth rate of about 8 percent in demand for electricity, and TVA's forecasts through the mid-1970s were showing continued high growth in demand.*

In 1966, TVA announced plans to build 17 new nuclear plants in seven states. Many other utility companies announced similar (though less ambitious) plans. The oil crises of 1973 and 1978, the Three Mile Island disaster of 1979, and construction problems and cost overruns caused most companies to cancel the construction of the majority of nuclear plants. A changing regulatory environment of the 1980s also encouraged electric utilities to focus on conservation instead of new construction. Encouraging customers to add insulation, purchase more energy-efficient appliances, and employ newer heating and cooling systems resulted in a significantly smaller growth rate in consumption. By 1984, after investing $5 billion in construction, TVA canceled 8 of the 17 plants.

Of TVA's nine remaining nuclear sites, three were operational in 1995 (Browns Ferry 2, Sequoyah 1 and Sequoyah 2). After 22 years of construction, Watts Bar 1 was beginning final testing and expected to be placed on-line in early 1996. One unit (Browns Ferry 3) began operations but was shut down because of repeated problems. Four other units were placed into "mothball" status, pending an analysis to determine whether they should be continued, converted to alternative fuels, or shut down completely. Total TVA spending on nuclear facilities is more than $25 billion, of which only $5 billion applies to functional plants. TVA is the only U.S. utility still actively constructing nuclear plants. The $25 billion constitutes the bulk of the $26 billion debt (mostly public bonds) of TVA, but the nuclear plants generated only 14 percent of TVA's total power supply in 1994. In 2004, TVA announced plans to reopen Browns Ferry 1 at an anticipated cost of $1.8 billion [Hampton and Ichniowski 2004]. If it opens on time in 2007, it will be the first new U.S. nuclear plant since 1996.

## TVA in the 1990s

TVA is under federal mandate to fund its electricity production from ongoing operations. By its internal accounting methods, TVA is meeting this mandate; however, $14 billion of the nuclear construction debt is not being financed from current operations. In 1995, TVA had a total debt of $26 billion, with financing costs of $1.9 billion a year (35 percent of its power revenues). TVA faces a Congressionally imposed debt ceiling of $30 billion, and TVA expects to increase its debt to about $28 billion by 1997—in part to cover final production costs at Watts Bar, in part to cover interest payments on its debt. As a federal agency, TVA cannot sell stock (like most traditional utilities), so all funds must be raised from bond sales. Although these sales are not guaranteed by the federal government, some investors believe that the federal government will not allow TVA to default on the bonds. Consequently, TVA has a slight advantage over potential competitors in terms of interest rates. Similarly, TVA does not pay federal income taxes.

TVA also anticipates the need for substantial expenditures to improve existing hydroelectric and coal-fired plants. Additional expenses will also be incurred in bringing all of the coal-fired plants into compliance with the Clean Air Act. Based on preliminary estimates, TVA anticipates spending between $1.1 and $1.6 billion between 1995 and 2015 (in constant 1994 dollars). By 2003, TVA was still reporting total debt of about $25 billion [annual report].

In public statements, TVA repeatedly emphasized that they had not raised electricity rates in nine years, and they are trying to hold them stable for at least 10 years. Nonetheless, TVA is not the lowest-cost producer in the area. However, for the immediate future, other firms are prohibited from selling electricity to TVA's customers.

As part of the Energy Policy Act of 1992, TVA is conducting an integrated resource planning (IRP) process—largely to determine future goals, changes in production and operations, and the least-cost means of providing power. TVA is conducting the plan with several interdisciplinary teams:

- Issues and Values Translation Team
- Evaluation Criteria Team
- Load Forecasting Team
- Existing Capabilities Team
- Supply-Side Options Team
- Customer Service Options Team

- Environment Team
- Rankings Team
- Strategy Development Team
- Uncertainties Team
- Integration Team

Each of these teams is responsible for identifying problems, making forecasts, and presenting and evaluating alternatives. Many of the teams use statistical and computer simulation models to test assumptions and evaluate the alternatives. The final report will present the reduced list of options to the governing board.

In 1998, the TVA chairman became frustrated with negotiating with Congress. He offered to drop all federal subsidies—in exchange for complete control of the company and its resources. He is beginning to concentrate on the opening of the electricity market to competition. On the other hand, several people have complained about the possibility of losing federal subsidies for the administration of thousands of acres of land and lakes open to the public.

## TVA Financial Performance

In 1995, the Congressional Government Accounting Office (GAO) undertook a comprehensive investigation of TVA and its problems. The GAO's financial comparison of TVA with potential future competitors is particularly useful. Additional comments and statistics are available in the total report.

Comparison of Key Financial Ratios for TVA and Neighboring IOUs, 1994
(figures in percent)

| Utility | Financing costs to revenue | Fixed financing costs to revenue | Net cash from operations to expenditures for PP&E and CSD | Accumulated depreciation/ amortization to gross PP&E | Deferred assets to gross PP&E |
|---|---|---|---|---|---|
| AEP | 16 | 8 | 90 | 38 | 1 |
| CP&L | 16 | 7 | 132 | 35 | 2 |
| DR | 19 | 9 | 86 | 34 | 5 |
| DP | 16 | 7 | 81 | 36 | 4 |
| ENT | 20 | 13 | 121 | 32 | 2 |
| IL | 14 | 11 | 115 | 31 | 5 |
| KU | 15 | 6 | 54 | 40 | 4 |
| LG&E | 14 | 6 | 82 | 35 | 1 |
| SC | 18 | 9 | 92 | 31 | 4 |
| TVA | 35 | 35 | 57 | 17 | 47 |
| IOU Summary | | | | | |
| Average | 16 | 8 | 95 | 35 | 3 |
| High | 20 | 13 | 132 | 40 | 5 |
| Low | 14 | 6 | 54 | 31 | 1 |

Notes: CSD: Common Stock Dividends; PP&E: Property Plant & Equipment;
AEP: American Electric Power; CP&L: Carolina Power and Light; DR: Dominion Resources; DP: Duke Power; ENT: Entergy; IL: Illinova; KU: KU Energy; LG&E: LG&E Energy Corp.; and SC: Southern Company.

Source: GAO analysis of 1994 annual reports.

Fiscal Year 1994 Key Statistics for TVA and American Electric Power
(Dollars in millions)

| | TVA 2006 | TVA 1994 | AEP 1994 |
|---|---|---|---|
| System capacity (MW) | 29,776 | 25,913[a] | 23,670 |
| System sales (in millions of kilowatt hours) | 176,370 | 122,574 | 116,714 |
| Net total assets | $34,520 | $31,842 | $15,713 |
| Total debt | $22,900 | $26,136 | $6,309 |
| Operating revenue | $9,185 | $5,401 | $5,505 |
| Net interest expense | $1,215 | $1,772 | $887 |
| Depreciation and amortization expense | $1,492 | $639 | $572 |

[a]Represents dependable capacity currently in service. It excludes about 2,230 MW of capacity for Watts Bar 1 and Browns Ferry 3 that TVA planned to bring into commercial service in 1996. Source: GAO summary of 1994 annual reports and 2006 Annual Report.

Over the past few years, TVA has been repeatedly criticized for failing to reduce its debt. It has also been severely criticized for counting its mothballed nuclear facilities as assets, and overvaluing them by several billion dollars. In 2001, the company wrote down some of its assets by $2.1 billion, generating a loss for the year. But that still leaves $4.1 billion in questionable assets on the books [McTague 2003]. TVA has tried to raise rates to generate more income. In 2003, it proposed a rate increase of 8.1 percent, which would have raised an extra $365 million. Even that increase raised so many protests by customers (municipal power distributors), that TVA dropped the proposal to 7.4 percent, and was considering reverting to no increase at all [*The Economist* 2003].

With the hikes in the national interest rates beginning in mid-2004, TVA could ultimately face a more severe crunch—trying to pay the interest costs on its debt. Many investors believe that the federal government will not let TVA fail or default on its bonds. But, with increasing calls for privatization of the organization, and the ability to remove $25 billion in debt from the federal books, there are no guarantees.

In 2004, 13 power companies had higher revenues than TVA, led by Duke Energy and Halliburton [Garvey 2004].

## MIS Activity

Prior to 1992, the IS department was highly fragmented; each business unit essentially had its own IS department. Computer hardware consisted primarily of large IBM and compatible machines centrally located in the Knoxville offices. Data management and software development were largely left to the individual business units. Most development of software was in COBOL. The business units were happy controlling their own group of IS employees. However, there was considerable duplication of effort. Additionally, the individual departments and their software tended to be maintained separately from other departments. There were virtually no corporate standards, so hardware and software purchased and designed for each business unit often required major modifications whenever someone wanted to share data across departments. Overall, the IS staff was spread too thin, and they were developing redundant, incompatible systems.

Overall responsibility for the MIS department technically belonged to a centralized core MIS team. However, the operating divisions tended to mistrust the central MIS department. They had earned a reputation of being late and over budget with most projects. The central MIS team was also accused of being heavily biased in favor of solutions involving centralized programs written in COBOL. It was generally accepted that the MIS team would always advocate a solution that they knew best—regardless of the technical merits of the alternatives. As a result, the business units often turned to outside consultants and programmers to create new information systems, bypassing the internal IS department completely. For instance, in 1992, the finance department called on Coopers & Lybrand and Oracle Corporation to develop a major new client-server based financial system.

In 1991, TVA signed a five-year contract to purchase up to $60 million worth of personal computers and local area network equipment from Concept Automation Inc of Sterling, Virginia. Part of the goal is to shift the company toward an open systems environment. Managers who need PCs within the company will order them from TVA offices in Chattanooga. The bulk of the purchases are expected to come from the headquarters in Knoxville, but offices in Huntsville, Alabama, and Chattanooga are expected to buy several PCs through the contract as well.

In early 1992, TVA took the first steps to implement an agencywide geographic information system. The authority awarded a $750,000 contract to ESRI for Arc/Info running on Sun workstations. The goal is to create a $13-million Automated Land Information System over eight years. The goal is to provide better management data to foresters, biologists, and engineers throughout the organization.

## Centralization

In 1990, the head of IS decided to centralize the IS department to reduce duplication and help control costs. This centralization offended the heads of the various business units, largely because they saw it as a loss of control. In the process of consolidating the IS departments, the head of IS also offended the IS workers because he was stressing a shift to a client-server approach. In particular, he tried to emphasize development using the Oracle database management system, signing a $16-million contract. The IS programmers and analysts felt that management was "shoving Oracle down their throats." The IS department is represented by three different unions, which provide alternative channels for complaints and grievances. As a result, the initial agreements with Oracle were investigated by the TVA inspector general for alleged collusion and kickbacks. After three years of investigation, the inspector cleared the contract.

Scott Woodlee began working at TVA in construction and in 1995 moved into purchasing. He examined the utility's purchases over a 12-month period and found that TVA was buying similar products from multiple vendors and paying different prices each time. By coordinating purchases, he was able to obtain volume discounts. The ideas grew into the Distributor Procurement Partnership Program. A key feature in the system is that most of the same supplies are also needed by the local and regional power distributors (e.g., city utility companies). TVA extended the application into the Supply Chain Committee in 2004 so that all of the partners can negotiate together for better prices. Woodlee noted that "it's getting harder by the day for distributors to make ends meet. With rising costs, they're working hard to find ways to save on expenditures" [Brooks 2006]. The system initially struggled to get vendors to join, but as the number of distributors grew, vendors realized the system provided a wider market. The system collects bids from the vendors and utility

companies purchase based on the winning contract. The system makes it easy to order new supplies—without going through a new bidding process each time.

## A New IS Director and a New Plan

In August 1992, the IS director was replaced by Robert Yates, previously the corporate treasurer to "clean up the mess" in the IS department. Yates noted that there were "a lot of turf battles, no clear-cut domains, and built-in conflicts of interest."

Yates consulted with N. Dean Meyer and Associates, Inc., and with the IS workers to help create a new IS structure that would satisfy the business units, please the IS workers, and improve the competitive position of TVA. The new plan basically keeps the current (centralized) structure. It organizes the IS workers into four categories: (1) service bureaus consisting of IS operations staff, maintenance, administration, and PC support; (2) technologists consisting of programmers, application specialists, database administrators, and various technical experts; (3) a consultancy of about 30 members who will help the business units determine their needs as well as market the IS capabilities; and (4) A small number of architects to define corporate standards. Yates also plans to institute a charge-back system to bill the business units for IS services. He is concerned that they look at IS as a "free good"; hence there would be incentive to overuse the IS department, instead of searching out other solutions.

In 1993, the MIS department began searching for a management software tool to help them centralize the administration of all the workstations throughout the company. For example, in 1993 there were more than 100 Sun high-end workstations and 400 smaller Sparcstation 2 machines in use. Robert Khym, TVA's manager of distributed systems software support, noted that "The next step will be finding something that will integrate all of our open systems."

In 1993, TVA began replacing its mainframe computers with Unix-based midrange computers. Each of the 24 dams, 12 fossil fuel plants and 4 nuclear reactor plants operate as separate entities. The agency wants to install lower-cost open-system minicomputers at each site. There is limited information flow between the various sites, but TVA is in the process of installing a wide area network to allow easier transfer of financial data. The existing IBM mainframes will be kept as centralized file servers.

As part of its consolidation plan, TVA signed a contract with PeopleSoft Inc. to use that company's client-server payroll software package. After some alleged problems about making the package work with the IBM DB2 database applications, the TVA inspector general's office called a halt to the installation and began an investigation into the purchasing process.

## MIS In the Early 2000s

Utility companies in general have turned to IT to reduce costs—the industry-wide deregulation has forced them to look for new areas to save money. Utilities need information systems to help generate power efficiently, transmit it across aging power grids, and respond to outages and customer problems. They also need to reduce costs. Since TVA is primarily a wholesale distributor, it needs to track relationships with municipal providers and forecast demands. Diane Bunch, VP of IS in 2000 noted that "Our generating and transmission facilities use 60 different models for load forecasting, production costing, maintenance planning, and market forecasting. We're reengineering the process and want to reduce the number of models by 50 percent" [Garvey 2000]. TVA also wants to reduce the amount of

power reserves it holds. Bunch observes that "Having the right reserves at the right time could mean $150 million to $300 million to our bottom line" [Garvey 2000].

In the late 1990s, TVA estimated that it was spending nearly $50 million a year on planning and performing maintenance work orders for its nuclear plants. The single Browns Ferry plant alone generates 14,000 work orders a year. The process is complicated by every-changing documents on the power systems. Working with an outside software vendor, TVA was able to define and purchase a new system to maintain all of the documents electronically. Developing the system and converting documents took the vendor 28 months. After such careful planning, Robert Rupe, process improvement manager at TVA Nuclear notes that "we butchered change management" [Hildebrand 2000]. Many of the people who would use the system had never used a keyboard, and thought the CD-ROM made a nice coffee cup holder. The new application was also based on a distributed system, so "some of the response times were actually slower, and people saw that. But we didn't explain that the overall process would result in huge time savings. We needed to manage expectations better" [Hildebrand 2000]. In the end, the $5.1 million system reduced the time to process work orders from 39.8 to 23.3 person hours; saving $8.4 million annually just in labor costs.

TVA also worked at improving its supply chain management. One key step was to join business-to-business marketplaces. Diane Bunch noted that "We have to find every efficiency in our business in order to stay alive. We can't (just) try e-commerce. We have to make it work" [Meehan August 2001]. TVA is asking is local power distributors to enter requests for basic items like poles and transformers onto its private website. From there, the system consolidates purchase items and routes them onto a national e-commerce site run by Pantellos Group. Bunch described the basic process: "When we get a work order at one of our plants, (the software) will check our inventory companywide to see if we have the right materials. And if we don't, it will then punch out (a purchase order) to the marketplace" [Meehan August 2001].

Re-engineering the supply chain management system began in 1996. In July 2001, the system went live in a weeklong big-bang implementation. Bunch noted that "from the sheer magnitude, it was the largest undertaking in the agency's history" [Songini 2003]. To reduce risks, the IS departments involved end users at every step, and specifically identified business experts at each location who had responsibility for the project's success. The system eliminated 20 homegrown and third-party applications, integrates 32 others, and creates an enterprise system that provides real-time data instead of waiting for nightly batch updates. By 2003, TVA had already saved $23.5 million [Songini 2003]. TVA also installed logistics software from Manugistics, that centralized routing of is freight operations.

To reduce development costs, TVA built its own front-end portal system using an Apache Web server linked to its UNIX business systems. The portal provides Web access to handle customer service, online billing, and access to the private marketplace by power distributors [*Comptuerworld* August 2001]. Diane Bunch described the portal goals in more detail:

> *Through this portal, our business partners have secure, immediate access to billing, real-time pricing, usage summaries, energy and environment news, weather forecasts, and a digital marketplace that leverages TVA volume contracts. We provide information in a fashion that lets customers personalize their portal displays. The goal: to increase the avenues of communication between TVA, its customers, and suppliers. Planned future enhancements are scheduled to include contract information, economic data, a customer information management system, as well as online billing and payment, Web-hosted bond offerings, and additional functionality for online power trading* [Bunch 2001].

The one drawback to the new system is that it generates a huge amount of data. TVA's wide-area network was carrying 21 terabytes of data month in 2001, as more traffic moved to the Internet-based systems. To give users better access to the data, TVA began building a data warehouse. The first phase was to consolidate TVA's financial and performance management systems. In the process, Bunch wants to improve IS development standards. In particular, to ensure clean data, she is insisting that all interfaces and data be fully documented. She observes that failure to document that information "would never happen in our nuclear facilities, and our goal is that it won't happen anymore with our information systems" [*Computerworld* August 2001].

The huge amount of data being generated also causes problems on the network. With TVA's emphasis on enterprise and distributed systems, the company saw dramatic increases in network traffic. Ed Wood, network administrator in Knoxville noted that "The programmers are far less network-sympathetic than they used to be. They must think we've got unlimited resources" [Meehan November 2001].

Beginning in 2001, TVA also began cleaning up its use of personal computers. The company migrated from Windows 95 to Windows XP starting in October 2001. In the process, the company whittled the number of desktop applications down from 4,700 to 2,300. In many cases people had installed multiple versions of the same application. Reducing the number of users of each application also enabled to company to renegotiate software licenses, saving several thousand dollars a year [Hoffman 2003].

TVA has reduced the total number of full-time employees by several thousand workers. However, it still hires over 4,000 part-time seasonal workers to handle maintenance and other tasks. Additionally, the company has reduced its full-time IT staff to around 650 employees, but still hires 85 contractors in IT. Just in internal positions in IT, engineering, and clerical, TVA hires 1,500 temporary employees. In 2004, TVA purchased a contingent-workforce management system from Elance. Before using the software, TVA relied on a paper-based system, backed up with faxes and hours in phone calls. The new system handles most HRM management aspects from initial job posting, to tracking projects that employees have worked on. It also supports competitive bidding when workers are provided by outside agencies. TVA anticipates recovering the software costs within a year [Hoffman 2004].

In 2002, TVA restarted Brown's Ferry Unit number 1 which had been inactive since 1985. In a nuclear plant, a network failure can shut down more than just a few desktop PCs. On August 19, 2006, operators at the TVA Brown's Ferry plant in northern Alabama noticed that one of the two operating reactors was not circulating enough water to cool itself. They manually scrammed the reactor to prevent damage to the reactor. Investigation

revealed the cause of the problem was excessive traffic on the closed Ethernet network used by the plant's control system. The network engineers were not able to identify the exact cause of the problem, but suspect it arose from faulty network code from the pump controllers. Eric Byres, CEO of Byres Security, Inc. stated that "I'm personally aware of at least a dozen incidents at this point that relate to this particular fault" [McMillan 2007].

Because of the importance of location and distance to the power utility, TVA has been a leader in implementing GIS-enabled systems. One system (TVAsites.com) provides information on property and buildings for sale in the TVA region. John Bradley, TVA Senior Vice President of Economic Development noted that "using technology tools such as TVAsites.com streamlines the process for corporate decision makers and site selection professionals to locate and expand their companies in the Tennessee Valley. TVA developed TVAsites.com as a comprehensive business development resource to save clients time and money while they select the optimal property or building for their business" [Directions Magazine 2006].

## The Future

Like other firms, TVA faces issues with its aging workforce. The company risks losing critical knowledge as its workers retire. In 2003, the average employee age was 47 and almost one-third (4,500) planned to retire within five years. In response, the HR department created a survey. At least once a year, managers interview employees and write down the answers to three questions: "(1) What knowledge will be lost when an employee retires? (2) What are the consequences of losing this knowledge? (3) How can the organization retain this knowledge?" [Leonard 2003]. HR staff members then grade each employee's skill and knowledge on a five-point scale. Jill Wallace, human resource service manager for TVA's nuclear division noted that "This is not rocket science; it really is a fairly simple process. But it has definitely made our workforce a stronger and more cohesive team. It has people thinking about how their job affects the organization and raised the awareness that what they do counts and is important to the successful operation of this TVA" [Leonard 2003].

In 2003, TVA ran a second trial implementation of a fiber-optic-based network to connect power stations. The system enables managers to watch all equipment along a line, and to send control signals to equipment to change configuration and other features. Real-time monitoring of lines, transformers, and other devices had not been possible earlier [Smith, et. al 2004].

In 2001, two finance professors (Dennis Logue and Paul MacAvoy) analyzed the financial records for TVA and observed that TVA has a high probability of going bankrupt [Logue and MacAvoy 2001]. Logue noted that "By most measures of solvency, they are broke" [McTague 2003]. Pressures from deregulation will continue. As interest rates continue to increase, the inability of TVA to reduce its debt according to its own schedule means that the costs of TVA's debt might become too large to compete. As of 2007, the finance professors were wrong—but largely because interest rates remained low for several years, leading TVA to issue low-rate 50-year bonds in 2006 [Euroweek 2006]. TVA still has a huge debt load to finance.

TVA's 2006 Strategic Plan noted that retail competition had almost stalled throughout the country, and wholesale competition was based on reliability and environmental effects as opposed to prices. Much of this change was driven by the Energy Policy Act of 2005, passed in response to the 2003 energy blackout in the northeast states. Consequently, a

large part of TVA's strategy is to return to a focus on reliability and match the 2 percent energy growth rates.

## Case Questions

1. How would you classify the operations and management structure of TVA? In particular, does it lean toward centralization or decentralization?

2. How would you classify the management information systems at TVA? How has the authority changed between 1991 and 1994?

3. What are the advantages of each business unit having its own MIS department? What are the disadvantages?

4. What did the MIS director attempt to accomplish in 1992? What went wrong?

5. How is Yates altering the MIS department and its mission? Will his plan work?

6. Create a five-year plan for the MIS department at TVA. Examine the potential problems you expect to encounter and how they should be solved. How can the MIS department support the new opportunities and changing environment?

7. How does the management environment at TVA affect your alternatives and implementation of solutions?

8. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

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## Greyhound/Laidlaw/FirstGroup

Greyhound Bus Lines started in Hibbing, Minnesota, in 1914, when Swedish immigrant Carl Eric Wickman began shuttling passengers to nearby Alice, Minnesota, using his seven-seat Hupmobile. By 1930, the company put together a national network by acquiring other small bus lines. The company then moved to Chicago and adopted the Greyhound as its corporate logo and name [www.greyhound.com].

Up to the early 1960s, Greyhound was very successful. However, increased automobile ownership and decreased airline fares put considerable pressure on bus companies. From 1960 to 1994, the industry's share of interstate travel dropped from 30 percent to approximately 6 percent of the traffic.

In 1987, Greyhound was purchased in a leveraged buyout by Dial Corp. Suffering from high debt payments and two violent strikes (some bus drivers were shot at in 1989-1990), Greyhound filed for bankruptcy protection. In late 1991, the company emerged from bankruptcy protection with Frank Schmieder at the helm.

Schmieder and his lieutenant, J. Michael Doyle, began an ambitious re-engineering plan. Neither Schmieder nor Doyle had much experience in transportation: Schmieder came to Greyhound in 1989, Doyle in 1987. Their plan called for significant cost cutting, by dropping routes, cutting workers, and cutting the fleet from 3700 down to 2400 buses. Their plan also called for a new, comprehensive computer system that would handle everything from passenger reservations to scheduling.

Wall Street was impressed with the new managers and their plan. Within a month after emergence from bankruptcy, Greyhound stock was selling for $13.50 a share—twice as high as expected by Greyhound's own advisers. In 1992, the cost-cutting measures led to a year-end profit of $11 million on revenue of $682 million, the first profit shown by Greyhound since 1989. By May 1993, the stock price reached $22.75.

### Discord at Headquarters

Life at Greyhound during the years from 1991 to 1994 was schizophrenic, depending on where you looked. Until Schmieder, Greyhound headquarters were in a Dallas high-rise, near the bus terminal. The offices were Spartan and filled with bus memorabilia. Schmieder moved the company to an upscale building in the suburbs. He hired an interior-design firm, paying it as much as $90,000 a month. Decorating costs included $50,000 of fixtures, custom cabinets, and $4500 for two chairs in Doyle's office. Company funds also paid for season tickets to the Dallas professional sports teams. The executives also flew first-class and stayed at expensive resorts. There were also monthly bills for consulting firms and executive-search firms. One bill from Bain & Co. ran to $175,000 a month. Schmieder also arranged two "communication breakthrough" seminars with the Meridian Institute for $560,000. Few lower-level managers were invited to participate in these sessions, and even headquarters workers scoffed at the calls for teamwork and customer service that began appearing in the corporate newsletter. In two years, Schmieder's salary rose 57 percent to $526,000, and Doyle's by 65 percent to $264,000.

In the meantime, workers throughout the company were squeezed by the cutbacks. At corporate headquarters, employees scrounged vacant offices for supplies. Mr. Oller, a marketing manager who worked for Greyhound for six months in 1992, observes that "There were never-ending meetings about who was going to get fired."

Several other corporate employees lasted a year or less. In the field, experienced managers were routinely sacked to cut costs. Most of the terminals were staffed with part-time workers and "customer-service associates." These employees earned $6 an hour regardless of their jobs, with little or no chance for a raise. Few of them had completed high school. Turnover at some terminals ran 100 percent a year and 30 percent was common. Ralph Borland, a long-time Greyhound manager working as vice-president for customer satisfaction, notes that the turnover rate did not bother Greyhound management, since "If people stayed around too long, they would get too sour and cynical."

When touring facilities, customer-service executives were "shocked" to find terminal workers making fun of customers and ignoring others. Ridership was falling. To cut costs further, the number of buses and drivers was cut (down by half since the mid-1980s) and routes were rescheduled. Bus drivers began complaining that they had to exceed speed limits to meet the new schedules.

## Financial Performance

Greyhound ($Millions)

| Year | Passengers | Packages | Food | Other | Total | Net Income |
|---|---|---|---|---|---|---|
| 2004 | 811.5 | 39.0 | 37.3 | 69.0 | 956.7 | (23.2) |
| 2003 | 830.6 | 39.5 | 39.7 | 65.7 | 975.5 | (28.9) |
| 2002 | 849.8 | 40.0 | 42.2 | 60.0 | 991.9 | (111.6) |
| 2001 | 876.9 | 41.2 | 43.7 | 60.6 | 1,022.4 | 2.0 |
| 2000 | 861.8 | 42.4 | 43.0 | 67.0 | 1,014.3 | 12.6 |
| 1999 | 783.3 | 41.5 | 39.1 | 62.1 | 926.0 | (16.3) |
| 1998 | 727.8 | 36.2 | 31.2 | 53.3 | 848.4 | 35.2 |

| Year | Current Assets | Long term Assets | Current Liabilities | Long term Liabilities | Equity |
|---|---|---|---|---|---|
| 2004 | 97.6 | 515.9 | 139.1 | 444.6 | (48.9) |
| 2003 | 80.7 | 540.7 | 140.5 | 475.0 | (71.7) |
| 2002 | 74.6 | 486.8 | 153.4 | 521.4 | (113.5) |
| 2001 | 110.8 | 577.6 | 126.3 | 374.2 | 187.9 |
| 2000 | 96.9 | 581.2 | 138.2 | 302.1 | 235.2 |
| 1999 | 87.6 | 564.5 | 175.3 | 206.9 | 227.9 |

Laidlaw ($ Billions)

| Year | Revenue | Net Income | Total Assets | Equity |
|---|---|---|---|---|
| 2006 | 3.132 | 0.125 | 3.039 | 1.208 |
| 2005 | 3.027 | 0.212 | 2.909 | 1.600 |
| 2004 | 3.027 | 0.062 | 3.948 | 1.377 |

Source: Annual Reports

The problems at Greyhound are reflected in its financial performance. Obviously, the company had problems when it declared bankruptcy. The company improved in the mid- to late-1990s, but passenger revenue peaked in 2001 [annual reports]. Even more amazing, check out the stockholder equity in 2002 and 2003. It is negative! How long can a company survive when its liabilities exceed its assets?

In 1999, Greyhound was acquired by Laidlaw, a Canadian company that owns a diverse collection of transportation firms. In June 2001, Laidlaw filed bankruptcy in the United States and in Canada. Two years later, in June 2003, Laidlaw emerged from bankruptcy protection [2003 annual report]. In response to this parent-company bankruptcy, Greyhound effectively became more financially independent. In 2000, already facing problems, Laidlaw cut off funding [Heinzl 2000]. Within a couple of months, Greyhound secured its own line of credit from Wells Fargo, a revolving line up to $125 million [*The Wall Street Journal* 2000].

## A New Information System

When Greyhound was the market leader and millions of people rode the buses, there was little need for a comprehensive information system. The company set basic schedules and sold tickets at the station. If demand was high, the company simply added more buses and drivers. If buses ran half-empty, it did not matter, because margins were high enough to cover the costs.

With tight margins and a push for efficiency, Greyhound managers needed better data. Existing ridership data was often months old; the company needed a system to track ridership, plan schedules, and identify where it was necessary to cut prices to compete. Management also wanted to be able to sell tickets in advance, enabling customers to reserve seats.

Elements of the proposed system were similar to the issues faced by the airline reservation systems. In some ways, the Greyhound system would be simpler, because reservations and tickets would be sold only through existing terminals, or through a toll-free phone number. The airline reservation systems provide additional support to travel agents. On the other hand, a bus trip is considerably different from an airline flight. An airline passenger traveling coast-to-coast might make one stop. A coast-to-coast bus trip would probably make 10 or more stops. Each leg of the trip would carry slightly different travelers, as some got on and off at intermediate destinations. Greyhound systems analysts estimated they would have to handle as many as 1800 vehicle stops a day, more than 10 times as many as an airline system.

Greyhound management assigned about 40 full-time people to develop the new Trips reservation system. They were given a $6 million budget and slightly over a year to develop the system. Systemwide rollout was planned for the summer of 1993. Thomas Thompson, senior vice-president for network planning and operations, notes that “Every bone in my body knew that we were starting a very difficult undertaking.”

## A First Attempt

The base software for Trips was written by an outside firm. The system was a nightmare. It required 40 hours of training for station clerks. Even then, the screens were cluttered and disorganized, often requiring several screens and options to book a simple ticket. The system also did not include all of the Greyhound destinations, so clerks often had to resort to the old log books to write tickets.

Greyhound tested the system in Houston, Dallas, San Antonio, and Austin during the 1992 Christmas season. The system crashed repeatedly, and it took twice as long to issue a ticket with Trips as it did manually.

In an executive meeting in February 1993, Thompson suggested that the system needed to be redesigned from scratch. He also suggested that the planned summer 1993

implementation be delayed. But Doyle reportedly ruled out any discussion of delays, declaring that "We made these commitments, and, by God, we're going to live up to them."

Thompson now believes that he should have pressed harder for a delay or that he should have quit the company. Instead, he kept on, and all notes and references to his comments were destroyed. Doyle denies that he destroyed documents or fought against the decision, claiming that the designer team made the decision to continue.

In April 1993, Greyhound executives made public promises that the reservation system would be operational by the summer. They also filed with the SEC for a public offering of an additional 4 million shares of stock. The prospectus promised that the Trips system would make it easier to purchase tickets, reserve space and improve customer service. An unnamed executive commented on the internal climate, noting that "My clear impression was that as long as we could have some form of reservation system—as long as we could just book one reservation somewhere—then by some means, we would be living up to our obligations."

Through June 1993, the team continued to revise the software. They also installed the system in additional terminals. At the end of May, it was running at 50 locations. However, computer terminals routinely froze up. The company also changed its long-distance phone carrier and established a toll-free phone number for reservations. In June, technicians were seriously considering delaying system when Doyle walked into a meeting and said the idea was not to be discussed.

In July, the board of directors was told that Trips was ready to go. Announcement of an increase in second-quarter earnings and strong ridership numbers resulted in a 4.5 percent increase in the stock price.

## Rollout

On July 27, Greyhound activated the toll-free number service, which was to book reservations through the now-200 terminals connected to Trips. The Omaha, Nebraska service had 400 agents selling tickets, in addition to the agents at the terminals.

Systems designers were uncertain about what to expect, except they believed the system would not work. It did not. The new phone lines handled 800,000 calls a day (up from a traditional 60,000). Many of them were repeated attempts by customers to get through—callers often tried a dozen times to reach the ticket agents.

The computers in Dallas were swamped. Ticket agents sometimes had to wait 45 seconds for the computer to respond to a single keystroke. It often took five minutes to print a ticket. The system crashed so often that agents resorted to writing tickets by hand. At some terminals, passengers were told to stand in line so that their tickets could be reissued by computer.

Passengers missed connections, were separated from their luggage, and often had to sleep in the terminals. At the New York Port Authority building, competing regional bus lines called in extra buses and lured away passengers. By September, technicians pulled the plug on reservations west of the Mississippi river. On at least one weekend, they told the Omaha center not to take any more reservations.

Somewhat surprisingly, none of this news seemed to reach analysts on Wall Street (of course, most of them travel by air). On August 4, Greyhound stock was trading at $21.75 a share—that's when Doyle decided to sell 15,000 shares that he had purchased with options for $9.81 a share. In the first two weeks of August, Schmieder also exercised options and sold 13,600 shares for a profit of $155,000.

On September 23, almost two months after the introduction of the Trips system, Greyhound announced that ridership fell 12 percent in August and that earnings would not meet the early forecasts. Greyhound stock fell to $11.75 a share in a single day. Thompson was removed as head of the Trips development team. His successor lasted only until January 1994.

In May 1994, the Trips system caused problems again. Hoping to gain riders, Greyhound offered a $68 fare for any trip in the United States with a three-day advance purchase. The price attracted thousands of customers. The Trips system crashed again. With too few buses and drivers, terminals were packed with angry customers. Agents simply stopped selling tickets.

In the first half of 1994, Greyhound's operating revenue plummeted 12.6 percent, with a net loss of $61.4 million ($4.19 a share). Meanwhile, the nine largest regional carriers in the nation showed increased operating revenue of 2.2 percent. In July 1994, Schmieder announced that Greyhound would abandon the long-haul business on concentrate on shorter routes. Three weeks later, he was forced to resign. Doyle also resigned. Shareholders filed suits alleging that Greyhound's public statements miscommunicated the status of the company.

## We Can't Quit Now

In January 1994, Greyhound hired Bradley Harslem, a former American Airlines reservations executive, as chief information officer to oversee the Trips system and solve its problems. In late 1994, the revised system was running at 248 locations. Training time was reduced to 16 hours, but even Harslem sometimes had trouble using the system. When he was hired, he observed that Greyhound had to be able to compete with Southwest Airlines and should have a similar type of reservation system. Additionally, he hoped to eventually sell the reservation service to other bus lines. Harslem was hoping to add yield management features so that Greyhound could charge differential prices to maximize its revenue [Bettw 1994]. By the end of 1994, the system was finally beginning to produce ridership data to assist managers in planning and scheduling. However, it still could not guarantee a passenger a seat on the bus. The system cost at least $6 million and triggered a loss of $61.4 million for the first half of 1994 [Computerworld 2002].

## The Second Half of the 1990s

One more element of the Trips system caused problems for Greyhound. Most of the tickets are sold within three hours of a trip. Generally, passengers walk up to a station or an agent location and purchase a ticket on the spot. The problem was that the original system was networked with an expensive, relatively low-speed proprietary network. Loading several agents onto the system at one time dragged it to a crawl. Additionally, users at headquarters and the reservation centers needed three terminals on their desks because the Tandem, UNIX, and personal computers all ran on separate, incompatible networks.

At the end of 1995, Greyhound switched to a TCP/IP frame-relay network. The new network run on AT&T leased lines, provided speeds up to 1.5 mbps and reduced printing time from 2 seconds to a half-second [Girard 1996]. Because the system uses standard Internet protocols, it supports multiple applications, enabling users to rely on just one terminal.

Greyhound installed the high-speed system in 153 large bus terminals and maintenance locations. The company pays $750 per month to lease the network equipment and the

communication line. To handle communication needs at smaller, out-of-the-way locations, Greyhound set up individual Internet accounts through CompuServe at $20 a month—a substantial savings over the $200 a month they were paying for the private lines. Overall, network costs were expected to drop by 40 percent, providing a payback within 18 months [Girard 1996].

In 1997, Greyhound implemented an imaging solution from WinOcular to process more than 125,000 bus tickets per day. The Greyhound imaging department has 40 full-time workers and uses 4 high-speed Kodak scanners. Printed bus tickets are scanned and recorded to CDs. The imaging system picks off the pricing data and electronically sends it to Greyhound's Oracle database. The $500,000 project reduced Greyhound's processing costs [www.winocular.com].

## The New Century

In 2000, Ralph Borland, vice-president of marketing for Greyhound Lines observed that "We're pretty obsessed with growth. We believe the bus has a rightful place in the transportation mix for North America in this new century" [Ramage 2000]. He also commented on the problems the company experienced in the early 1990s. In particular, Greyhound had been targeting the discount airlines as its main competitors. "Until the early 1990s, we tried to be more like an airline by offering reservation systems and capacity-fixed travel. Our consumers thoroughly rejected those concepts and brought us to the brink of bankruptcy" [Ramage 2000]. By capacity-fixed travel, he means that the bus company established fixed routes and schedules. By 2000, the company had moved to a more flexible system—when passenger demand increases, more buses are added to the route. Craig Lentzsch, Greyhound's president in 2001, echoed those sentiments about the early 1990s "we didn't treat our customers right, we didn't answer the phone, we didn't give out good fare and schedule information" [Heinzl, Pinkston, and Machalaba 2001].

In 2001, Greyhound began a series of discounts to encourage more travel by some of its primary customers. Most of the passengers make under $35,000 a year—and its two biggest demographics are youths 18-24 and the senior market [annual report]. With new advertising campaigns stressing competitive prices, the company hoped to expand its passenger miles both in the United States and Canada. A 7.9 percent increase in the number of passengers in Canada was attributed to the company's $139 Go Anywhere campaign [Ramage 2001].

Along with the rest of the travel industry, Greyhound was severely hurt by the 9/11 attacks. Actually, the company experienced a 50 percent surge in traffic immediately after the attacks—largely because many people needed to get home. But, the travel numbers fell later. Greyhound's passenger numbers peaked in 2000 at 25.4 million travelers, and have declined every year since—down to 21.9 million in 2003 [www.greyhound.com]. Their financial performance has suffered even more.

In 2004, in its last Annual Report, Greyhound noted that the TRIPS system was in use at 464 locations. Elsewhere in the annual report, Greyhound stated that it had 120 company-operated bus terminals and worked with an additional 1,300 agency-operated terminals [Annual Report 2005].

In its 2006 Annual Report, Laidlaw stated that "Greyhound has initiatives underway to expand and enhance its Internet based ticket sales and package tracking interfaces in conjunction with its efforts to increase passenger and package revenue and lower operating costs" [Annual Report 2006].

In February 2007, FirstGroup, Britain's largest bus operator, announced that it was purchasing Laidlaw for £3.7 billion. The deal might be derailed by antitrust regulators because it would combine FirstGroup's U.S. school bus operations of Yellow Bus with Laidlaw's school operations, but it is likely to succeed. [Business Week Online 2007] FirstGroup had €3.7 billion in revenue in FY 2007 [FirstGroup Annual Report 2007].

## Routes and Competition

One of the more interesting issues revealed in Greyhound's 2003 annual report is that most of Greyhound's passengers come from the largest cities. In fact, the 50 largest sales outlets generated about 50 percent of the 2003 ticket sales. Already in 2003, the company began cutting routes—reducing bus miles by nine percent [2003 annual report]. The cutbacks continued into 2004 with a major announcement that Greyhound was substantially altering its routes in the United States. The press release was blunt "In the past two decades, Greyhound has not had sufficient profitability to fund its operating and capital investment requirements to be a viable company" [Press release June 25, 2004]. Notably, the company began eliminating many rural stops, and focusing on long-haul customers. If you read the 2003 annual report carefully, you will also see that the company phased out almost all of its promotions and price discounts. It is relatively clear that the company hopes to survive by seriously reducing its size.

In its 2005 Annual Report, Greyhound emphasized that "the typical passenger travels to visit friends and relatives and generally has an annual income below $35,000." Many of the passengers claim they own cars but choose the bus because of the lower cost or because they are traveling alone. "The majority of the Company's customers usually make the decision to take a trip only a short time before actually traveling and, for the most part, pay cash for their tickets one to three days before the day of departure" [Annual Report 2005].

It seems likely that Greyhound's competitors will help it decline in size. The company has already noted that some southern-state Hispanic-oriented bus lines have started encroaching on its routes. By 2004, the company was also facing stiff competition from so-called Chinatown bus companies on the major East Coast routes. The new companies offer rock bottom prices and no-frills service. Although, it is hard to say how anyone can provide fewer frills than a bus trip, the lower prices are clear. A trip from Boston's Chinatown to downtown Manhattan on Travel Pack/Lucky Star will cost only $10. Greyhound charges $30 for the trip. Although, the competitors do have to be careful; passing motor vehicle inspections is not really a frill—New York police pulled 16 buses off the road in one week. Nonetheless, the new lines have the potential to hit Greyhound hard in its prime markets. Dan Wong, a student who frequently rides the buses comments that "I don't know why anyone would take Greyhound. This is much cheaper" [McLure 2004].

By 2007, many of the competitors have increased prices to cover costs—particularly the huge jump in fuel costs. But LimoLiner, a new regional competitor offers direct service between Boston and New York—with a twist. The bus has only 28 seats and every one has a power outlet for laptops. It has wireless Internet connections and satellite TV [DeJean 2005 and limoliner.com].

## Trips Is Working

In its 2003 annual report, Greyhound notes that its Trips system continues to work. The automated fare and schedule quotation and ticketing system was in use at 434 locations.

On the other hand, Greyhound had 130 company-operated bus terminals and 1,520 agency-operated terminals, so Trips is being used in about 22 percent of its locations. The company also maintains a staff of 400 people just to handle phone inquiries and reservations. The telephone centers and website handled 40.1 million requests in 2003 [annual report]. The annual report also recorded a cost of software of $55.9 million, with an accumulated amortization of $33.0 million in 2003. The software cost number was $5 million higher in 2003 than in 2002. The report does provide a breakout of the software costs, and part of those costs likely include other software purchases.

## Case Questions

1. List all of the things that Greyhound did wrong.

2. What were the primary causes of the problems?

3. If you were running Greyhound, what could you have done differently to prevent or minimize the problems?

4. Because no one can change the past, what would you suggest Greyhound do now to solve its problems?

5. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

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## Blockbuster Video

In 1985, Blockbuster Video (ticker: BBI) quickly became a sensation. Households had just begun to acquire video-tape players in earnest. Few people were willing to pay $85 to buy Hollywood videos. Cable TV existed, but most people still watched broadcast television stations, and only a few premium Cable channels existed. Satellite receivers existed, but the huge satellite antenna was generally only used by people who lived in the middle of nowhere and had the space to put the ugly dishes. Customers quickly jumped onto the idea of renting videos. The early market was dominated by small mom-and-pop rental shops that bought a few copies of hit movies and rented them in a small regional area. For a while, video-rental stores had a tinge of disrespectability because many of them rented adult videos.

Then, Blockbuster Video went national with large, bright, well-lit stores. To remain family-oriented, the chain does not carry videos with anything more than an "R" rating. Blockbuster quickly took over the market. The original system pioneered the use of bar codes. Customers carried a bar-coded ID card and movie cases were printed with specific codes. The computer system made checkout easy and enabled people to return videos after-hours simply by placing them in a drop box. The company initiated a three-night, $3 rental program, making it easier to rent videos for the weekend.

### A History of Growth and Problems

Blockbuster was started by David P. Cook, a Dallas computer expert who wanted to develop a big, bright, computerized video superstore. H. Wayne Huizinga purchased a stake in the company in 1987, became its chairman within months, and was the catalyst for its growth. Huizinga is the son of Dutch immigrants and began his career driving garbage trucks. He started a garbage business in Miami that merged with his grandfather's in Chicago. At one point he went on a buying spree and bought 90 garbage companies in nine months. Ultimately, he merged all of his companies together into Waste Management Corporation. Huizinga applied the same fervor to the purchase and opening of video stores. In 1987, Huizinga moved the corporate headquarters to Fort Lauderdale, Florida; overseeing 200 stores at that time.

At the end of 1990, Blockbuster owned 787 stores and franchised 795. Even so, it represented only 11 percent of the market. As a result, Blockbuster Company executives planned to open 400 stores per year and double the market share over the following three years.

In 1994, Huizinga sold Blockbuster Video to Viacom for $8.9 billion [Shapiro 1997]. Headed by Sumner Redstone, Viacom is an entertainment industry giant, with ownership in movie studios (Paramount), cable television, television broadcasters (CBS and UPN), and radio stations (Infinity).

By 1997, the business slumped. Redstone eliminated two-thirds of the corporate jobs and moved the headquarters back to Dallas [Shapiro 1997]. Although criticized by many, Redstone defended the merger. One of the more interesting perspectives is that in those three years, Blockbuster generated $1.5 billion in cash flow—largely used to pay down the debt used to purchase Paramount. In other words, Redstone used Blockbuster as a cash cow—milking the revenue stream to pay for his other acquisitions. In 1997, Viacom took a charge of $300 million to write down inventory at Blockbuster [*Wall Street Journal* 1997]. Redstone told stockholders he would sell off Blockbuster within a year.

What happened in three years? The biggest change was changing rental patterns. As more households acquired cable TV, customers no longer wanted to rent older videos. Instead, everyone wanted to rent the same two or three hit movies on the weekend. Blockbuster originally had strength by investing in a wide collection of titles. With the new approach, customers only cared about the new releases. That meant that Blockbuster needed to buy hundreds of copies of a single title. But, at $65 a tape, those costs were high—and after about a month, people moved on to rent the next release, so the store no longer received money to cover the original purchase price.

In 1997, CEO John Antioco found a solution. He negotiated a deal with the leading Hollywood studios. Blockbuster would purchase tapes for $6 upfront, then give the studios 40 percent of the rental revenue. The deal gave Blockbuster a huge advantage in the market for new releases. Blockbuster advertised that customers would always find specific new-release titles in stock, or they would get a free rental on the next trip. Competitors could not match the cost savings. About 2,500 of them (10 percent of the U.S. market) went out of business [Harnish 2003]. The deal also required Blockbuster to carry every title released by the studios [*The Wall Street Journal* 2001].

The interesting point of videos is that by 2000, the movie studios were making more money at the rental counter than at the theater. Home video was brining in $2.9 billion in revenue, versus $2.2 billion in the theaters. So, the studios had a huge incentive to build stronger ties with the leading video rental company. Given the new cash flow, Redstone decided to keep Blockbuster, having sold off only 18 percent of its shares.

But, entertainment technology rolled on. By 2001, the world was quickly switching to DVDs for movies. In late 2001, Blockbuster again had to write down its inventory of tapes (and many video games) by $450 million [*The Wall Street Journal* 2001]. Eliminating 25 percent of its VHS inventory, the company moved into DVDs. The growth in DVDs continued. By early 2002, U.S. consumers had purchased over 31 million DVD players [Orwall, Peers, and Zimmerman 2002].

The catch with DVDs is that the movie studios radically altered their strategy. Instead of emphasizing the rental market, the studios released new movies on DVD for sale at $20-$30 each. Additionally, DVDs do not deteriorate with playing, so customers feel it is easier to simply purchase the DVD. The discount chains or Wal-Mart, Target, and Best Buy jumped into the deal and use the big movies to lure shoppers into their stores. DVDs a few months old often sell for as little as $10. Hollywood is torn—while they make money on each sale, the companies no longer receive the ongoing rental income. The deal with Blockbuster never applied to DVDs. The big retailers are happy and will fight any changes. Wal-Mart spokesman Jay Allen notes that "Wal-Mart will not be happy if the prices start inching up. Our customers want fresh DVD product for under $20. You can't put the genie back in the bottle" [Orwall, Peers, and Zimmerman 2002]. Warner-Brothers is one of the drivers for low pricing. In effect, trying to wrest control of the rental market away from Blockbuster. Warren Lieberfarb, CEO of Warner Home Video noted that Blockbuster controlled 40 percent of the rental market and often used that clout in negotiations with Hollywood, using "that share to increase their margins at the expense of the studios" [Orwall, Peers, and Zimmerman 2002].

In 2006, most of the videos (81.8 percent) rented through Blockbuster were purchased under revenue-sharing arrangements. Game titles under revenue sharing reached 51.5 percent in 2006. The arrangements mean that Blockbuster pays a smaller purchase fee, but a negotiated percent of the rental fee is paid to the studios [2006 Annual Report].

In 2002, customers spent considerably more on DVD purchases than on rentals—a first for the industry. Retail sales reached $12.26 billion and rentals slipped to $9.92 billion [Peers February 2003]. Feeling the squeeze on rentals, in early 2003, Blockbuster responded by moving more into sales. Yet, in 2002, Blockbuster made 80 percent of its revenue in rentals (and late charges). Rentals are profitable, with a margin of 65 percent, versus 15 percent in retail sales. In 2002, Antioco pushed Blockbuster into sales, selling both new movies and previously viewed titles. Antioco knows he cannot compete with Wal-Mart—which has a 20 percent market share in DVDs. He notes that "What we are about is convenience, selection" [Peers February 2003]. Mr. Redstone was not convinced observing that "we have decisions to make. Do we spin (it) off? Do we sell it? There are companies who would buy it. Do we keep it? Do we buy it in? We don't know the ultimate answer. We should be very careful, skeptical, and questioning about the future of Blockbuster" [Peers February 2003]. At the end of 2003, Blockbuster had $4.5 billion in revenue from rentals and $1.3 billion from sales of merchandise [www.blockbuster.com].

In the meantime, Viacom got serious about divesting Blockbuster. In the third-quarter of 2003, the company experienced a 9.1 percent drop in same-store revenue [Peers December 2003]. In a press release on June 18, 2004 [www.blockbuster.com], Viacom announced that it would split off Blockbuster. Viacom shareholders could exchange Viacom shares for the new Blockbuster shares. The deal was designed to be completed in the third quarter of 2004. After Blockbuster was spun off from Viacom, the new company wrote off the Goodwill accounting valuation of over $1 billion because the market value of Blockbuster had declined since the Viacom purchase. Rentals were also dropping in 2004 [Peers 2004].

In 2005, in an attempt to regain customer support, Blockbuster dropped late fees. Late fees made up almost half the revenue at many stores, so the immediate impact caused a decline in revenue. CEO Antioco also reported that Nigel Travis quit as president. Blockbuster needed a way to slow the tide of customers running to Netflix [Wall Street Journal December 14, 2004].

At the end of December, Blockbuster announced its intention to try and purchase Hollywood Video [Wall Street Journal December 28, 2004]. Blockbuster ultimately lost its bid when Movie Gallery purchased Hollywood Video on April 22, 2005 [Hollywood Video Web site]. Also in April 2005, Carl Icahn had purchased enough shares to become Blockbuster's biggest shareholder. Mr. Icahn has a history of buying large stakes in firms and breaking them up or forcing the board to make major changes. He immediately proposed two new candidates and himself for Blockbuster's governing board, running against Antioco. Mr.Icahn suggested that the company was poorly run and that the company could generate income for many years to come. Noting that the market for renting videos in stores is down 17 percent from 2001 to 2005, Mr. Icahn wanted Blockbuster to tighten up its control and spending, freeing up cash to pay dividends to investors. He argues that many of the investments made by Blockbuster were foolish, stating that "the way they're doing it helter-skelter is sort of a buckshot approach" [Peers 2005]. In July 2007, Blockbuster appointed James W. Keyes as chairman and CEO. Mr. Keyes was former-CEO of 7-Eleven. Carl Icahn praised the selection, although it is not clear how Jim's experience in the gas and convenience store industries will translate to video rentals [press release July 2, 2007].

High definition TV represents a huge unknown, but possibly huge potential, for video stores. Antioco in early 2007 predicted that "we think that high-definition DVD is going to be a significant part of the business starting in late 2007 and then picking up real mo-

mentum in '08" [Jones 2007]. Of course, the company is fighting confusion over which version of DVD to carry: HD-DVD or Blu-Ray. In 2007, the company decided to focus on Blu-Ray, dropping HD-DVD from its stores because of lack of sales [LaGesse 2007].

## Netflix

By 2003, the DVD rental market became even more tangled. Netflix (ticker: NFLX), an e-commerce startup, threatened the entire rental model. Netflix customers sign up on the website and enter a list of preferred movies. They pay a monthly fee (about $20), and Netflix mails them up to three DVDs. Customers keep the movies as long as they want—with no late charges. When they return a movie (postage paid), Netflix looks at the list and ships them another one. By 2003, Netflix was shipping 300,000 DVDs per day to over one million subscribers; accounting for almost five percent of the U.S. home rental market. Netflix faces the same problem Blockbuster had—it cannot stock enough of the new release titles to keep all customers happy. However, it simply ships another title on the customer's list, so customers get at least something that they want. The process means that Netflix circulates 98 percent of its 15,000 at any point in time [Null 2003]. Blockbuster (and Wal-Mart) ultimately responded with similar programs. However, Netflix remains the leader—largely from word-of-mouth support by its existing customers.

In 2004, Blockbuster tried a new technique to fight Netflix: trade-ins of DVDs. Since DVDs effectively do not wear out, the quality of used copies is as good as the original. The company tested the system at a few U.S. and Scottish stores, and decided to roll out the program to 2,000 U.S. stores [*Marketing Week* 2004].

In 2005, Wal-Mart dropped out of the online video rental business that it started to compete with Netflix. Wal-Mart also noted that DVD sales were growing rapidly, and that it had the potential to dominate sales of DVDs [Hansell 2005].

In November 2006, Blockbuster launched Total Access as a means of competing with Netflix. For about the same fee as Netflix, customers can order movies by mail but can also return them to their local Blockbuster store for new movies. With heavy advertising, Blockbuster added 700,000 subscribers in the last two months of 2006 [Jones 2007].

Despite intense competition, Netflix has been able to survive and grow, achieving revenues of $1 billion in 2006. CEO Reed Hastings noted that the company rents out 1.5 million DVDs a day. Yet, Mr. Hastings points out that he, along with many others, believe DVD rentals will eventually disappear. Consequently, the company is investing $40 million to provide 5,000 films for download in 2007. Mr. Hastings also observed that the competition is unrelenting, stating "we have to recognize that now there are tens and maybe hundreds of start-ups who think that they're going to eat Netflix's lunch. The challenge for a management team is to figure out which are real threats and which aren't." Yet, the market growth potential is still enormous. He forecast subscriber growth of 2 million for both Blockbuster and Netflix [Wingfield 2007].

The battle between Blockbuster and Netflix is only beginning. In 2007, Blockbuster announced a lower-priced online option to undercutting rates at Netflix by $1 per plan. Most analysts suspected that Blockbuster could purchase market share with the price but not make profits [Pruitt 2007]. Additionally, several customers have been critical of the procedures used by Netflix to control rentals. Netflix specifically states in its terms of contract that new shipments will be delayed to customers who rent the most often [Elgan 2006]. You can also search the Web for complaints against Netflix. On the other hand, Netflix is trying to find ways to improve its recommendation system. In late 2006, the company

created a contest, offering $1 million to a team that can use movie ratings by customers and other data to make recommendations to customers regarding new rentals [Gonsalves 2006].

## Blockbuster Technology

Blockbuster's original barcode checkout system was written for a Digital Equipment Corporation Microvax running FORTRAN code. The checkout terminals were simple DEC terminals. Each Microvax is tied to a Digital cashier system, printers, a manager's workstation, and a modem. Blockbuster Video was not online. Each store was called by the corporate headquarters twice a day. Blockbuster maintained this arrangement because it was simple, solid, reliable, replicable, and consistent.

As the CIO of Blockbuster in the 1990s, H. Scott Barret's goal was to keep the organization "technology appropriate." He believes there is a "herd mentality" about client-/server systems and has publicly questioned the financial return on this additional investment. In his opinion, many companies are pressured to implement client-server by the collective weight of hype issued by the press and vendors.

In 1990, Blockbuster planned to categorize its 30 million customers according to the types of movies they rented and to "sell information from the database ... to direct mailers, for planning target-marketing campaigns." Blockbuster used sophisticated computer systems to keep records of each individual's transactions. The plans raised difficult privacy issues for the same reason it would prove to be a gold mine for direct mailers. Video choices are among the most revealing decisions a consumer makes [*Wall Street Journal* 1990]. While a federal law forbids video stores from disclosing the names of the movies its customers rent, it does not forbid stores from telling direct marketers "the subject matter" of the movies a customer has rented. Blockbuster, whose members represent one out of six American households, says its database will be legal because it monitors video categories, not specific titles. In 1990, the chain organized its shelves by 37 categories, with plans to add 30 to 40 more.

Blockbuster ultimately implemented client-server, to recapture the major benefit offered by its legacy system, a consistent retail systems architecture. In 1994, Blockbuster acquired a music store business that ran different systems and had different requirements than its video stores. The music stores came with five different PC-based systems. Blockbuster Video wanted to get back to a single system for all its stores. To standardize its retail systems, Blockbuster worked with Microsoft and Oracle to build a Windows NT-based retail system to be implemented throughout its stores worldwide. As it migrated to client-server, Blockbuster maintained its traditional host architecture. All processing occurs on the server; client computers are relatively dumb. Blockbuster was looking for other benefits from moving to client-server: reduced training; reduced support costs; and access to more advanced technologies, software, and graphical user interfaces.

To further its ability to track its customers, Blockbuster tracks every single customer's rental history, every single store's daily business, and every single store item's sales record. Data on more than 40 million customers gives Blockbuster an important source of information on consumer demographics and purchase decisions.

With a consolidated database, Blockbuster turned to Hyperion's Essbase analysis software. The company uses the tools to analyze things like the effects of weather on rentals and exploiting peak rental times. The company originally estimated that it could save $30 million in operational costs over the life of the project—largely by automating the data analysis [Songini 2001].

In its quest to become the neighborhood entertainment source, Blockbuster uses its extensive consumer database to select the product mix. "The goal is neighborhood retailing and the customization of each product for each store," says marketing manager, Baskin [Desjar, 2001]. "The key is to cater to the local market and service the local customer." Baskin says the chain has the "strategic advantage" of knowing the entertainment buying habits of half of the households in the United States. Managers at individual locations will have the most input on which products to stock. "Having unmatched demographic information is a great guide, but it's not a silver bullet," says Baskin.

Blockbuster tried to diversify by expanding into music stores. It even attempted to add book sales, tailoring the titles to specific locations. In 1999, after consistently losing money, Blockbuster sold all of the music stores.

In 1999, Blockbuster outsourced the main order-management services for its website to OrderTrust [Bacheldor 1999]. The company provides the software and security to handle the sales transactions. It also provides links to multiple suppliers. Consequently, the Blockbuster site can advertise many different products, and the orders can be routed to separate suppliers.

Blockbuster handles almost all of its videos and games through its distribution center in McKinney, Texas. The system mechanically repackages movies and games to standardize packages for rental. The company ships movies to a third-party delivery agent for final distribution to stores. The company also operates 35 smaller distribution centers across the U.S. to handle the online rentals. Company-owned stores tie their POS systems directly to a data center at the distribution center, transmitting sales data at the end of the day. The system uses the data to optimize the supply chain in terms of ordering new movies and shipping in-demand items to stores [2007 Annual Report].

## Video Game Market

In 1994, Blockbuster formed a joint venture with IBM called NewLeaf Entertainment. The goal was to develop a new way to rent video games and even music. Retail stores, such as Blockbuster, would host a server that contained all of the video games. Customers would select a game, and the system would burn a copy onto a cartridge or possibly a CD-ROM. The NewLeaf system could stamp out any Sega Genesis game on a blank cartridge in less than a minute. The system eliminated the inventory problem and made it possible for every customer to leave the store with a game in hand and money safely deposited in the cash register.

NewLeaf president David Lundeen, hoped to expand the NewLeaf system beyond the rental market into toy and electronics stores. He envisioned stores being able to sell children their first game on a rewritable cartridge for approximately $70. When children tired of the game, they could bring the cartridge back to the store where a salesperson would use the NewLeaf system to reprogram it with a new game for a lower price, perhaps $30. The stores and game publishers would make more profits through additional sales and lower materials costs. The game players would save money and be able to play more games. NewLeaf would make money selling its system.

NewLeaf's server was designed to support rewritable CDs as well as cartridges. Lundeen presented this option to the music industry for adaptation to the audio CD market. However, an earlier proposal to the music industry by a different company was turned down, largely because the industry feared loss of sales due to illegal copying. The system was ultimately abandoned.

## Blockbuster Video Enters the CD-ROM Market

Blockbuster Video test marketed a new program in 57 company-owned stores in its San Francisco market. As part of the trial, Blockbuster stocked more than 200 CD-ROM titles from more than 37 software publishers. These included Compton's NewMedia, Software Toolworks, and the Voyager Company. Fast-action games proved to be most popular. Titles ranged from games and adventure to education, entertainment, and reference. Each of the stores carried five different hardware platforms: Panasonic's Real 3DO Multiplayer, Sega's Genesis CD player, Philips' CD-I platform, Apple's Macintosh TV and IBM's PS/1 computer system.

Blockbuster carried a range of action and strategy games, educational programs, and reference works. For $4, any program could be rented for three evenings. Blockbuster charged $14.95 to rent a SEGA, Magnavox, or Panasonic CD player, and $19.95 to rent a player and three programs for three evenings.

Blockbuster's business model for the pilot was based on extensive research in tracking consumer profiles and buying habits at its stores. Research indicated that the average Blockbuster customer profile is one that every multimedia publisher desires. Typical customers are in their mid-thirties, are married with children, and have median incomes of more than $50,000. The percentage of Blockbuster customers with personal computers in their homes is nearly two times the national average. Additional data that convinced Blockbuster to pursue new media markets came from the game industry. Sega concluded that three out of five of its video games are rented before they are purchased. *Gaming* magazine and *Game Pro* both found that more than 80 percent of the people they questioned would prefer to rent game cartridges and CD-ROMs before buying them.

## Blockbuster Video Enters the Modem Market

Realizing that the video rental market is particularly susceptible to technological change, Blockbuster Video became a substantial investor in Catapult Entertainment. Based in Cupertino, California, the venture's first two products were a modem for 16-bit game consoles and an online service to connect them. The modem plugs into a console's cartridge port and includes a port for a second cartridge. It was available for Sega Genesis and Nintendo's Super NES. Catapult positioned the system to support existing multiplayer games without modification. Players inserted a game into the modem's own cartridge port and then dialed into Catapult's network. There, they were paired with a connected opponent who had the same game cartridge installed, and with whom they could exchange messages while playing. The service was available for a monthly base fee for a fixed number of games.

Blockbuster's research indicated that players buy games for their competitive aspects; competing via the phone lines was expected to be popular. Catapult cost $5 to $10 per month to play, paid by check, credit card, or cash using a rechargeable Smartcard that functioned like a debit card. The card was charged at a retail outlet and then debited when inserted into the Catapult modem. Parents could control game play by setting spending limits on the account or on the Smartcard.

## Games Today

Of course, the problem with all of the fancy game technology is that the underlying hardware world changed. Sega and Nintendo slipped from view as the Sony Playstation and Microsoft X-Box, along with PCs, conquered the gaming world. Additionally, fear of mass copy-

ing scared most vendors away from the technologies. Finally, the Internet made it possible for game machines and personal computers to connect directly to each other or through central game services—without the need for cumbersome services. In the meantime, Blockbuster still rents games—but they are handled much like DVDs, where everyone rents an original copy. With increasing competition for video rentals, Blockbuster began focusing in 2003 on game rentals. The company also buys back used games and videos for resale [Peers 2005].

## Blockbuster Experiments

One thing you have to say about Blockbuster management is that they appear to have tried almost every retailing option under the sun. In 1996, new chairman Bill Fields, fresh from a stint at Wal-Mart, decided that videos were not the answer. He even removed the word "Video" from the store's name in advertising. His goal was to make the stores a neighborhood entertainment center. But, he also stocked the shelves with CDs, movie merchandise, and candy [Goll 1996]. Ultimately, the retail attempts were failures and irritated the customers. Fields did not survive long.

For a while, the company even tried using its ties to the other companies in the Viacom stable. Blockbuster had acquired several hundred music stores that it tired to merge into the system. Since Viacom owns MTV and VH1, Gerry Weber, one-time president of Blockbuster Music, tried to get help in lining up emerging singers to support the stores. He commented on the failure of MTV to respond "As far as getting any leverage from being associated with MTV and VH1, it just didn't exist. I often felt I would have been treated better if I had not been part of the company" [Shapiro 1997]. Ultimately, facing severely declining sales, the music division was sold to Wherehouse.

In 1998, Blockbuster launched an EntertainmentMinder service for customers. Clients could subscribe free and receive weekly messages about new video, music, or game releases. They could also receive special offers. Remember that the Blockbuster system tracks all rentals by customers, so the company can evaluate the success of its promotional campaigns [Diederich 1998]. Although the name has been changed, most of the features remain with the e-Newsletter system.

In 2001, Blockbuster again turned to retail sales—this time with Radio Shack as a partner. Radio Shack created its own small stores within several thousand Blockbuster stores. The Radio Shack stores will remain independent and have their own sales staff, inventory control, and POS systems. The main goal for Radio Shack was stated by Radio Shack's CEO Leonard Roberts as "access to more than 3 million Blockbuster customers each day, including more women and young adults" [Ulfedler 2001]. In exchange, Radio Shack gives Blockbuster a license fee for using the space.

## Alternative Video

Almost since the beginning, some people have predicted that Blockbuster's life span is limited. In theory, new technologies should remove the need to rent videos—or at least make it easier, so that customers do not have to physically pick up and return the tapes or DVDs. Cable TV, satellites, and pay-per-view have been some of the biggest threats. As the home-delivery systems add channels and multiple pay-per-view movies, people can easily rent the same video directly. Of course, the systems do not provide total control to the viewer—there is still limited selection and a limited number of start times.

For over a decade, technologists have hyped video on demand. A concept where customers would be able to have any movie delivered digitally at any time—for a fee. Several companies have attempted to create these systems. Some even suggested that videos could be sent down phone lines to a customer's television set. Several companies experimented with sending video over the Internet. It was always a stretch to believe that people would want to watch movies in real time over the Internet on their personal computers. It was even more of a stretch to believe that the bandwidth existed. An early 2000 report suggested that if 100,000 people simultaneously watched a 30-minute video online, it would hog five percent of the Internet's bandwidth [Kontzer 2001]. Streaming video technologies have improved since that time, but the Internet was never designed for broadcast signals—where everyone watches the same thing from one server at the same time.

Blockbuster tried to jump into the game and in 2000, signed a 20-year partnership with Enron Corporation to deliver video on demand [Li 2000]. The deal quickly died, even before Enron crashed and burned in the giant accounting scandal. The subsequent arrangements left Enron feeling less than satisfied, and it broke off the relationship. "From Enron's standpoint, the main reason for discontinuing the relationship had to do with content," said Enron spokeswoman Shelly Mansfield. "We just felt that, through the exclusive relationship, we weren't able to attract the quality or quantity of movies that is necessary to really make this service thrive." According to media analyst Tom Wolzien, "Nobody has a network to the consumer here, and Blockbuster couldn't get the movies" [Kerschbaumer 2001]. Blockbuster executives were probably happy the relationship fell apart before Enron's accounting scandal and collapse in 2002. Blockbuster also tried to setup a deal with MGM in 2000 to stream recent releases from that studio off its website [Tedesco 2000]. The deal never really made it past an experimental test, and downloads of movie trailers (previews).

In 2004, you can actually watch some movies from your PC, through Movielink.com, a studio-sponsored site. The system uses Microsoft's digital rights management technology to protect a downloaded video file. You do not have to be connected to watch the movie. Instead, you download a one-half gigabyte file and can watch it as often as you like within 24 hours. To reduce download times, the quality is substantially below the level provided by DVDs. And, relatively recent releases rent for a whopping $5 [www.movielink.com].

One of the stranger relationships that Blockbuster entered was a partnership with DirecTV, the digital satellite provider. In 2000, the company began signing up subscribers at its Blockbuster Video stores. CEO Paul Antioco stated that "Our goal, which we are highly motivated to achieve under this agreement, is to add significantly to our financial outlook by having as many Blockbuster customers as possible subscribe to DirecTV and enjoy movies over pay per view" [Scally 2000]. Since the movie studios own the rights to the videos and would presumably make most of the money on pay-per-view, it is not at all clear how this step was going to generate money for Blockbuster. On the other hand, at that time, Blockbuster did receive some revenue for selling the base systems. Today, the satellite companies provide the equipment and installation free—and Blockbuster no longer pushes the sales.

In 2006 and 2007, Netflix began renting movies directly over the Internet. Although the download times were relatively slow, customers could download and watch a video on their computers as streaming video. In 2007, before he lost his job, CEO Antioco announced that blockbuster would also offer a digital download service sometime in 2007. It is not

clear if the system will actually be offered or if customers will pay to wait hours for a video to download [Jones 2007].

In 2006, consumer spending for in-home videos was estimated at $25.5 billion, a slight increase from the $25.2 billion of 2005. Of that total, about $1.4 billion represented pay-per-view and similar services. About $16.9 billion came from the sale of movies, leaving $7.2 billion for in-store and online rentals [2007 Annual Report].

In 2005, an interesting new competitor entered the market, but you probably did not hear about Red Box until 2007. Red Box is a standalone machine-operated DVD rental system that makes it easy for anyone to rent videos for $1 a day. The company has signed deals with several grocery chains and McDonalds to provide locations for the machines. Customers can rent videos from any box and return it to any box. Of course, the list of titles is limited to the storage capabilities of the boxes (about 500), so it is likely that the company will stock current releases. But, those are exactly the titles most commonly rented at Blockbuster, so it puts Red Box in direct competition. Ultimately, Red Box can gain a substantial advantage in terms of location. It is considerably cheaper to install machines around town than to build new stores. And the labor costs are considerably lower—basically just updating the movies or restocking the machines a couple of times a week. Plus, Red Box is largely owned by Coinstar, the company that installs and maintains thousands of existing coin-operated systems including the skill-cranes and kids rides you see at various retail stores, so the company already has the labor and distribution networks in place. The rest of Red Box is owned by McDonald's Ventures, and in 2007, the machines began appearing at my McDonald's restaurants [Coinstar 2006 Annual Report].

## Case Questions

1. What business problems are faced by Blockbuster video?

2. What types of data do they need to collect? How is it collected? What types of reports are produced?

3. Why did the games systems fail?

4. How could Blockbuster use its customer database to increase revenue or profits?

5. Will video stores be around 10 years from now?

6. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

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## Federal Aviation Administration (FAA)

### Aging Technology in an Increasingly Complex Environment

The Federal Aviation Administration (FAA) is charged with overseeing all public (nonmilitary) flight operations in the United States related to safety and access to the air. The agency establishes safety criteria, issues licenses for pilots, and provides air-worthiness certificates for planes. The agency also operates the air traffic control system throughout the United States. Funding for the agency is generated through user fees and taxes on aircraft fuel, tires, and airline tickets. By 1990, the Aviation Trust Fund held $41 billion, built up from the prior 20 years. By 2006 that value had declined to about $11 billion [Budget in Brief 2006]. The FAA is an executive agency and theoretically operates under the direct control of the U.S. president. However, tax rates and expenditures are established by Congress. Over half of the Trust Fund money comes from excise taxes on airline tickets. With average prices declining, the amount of revenue declined in the early 2000s. the authorization for the Trust Fund taxes expired in 2007 and the FAA began arguing for a new funding mechanism in 2005 [Budget in Brief 2006].

Since 1960, the FAA has exerted control over all commercial airliners from takeoff to landing. Once they take off, planes are tracked in the following ways:

- By tower controllers with binoculars and local radar.
- By controllers in terminal radar approach controls, or Tracons, that may serve airports.
- By controllers in the 20 air route traffic control centers around the country.

Controllers in the airport towers, Tracons, and control centers share data from a nationwide network of radar installations. They use a network of radar installations to talk to the planes. In 2005, with the launch of several startup commercial space ventures, the FAA was also charged with inspecting their facilities and coordinating launches to avoid accidents and injuries.

Air traffic control in the U.S. is an exceedingly complex problem. In 1994, the 300 major airports generated 50,000 flights a day. The air traffic control system is responsible for scheduling the takeoffs, landings, and flight paths of all these flights. In 1990, 466 million passengers a year were flying on U.S. airlines. In 2002, the airlines carried 714 million paying passengers. With more airlines and more daily flights, the air traffic control system is dealing with more difficult problems every year. The busiest airports (Atlanta tops the list) cause even more complications—trying to schedule hundreds of flights per hour.

Traffic control is organized into three levels: nationwide U.S. airspace, 20 regional air traffic centers, and individual airports. Air traffic control operators at each airport have immediate control over takeoffs and landings. Regional operators watch traffic within their defined air space. Systemwide control is provided by the Central Flow facilities located in Washington, D.C. The Central Flow managers examine traffic across the entire United States and resolve conflicts and problems that arise between regions. The 40 traffic management specialists plan each day in advance, creating alternative routings for problems arising from snowstorms, accidents, and closed runways.

## Early Systems

The early traffic control system was built with hardware and software from Sperry-Rand/Univac, a computer company that was purchased in the mid-1980s by Burroughs. The combined company is now called Unisys. The airport-based traffic control computers were based on a 256K bytes of main memory and performed 500,000 instructions per second. The original systems were installed in the early 1960s. The 20 regional centers had their own computers—IBM 9020 machines that were custom made for the FAA in the 1960s.

## Improvements

In 1981, the FAA was given approval for a comprehensive new plan to upgrade the computer system. New airports, such as Dallas-Fort Worth coupled with deregulation of the airline industry in 1978 led to huge increases in air traffic. The $12-billion plan called for replacement of 12 major systems during the course of 12 years. An additional 80 smaller projects were included in the plan.

By 1990, only 1 of the 12 systems had been replaced and the project was $15 billion over the original budget and was an average of four years late. The one project that was completed was known as Host, because it called for replacement of the mainframe computers at the 20 regional control centers. IBM installed its 3083 mainframes on schedule but was $16 million over budget. Even then, the 3083s were technologically obsolete at the time they were installed, because the newer IBM 3090-class machines had been available for a year.

In 1982, the White House Science Council examined the problems being encountered by the FAA and ordered the agency to

> *engage a prime contractor to formulate performance goals, design specifications and systems integration, [including] design, implementation, and maintenance of hardware and software . . .*

The council's goal was to force the FAA to hire an outside contractor, rather than attempt to hire its own staff and build the system in-house. The FAA chose not to accept the advice, allegedly because the agency found it difficult to separate the new system from the existing processes. Martin Pozesky, assistant administrator for the upgrade program at the FAA claims that

> *We would have had to turn over the current air traffic control along with the modernization plan and then have [the contractor] turn it back to us at the end.*

Instead, the FAA gave a $3.6-billion contract to IBM in 1988 to build the new system. Other subcontractors were involved both directly with the FAA and indirectly through IBM. In terms of managing the process, the FAA subcontracted to Martin Marietta for advice but did not give the subcontractor control over the contractors, such as IBM, that were working on the new system. When the six-year contract expired, the FAA issued a new $139 million contract with TRW to provide additional advice and day-to-day management.

This lack of oversight and control is somewhat surprising, given the negative evaluations that were given the FAA for prior contracts. In 1980, the Senate Appropriations Committee noted that

> *The FAA has no ongoing, well-defined and systematic management approach to evaluating software and operational cost, capacity, and performance of the current system to meet projected short-range workloads.*

The General Accounting Office (GAO), the watchdog of Congress, echoed that sentiment several times later.

## Problems

The computer systems to run the air traffic control system were originally written in 1960. Because the computers and the programs are now 35 years old, serious problems exist in their continued operation and maintenance. The FAA is still operating equipment with vacuum tubes, dense webs of wiring, thousands of circuit boards, and other out-of-date components. This equipment often stumbles or breaks down completely. In 1994, there were at least 11 times when the systems failed completely. This situation leaves the air traffic controllers with no means to keep airplanes separated and flying on course.

The influx of young technicians who were hired in 1960 are now facing retirement. This issue is exacerbated by the firing of those air traffic controllers who struck the government under the auspices of the PATCO Union in 1980. Many of the technicians who could retire did so in 1995 or 1996 because Congress planned to cut the retirement benefits of those who retire subsequently after this time period.

Few technicians are in training and there is no one to hire from industry because some pieces of the equipment are so old that they are used nowhere else. The FAA stopped training technicians to repair them years ago. Parallel to this, the FAA is cutting back on maintenance and repair. To reduce costs and the need for technicians, equipment is going unattended on night shifts.

Breakdowns occur with increasing frequency. Some are obvious only to pilots because they are told to wait on the ground or to increase spacing in the sky. This enables controllers to reduce the traffic to a level the antiquated equipment can handle. Others are obvious when there is no controller's voice at the other end of the radio. When this happens, pilots must switch frequencies to reach the controller they left.

A near collision in 1995 underscores the seriousness of the situation. Faulty equipment in San Juan, Puerto Rico, led a controller to direct to planes toward a head-on collision. This was only prevented by the plane’s on-board collision-avoidance systems.

The National Transportation Safety Board sent investigators to the Aurora, Illinois, center as well as others to investigate the safety issue. Aurora is 1 of 20 high altitude and intercity control centers across the country.

Even newer equipment has problems. Eleven failures have occurred since a 75 minute power failure September 14 at the Chicago Air Traffic Control Center in Aurora. Power failures have also occurred at the Ronkonkoma, Long Island, and Oakland, California, Chicago, Washington, and Fort Worth centers. The unions representing the controllers cite failures at centers in Miami, Los Angeles, and San Juan. Union officials cite their ability to make-do with equipment so old there are no spare parts commercially available. Neither the manufacturer nor third-party vendors service it. Jack Johnson, president of the Professional Airways Systems Specialists, has stated that inadequate maintenance is responsible for the growing number of failures and long repair times necessary to rectify them.

A study of the New York Center concluded that the IBM 9020e had failures 90 times between January 1992 and June 1993. This was particularly crucial because this is the section of the system that takes radar and flight-plan data from the mainframe and delivers it to the controllers’ screens.

Since 1993, the FAA has reduced its annual budget by $600 million nationwide and has cut its workforce from 53,000 to fewer than 47,000.

The FAA continues to defend its cuts in the technician force, even though this results in cuts in maintenance. Consequently, parts that break tend not to get fixed. Equally important, careful records are not kept of how often each part needs service. According to Stanley Rivers, deputy director of the Airways Facilities Service of the FAA, the FAA cannot afford to have technicians do repairs that are not necessary or are redundant.

At the Air Traffic Control Center in Aurora, of the 55 technicians, 24 are eligible to retire immediately; 5 more will be eligible within three years. The last time someone was hired was three years ago; it takes three to five years for a new technician to be qualified.

Because of the critical situation in the Chicago Center, the FAA wants to transfer 50 people from other centers to augment the current 400-controller staff. According to Mark Scholl, the top union official in the Chicago Center, the learning curve for inexperienced controllers is so high that even hiring in September 1995 did not cause a benefit for at least a year.

According to Wanda Geist, the head of the Aurora union branch,

> *We have 70 items waiting to be fixed on the bench. We're not covering midshift. I don't know about the control technicians, but the techs' morale is as low as I've seen it, and people who've been here 30 years are saying it, too. We're in a situation where our workload has doubled, we're losing incentive pay, and there's constant talk we're going to lose benefits—retirement, health, the whole bit.*

According to Jerry Weller, the U.S. House Representative from the area: "Not only is there a technology failure, but there is a personnel failure as well."

The age of the system is contributing to its lack of integrity. Faulty and unreliable performance lead to "ghost targets" of planes that are not really there; some planes not showing up at all, and others that are hard to discern in all the flickers and blinks. A *ghost* is an artifact made somewhere in the center's cluster of computers that integrates data from eight radar stations covering 120,000 square miles. The equipment is increasingly unreliable; it cannot be trusted to be doing the functions that it reports it is doing. The limited memory means that information about a plane may not be placed on the screen. Ghosts complicate the controllers' job by forcing them to remember which locations are real and which are illusions.

A May 17, 1995, failure at the Aurora site provides an example of the integrity problem. At 8:30 the screens on the system began to flicker; it then lied to the controllers about the functions that were still in operation. The green circular screens indicated that the system was continuing to work when in fact it was not. For seven minutes the system told the controllers it was all right to use the mouse when in fact the computer switching was not working.

Each controller is supposed to be limited to 15 planes at any one time, with no more than 49 in an hour. In reality, controllers are assigned 25 to 30 planes in a rush period. Summer is a particularly difficult time because air traffic is heavy, afternoon thunderstorms force planes to be rerouted, and air traffic controllers schedule vacations.

## Computer Failure Causes Blackout in the Chicago Center

On August 9, 1995, the green radar screens in the Chicago Air Traffic Control Center in Aurora went blank, losing vital radio contact with more than 150 planes. The cause was a power outage at a regional control center near Oakland, California. This problem was the result of computer problems, power outages, telephone line failures, equipment breakdowns, and human error.

Overall, six major outages impacted air traffic facilities from coast to coast in 1995:

- May 17, 1995, Chicago Center. At 8:30 the screens on the system began to flicker; the system then lied to the controllers about the functions that were still in operation.
- May 19, 1995, New York Center. A 2½ hour outage in a telecommunications line delayed 83 flights.
- May 25, 1995, New York Center. A power outage caused by human error resulted in 485 flight delays over six hours.
- June 6, 1995, Washington, DC Center. A computer that processes radar data went down for two days.
- July 19, 1995, Dallas-Fort Worth Center. Computer problems interrupted work at a regional control facility.
- August 9, 1995. Chicago Center. Both radar and radio contact with more than 150 planes was lost.

The centers in Chicago, Washington, Cleveland, Dallas, and New York experienced 20 interruptions from June to September 1995. They all depended primarily on an IBM 9020E computer. This computer should have been retired by now. However, the replacement system is not in place to accomplish this goal. David Hinson, FAA administrator, revamped the original plan with equipment scheduled to arrive in 1999.

These interruptions and the safety hazards that they have caused got the attention of the Congress. Hearings were held at the Chicago Center the week of September 26, 1995, to analyze the enormity of the problem and to "hold the FAA's feet to the fire."

Air traffic controllers have been reporting problems with existing systems for years:

- In 1992, West Coast air traffic was delayed for several hours. An IBM 3083 at the regional station crashed. In the process, it removed the identification labels from the radar screens of controllers from Oregon to Los Angeles. The controllers switched to an older backup system but had to increase plane separation from the typical 3 miles up to 20 miles. Pilots and controllers used radio communication and manually filed flight plans to compensate. Ron Wilson, a spokesman for the San Francisco airport, notes that although there are frequent disruptions, "The FAA computer failures generally don't last long, just long enough to screw things up." At Oakland, California, an average of three times a month the controller screens fail, and controllers have a few seconds to memorize the position, speed, course, altitude and destination of the 12 planes they are typically guiding. Then their screens go blank for at least 10 seconds. Sometimes when the screens come back, they are missing critical data.
- In 1991, the FAA ordered 44,000 small planes to be equipped with transponders that transmit flight information to the controller screens. Previously, only commercial planes were required to use the transponders. The additional informa-

tion will increase the load on the FAA computers, pushing the constraints even harder.

- In 1988, a software upgrade at the regional station in New Hampshire crashed the computer and resulted in a loss of the data labels that enable controllers to identify the planes.
- October 14, 1989, was a big day at the Dallas-Fort Worth (DFW) airport. A football game between the University of Texas and the University of Oklahoma brought in hundreds of extra commercial and private planes. The computers overloaded and some systems were taken offline. Controller screens froze for 19 minutes. More than 100 planes were in the airport's airspace and several reported "near collisions," in which they were too close for safety. Controllers at DFW kept track of computer blackouts, recording 12 computer failures in 1988 and 1989.
- Joel Willemssen, assistant director of the US GAO's information management and technology division, reports that 70 percent of the 63 largest airports in the United States have experienced problems with blank or flickering computer screens. John Mazor, a spokesman for the Airline Pilots Association, notes the problems cause

  *delays, diversions and, in the worst possible cases, accidents. It's not as dangerous as you might think, but it's not something you want to have happen to you.*

- The Los Angeles basin region handles 21 airports with 6.5 million flights a year. The GAO notes that the FAA computers in the region have repeatedly suffered from the loss of critical data and slow responses because of the overload.
- The airlines estimate that the problems with the FAA cost travelers $3 billion a year, not counting the frustration and stress of delays and missed connections.
- In 2007, the FAA's National Airspace Data Interchange Network (NADIN) flight-planning system in Atlanta shut down for several hours, causing flight delays and cancellations across the East Coast. Investigators were unable to find the cause of the problem, but NADIN was scheduled for replacement in 2008 [Weiss 2007].

## Advanced Automation System

One of the more visible components of the plan is the Advanced Automation System (AAS), which is designed to provide updated tracking displays to the controllers. It was supposed to be completed by 1990, but at that time was delayed until 1993. The system is designed to utilize IBM RS-6000 computers to display flight information, schedules, and current location along with weather fronts. The color systems will have higher resolution, be easier to read, and carry more information.

In 1994, an internal study of the AAS showed that it was still two years behind schedule, and probably would fall back another two years before completion. The project at that time has cost $2.3 billion and is estimated to eventually cost about $7 billion. David Hinson, FAA administrator, announced that he was replacing top managers on the project, dropping portions of uncompleted work, and demanding performance guarantees from the contractors. One system being canceled is the Area Control Computer Complex, which was designed to interconnect the host computers at the airport and regional levels.

- Private pilots have objected to the FAA plans, led by the Aircraft Owners and Pilots Association (AOPA) of 300,000 noncommercial owners. The AOPA has proposed a satellite-based system that the association estimates would save $6 billion over the current AAS proposal. The FAA response is that "satellites aren't a replacement for the current [system]." The commercial airlines are also resisting the proposal and suggesting that it should be delayed until 2010.
- In the meantime, because the new AAS is not available, the FAA is trying to make-do with the existing Univac terminals. For starters, the agency is increasing the internal memory systems with modern technology. The FAA also awarded a $150-million contract to Unisys to either refurbish older machines or open up an old production line to produce more of the 15-20 year old terminals. Much of the equipment, the 30-bit Univac terminals, radar-gathering and data-filtering units, are still based on vacuum tubes.
- IBM is continuing work on the contract. Noting that it is the largest contract the company ever received, the workers note that they underestimated the complexity of the problem. They also experienced problems with the Ada compilers and limited support environment. The project was estimated to require two million lines of new code. There is some belief by the GAO that even if the project is completed, it will be obsolete.
- The GAO and FAA have considered additional options, such as entirely new systems from IBM or from BDM Corp. However, they have been rejected because they are too risky or would take too long to implement.
- Airlines and governments in other nations are also upset at FAA plans to implement a satellite-based locating and instrument landing system (ILS). International airlines prefer to have a worldwide standard system, but they are concerned about using a satellite system that is controlled by the U.S. Department of Defense.

**The National Control Flow**

Experts at the national Control Flow center deal with different types of problems. Although they are not responsible for the immediate location and safety of planes, they solve problems across the entire United States. For example, in 1994, a traffic management specialist observed a thunderstorm in Chicago and diverted approaching flights to outlying airports. Although the decision seemed reasonable, it caused some problems. One airline lost millions of dollars when it found out the next day that its planes were not where they were supposed to be (in Chicago) and had to retrieve them.

To assist planners at the national level, the FAA is building an expert system called the Smartflow Traffic Management System. The system was developed by one senior programmer from the Computer Sciences Corporation using TAE Plus, a GUI generator from Century Computing, Inc. Code is generated in C++, with the rules created by a NASA-developed language called CLIPS. The system was developed with the support of 10 veterans with 10 to 15 years experience. It encompasses 15,000 rules, 30 screens, 100 buttons and 50,000 lines of C++ code. Yet, the GUI-based system was developed by Kevin Brett in about two months. It runs on an HP-based midrange computer across a LAN. Users see color-coded maps at each of the three FAA levels and can click on each object to obtain more

detail. The system replaces a DSS that enabled controllers to perform limited "what-if" analyses. The new system uses flight-plan data to examine the traffic patterns eight hours in advance to anticipate problems and recommend solutions.

The 2007 budget of the FAA called for $375.7 million to continue the Enroute Automation Modernization (ERAM) initiative to replace the obsolete hardware and software of the main host computer system [Budget in Brief 2006].

**Global Positioning System (GPS)**

GPS is a satellite-based navigation system that was developed by the Pentagon and previously available for use only in connection with military air travel. GPS allows pilots to navigate based on satellite signals instead of radar signals. It allows real-time flight planning for pilots. As more satellite technology becomes available, the integration of air traffic as well as weather information and other data communication will become a necessary technological step. Four dimensional GPS readings—longitude, latitude, altitude and time—enable an aircraft to come within a few feet of any given target. Encryption technology is currently in place to protect security in the transmission of the satellite messages.

In 2004, the FAA began testing GPS tracking for air traffic control in Alaska. Because of the vast rugged terrain, it would be impossible to put radar stations across Alaska. Additionally, the onboard GPS units can report position data every second, while radar hits a plane only once every six seconds. The ADS-B technology GPS systems connect through the Iridium satellite system [Jackson April 26, 2004].

**Standard Terminal Automation Replacement System (STARS)**

"STARS is the next big step in the FAA's comprehensive effort to upgrade air traffic control facilities across the nation. The new system will provide the platform for improvements to handle the ever-growing volume of air traffic safely and efficiently well into the 21st century," said FAA administrator David R. Hinson [Dorr 1996]. STARS will standardize all air traffic control equipment at the 172 FAA facilities as well as the 199 Department of Defense facilities. STARS will supply new hardware and software to these facilities. The program will be a complete replacement for the aging systems currently in use.

The most important feature of the STARS system will be the ability to display transmissions. The Automated Radar Terminal System (ARTS) that is currently in place was developed in the 1970s and 1980s. The FAA believes that interim programs are limited in their ability to extend the ARTS life in the short term. It is generally accepted that this system does not have the capabilities to take air traffic into the next century. ARTS software contains various versions and languages that are very labor intensive as well as expensive to support.

The STARS program includes a commercial standard system that the FAA believes will be much cheaper and easier to maintain. A key feature is the ability to extend advance the capacity of the system without reengineering the basic architecture. By building on commercially available hardware and software, the development time for the software will be reduced significantly. The resulting maintenance costs will also be lower than those associated with the current ARTS system.

By 2003, the STARS project was behind schedule by at least six years and millions of dollars. The system was supposed to be completed in 1998 for $12 million. But, after more than six years of development the system was still not implemented [McCartney 2003]. However, an initial version of the system was installed in Philadelphia in late 2002.

The system gathers data from several radar systems on color displays. However, not everyone was happy with it. Controllers in El Paso noted that the system could not distinguish between planes sitting on the runway and trucks on a nearby highway [*CNN* November 17, 2002]. In mid-2004, the FAA announced that it was ready to begin implementing the new system. The Phase I rollout would take place at airports with the oldest equipment and cost $1.4 billion. Nineteen of the 50 sites were online as of 2004. But, the last of the 50 airports were not scheduled to receive the new equipment until the end of 2007. There was no budget or schedule for the remaining 100 plus airports. In 2004, the GAO and inspector general urged the FAA to gain control over costs. The project was already seven years behind schedule and estimated costs had risen to $1.9 billion [Mosquera April 26, 2004].

**Wide Area Augmentation System (WAAS)**

The Wide Area Augmentation System is used in conjunction with GPS. Using a network of 36 ground stations to "distill" satellite GPS signals, WAAS will allow commercial aircraft to pinpoint a location within seven meters. With the use of WAAS/GPS, the FAA hopes it can close many of its ground control centers and allow pilots to fly more direct routes. Consolidated, these tools are projected to lead to the concept of free flight.

The WAAS system fell even further behind than the STARS project. The satellite-based system was pushed back by five years and the estimated costs were tripled [McCartney 2003].

**Free Flight**

Free flight is a consolidated goal toward which the FAA is working. Free flight would enable pilots to control their own navigation procedures. The pilot would use the WAAS and GPS systems for navigational purposes and choose their own routes, speed, and altitude. Ground support will be held to a minimum and would be most important when flights are in congested airport areas when airplanes approach restricted air space, or when safety is at stake.

Two principles that drive the free flight plan are the protected and the alert airspace zones. The sizes of these zones are determined based on aircraft speed, performance characteristics, communications, navigation, and surveillance equipment. The protected zone is the zone closest to the aircraft. No aircraft should overlap the protected zone of another aircraft. The alert zone is one that extends far beyond an aircraft's protected zone. The distance between planes will be monitored closely. If a plane touches another plane's protected zone, the pilots and the air traffic controllers will determine the course corrections that are needed. Under the free flight system, interference will be minimized until the alert zones collide.

Of course, after September 11, the issue of free flight is probably obsolete. The FAA and security agencies are even more interested in controlling and restricting flights. Nonetheless, the FAA and the GAO continue to investigate free flight options. A main step in the process is the Traffic Management Advisor. This software helps controllers efficiently regulate the space between airplanes as they arrive at airports. Under Phase I of the free flight program, five software tools are being tested at various sites. Phase II represents the expansion of the system—if they work. One system, the User Request Evaluation Tool (URET), was deployed late so it will require additional testing. It is designed to identify conflicts and respond to pilot requests for route changes. A third tool, the Final Approach

Spacing Tool (FAST) has been abandoned because of risks found in testing. It was designed to assign runways and schedule landings [Langlois October 2001].

Some researchers note that reducing flight times will not be sufficient to speed up the system. Delays are also created by slow operations at the terminals, including refueling, baggage handling, and unscheduled gate changes. These researchers suggest that significant improvements are needed to improve communications among airport terminals. One possibility is wireless PDAs carried by all personnel and updated by the airlines.

The September 11 attacks caused the FAA to delay implementing some aspects of the free flight (CPDLC) deployment. A major reason for the delay was due to the costs that would be imposed on the airlines. The FAA was also not ready to implement the new technologies [Vasishtha 2002].

## Technology Innovations

The FAA has suffered through several failed projects over the years, including the Advanced Automation System (AAS) that was designed in the mid-1990s and thrown away in favor of the STARS project. The FAA also designed and implemented new radio communication technology. The goal was to transfer data by text, to reduce the use of voice communications. The Aircraft Monitory System (ACMS) was designed to collect data on the plane and send it to controllers. The Aircraft Communication Addressing and Reporting System (ACARS). The ACARS system was introduced to cut down on the use of spoken radio messages to transmit information to the ground. It was thought that if the flight crew could save time by transmitting data to the ground rather than conveying it by voice to the air traffic controllers, they would be better able to concentrate on flying the plane. ACARS directly interfaces with ACMS and sends and receives messages directly to and from the pilot. The pilot punches his message, such as flight plans, in an alphanumeric keypad or touch screen. Both systems operate on the Aeronautical Radio system (ARINC) that runs on VHF radio waves and handles the data transmission between the plane and the ground controllers. The system is owned and operated by the major airlines. The main drawback to ARINC is that because of limited bandwidth, the system transmits data at 2.4 kbps. In 2004, some airlines (notably Southwest) began installing a newer data service called VHF Digital Link Mode 2 (VDLM2), that can transmit data at rates up to 31.5 kbps [Brewin 2004].

### Network

In 1998, the FAA replaced its mainframe-based system for acquisition management with a distributed architecture. The old system ran on 1980s-era minicomputers at 12 centers nationwide and processed more than 200,000 purchases per year. It was not updated for more than three years and was not Year 2000 ready. Mounting problems in the old system led many FAA officials to revert to paper to track agency purchases.

The new system is called Acquire. It uses Oracle Corporation's Alert software and the Discoverer/2000 querying tool. The FAA must also use Oracle Federal Purchasing software to get Acquire to run on a network that links headquarters to regional offices and field centers.

The FAA also began preparing a communications system overhaul aimed at readying the agency's infrastructure to meet the needs of the 21st century. The FAA Integrated Communications Systems for the 21st century (FICS-21) program is projected to cost an estimated $2.75 billion.

FICS-21 will provide ground-to-ground transmission switching and network management control for voice, data, and video communications. The new initiative will replace at least 11 major programs, including FAA-owned and leased networks. FAA FICS-21 program manager Jeff Yarnell says it is a good time to rebuild the FAA's telecommunications infrastructure because many telecommunications contracts expired at the turn of the century.

In 2004, the FAA finally began rolling out its new communication backbone. The new FTI system was installed at 27 facilities. Steve Dash, FAA telecom manager said that the system is replacing five disparate networks. He noted that "It's the first phase. The backbone will tie together the major operation facilities" [Jackson January 26, 2004]. Ultimately, the system will be connected to the other 5,000 FAA facilities and save $700 million in telecommunication costs over 15 years. Installation of the system was contracted to Harris at an estimated total cost of $3.5 billion. As much as possible, the system will use off-the-shelf networking and telecommunication products. The new FTI system fell more than a year behind schedule and in 2006 and 2007 the agency ended up paying for both systems simultaneously because they had to maintain the old one while transitioning to the new, incomplete system [Sternstein 2006].

The FAA also provides services to pilots (and the public) through its website. Pilots account for 30 percent of the site traffic. To provide faster service, the FAA installed an expert system from RightNow Technologies that examines questions posed by visitors. The software compares the question to answers that have been provided to other users. Matches that are close are immediately displayed to visitors. Other questions are forwarded to the appropriate FAA authorities. Greg Gianforte, CEO with RightNow comments that "We use a series of both implicit and explicit learning capabilities, which include artificial intelligence and machine learning, to observe the historical usefulness of each knowledge item and provide greater visibility to knowledge." Typically, the system can automatically handle 90 percent of the inquiries [Chourey April 26, 2004].

In conjunction with NASA, the FAA is using a simulation system called FutureFlight to test changes to airport control systems. Researchers testing configurations of the LAX airport found that safety could be improved by moving a taxiway to one end of the airport. John Bluck, speaking for the Ames Research Center notes that "The idea is to try it [changes] in a safe way that's as close to reality as we can make it. You don't have to try something new on a real airport, where you have thousands of lights coming and going" [Langlois October 2001].

## The Future

The FAA has faced considerable criticism over the delays and cost overruns associated with replacing its primary systems. The agency makes heavy use of outside contractors, which is probably a necessity. However, the agency needs to write better contracts so that it can maintain control over costs and schedules.

The successful implementation of STARS is becoming critical. Like other federal agencies, by 2014, as many as half of the air traffic controllers can retire (about 7,000 people) [Chourey July 5, 2004]. These workers require intensive training, and their salaries represent a significant expense. In 2002, more than 1,000 controllers earned over $150,000 [McCartney 2003]. The FAA is going to need better automated systems to make the systems easier and safer. With increased traffic demands, the FAA will have to find a way to improve productivity.

In the 2008 budget year, the FAA is pushing for a new funding mechanism. In part led by the commercial airlines who are afraid of the microjet market, the FAA is trying to push for a cost-based user fee system. Direct fees to commercial carriers and fuel excise taxes collected from general aviation would be determined by the FAA using some unspecified process to match the fee to costs of the services provided to the two user groups. The FAA also wants the authority to levy additional fees for the most congested airports [2008 U.S. Budget]. The agency claims that the NextGen project cannot be built without more funding. Planned for completion in 2025, the project is estimated to cost $15 to $22 billion [Bain 2007]. In 2007, the FAA awarded an initial design contract to ConceptSolutions, LLC for a five-year $32 million project to design the NetGen system [Hardy 2007]. The FAA claims the system is vital to increase flexibility and handle the anticipated 30 percent increase in flights.

In 2000, Congress approved creating an internal manager to oversee the flight-control operations, but the position went empty for three years until the FAA hired Russell Chew in 2003. Coming from business, Mr. Chew has removed layers of bureaucracy, instituted cost measurement programs, and attempted to instill business management into the system. He ordered the first inventory of equipment ever conducted at the FAA. With measurements in place, the FAA determined that it cost $457 to handle one jet on one flight in 2003. With cost-cutting measures, he reduced the number to $440 in 2004. He has also tried to reduce costs, by urging for consolidation of facilities. But, Congress ultimately controls spending and representatives tend to fight plans that call for a reduction of jobs in their districts. Mr. Chew also faces resistance from other FAA managers. Marion Blakey, FAA Administrator observed that many FAA employees "see any kind of change as very threatening" [Meckler 2006].

## Case Questions

1. What problems arise from the use of out-of-date technology?
2. Why is the FAA relying on ancient hardware and software?
3. Why will it take several years to convert to new hardware and software? What problems are the controllers likely to encounter in the conversion process?
4. What options are available to the FAA? Hint: Do some additional research.
5. As a governmental agency, costs and funding are an important issue. Are there ways to minimize the issues with cost?
6. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

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## Reebok and Adidas

The athletic shoe industry in the United States was an $8.25 billion market in 2003. The four largest companies (Nike, Reebok, New Balance, and Adidas) controlled 70 percent of that market [Cassidy 2004]. The industry grew from almost nothing in the early 1980s to a global powerhouse. Reebok (ticker: RBK) can trace its history back to Joseph William Foster, who made some of the first spiked running shoes by hand in London—in 1895. In 1958, two grandsons started a companion company known as Reebok. But, the modern version was born in 1979 when Paul Fireman saw the shoes at an international trade show and negotiated for North American distribution rights. At $60 a pair, the shoes were the most expensive running shoes in America [www.reebok.com].

In 1982, Reebok helped launch the aerobic dance industry with a shoe specifically targeted to women. With explosive growth, the company went public in 1985. Growth continued, supported by the Step Reebok program in 1989. By 1995, the company had grown from $50 million in sales to over $3 billion in a decade. Reebok's 1993 sales of $2.9 billion placed it second behind $4.4-billion Nike, Inc. The nearly $1 billion increase in sales from 1989 to 1993 indicates Reebok's success in gaining market share.

### Paul Fireman, president and CEO of Reebok

Paul Fireman founded Reebok in 1979 and remains the largest shareholder. From 1986 to 1990, Fireman was one of the ten highest paid executives in the United States. Under his control, Reebok sales grew from $1.5 million in 1980 to $1.4 billion in 1987. In 1988, Fireman relinquished the CEO role to spend time working on other projects, including developing golf courses in Puerto Rico and Cape Cod. In the late 1980s and early 1990s, Reebok suffered from two weak marketing campaigns ("Reeboks Let U.B.U." and "Physics behind the Physique"). More importantly, the aerobics fitness craze began to subside. Women aerobics shoes were a major component of Reebok sales, so the sales decline hit them especially hard. In 1992, Fireman returned as CEO.

### Tom Trainer, CIO

Tom Trainer joined Reebok in 1991 as the chief information officer (CIO). He noted that his role "is to enable the kid in Reebok to stay fresh and creative while also allowing the grown-up corporation to compete in global markets" [Pulliam and Pereira 1995]. To accomplish these objectives, Trainer implemented videoconferencing, computer-aided design, the Internet, and laptops for the sales force. The goal was to improve communications among employees, faster development of products, and more effective sales presentations.

Before Trainer joined Reebok in 1991 as vice-president of information systems, the information systems area was less than up-to-date, with no global information system or way to look at data. Communications, primarily by telephone and fax, between the manufacturing partners and worldwide distribution network were slow. Turnaround on new products was equally slow. This was a critical problem because Reebok is a fashion-oriented business with three product cycles a year in footwear and five in apparel. While sales representatives from Nike were walking in with laptops to display their lines, reps from Reebok were walking into offices with bags of shoes.

Trainer's early days were spent accomplishing short-term projects that got him points with the board of directors. He fired six of eight senior staff. He kept 85 percent of the old programming staff, retraining many of them. In addition to his IS responsibilities,

Trainer drove the re-engineering process in the company. To do so, he spent a great deal of time on the road, building relationships with Reebok executives around the world. He also studied Sony Corporation to learn ways that it meets customer needs.

To accomplish his re-engineering, Trainer formed five megaprocesses that streamlined procedures for production, sales and marketing, research and development, administration, finance, and distribution. In 1992, he presented a four-year, $75-million strategic information systems plan to Reebok's executive committee. The board approved it on the condition that it give Reebok strategic advantage.

To improve its communications, Reebok installed a privately designed architecture for voice, video, and data. Reebok communicates not only with its worldwide distribution base but also with its ad agency and other suppliers. IT currently developed an electronic image library to enable product shots to be distributed to every country where Reebok does business. The system dropped the new product lead time from six months to three, and, in some cases, 30 days.

Before the new ordering system was installed, orders were first printed out locally and faxed to the international headquarters in London. London would take all of the faxes and send them to the United States to be entered in the mainframe. Different standards for shoe sizes from different countries added to the delay. Once the information was entered in the mainframe, production and manufacturing would evaluate the orders.

To improve this process, Trainer developed a software package called *Passport*. *Passport* rationalizes product codes and shoe sizes. It also gives small distributors and subsidiaries access to the system through personal computers. It can also function as a module by plugging into larger systems.

Laptops were also given to the entire Reebok sales force. When orders were paper based, replacing material in a shoe to change its price from $95 to $65 might take 30 days and mean a lost sale. With the new system, these changes could be made almost automatically. Salespeople are able to check inventory and look into special orders. They can also access two years' catalogs with full motion video and sound clips of Reebok's advertisements. *Lotus Notes* is used to store the catalogs with mail links through *cc:Mail*.

Another Reebok initiative is to use electronic data interchange with 10-15 percent of its retailers. This commitment enables goods to be tracked through shipping companies, customs, and warehouses. *Hoover,* a data capture system to "suck in" information from databases around the world, is linked to customer databases that track what customers have ordered and what they want.

Reebok experienced some problems implementing the new systems. Particularly difficult was the effort to integrate the Canadian operations into the U.S. business operation. Concentrating development and support in the United States did not take into account the specifics of invoicing under the Canadian law. This mistake added time and resources that had not been budgeted to the project.

## Reebok early 1990s

In the early 1990s, facing continuing declines in the aerobics' market, Fireman changed the focus and tried to expand into other areas. To a large extent, Nike was killing the competition—largely by focusing on star athletes and spending more than 10 percent of its revenue on marketing. In the early 1990s, Fireman knew that he would have to compete directly in the sporting world [www.reebok.com]. His basketball market strategy copied a page from Nike, and relied on the new "Shaq Attaq" line supported by Shaquille O'Neal from the Or-

lando Magic. While sales did increase, they did not reach the 25 percent levels predicted by Mr. Fireman—reaching only 20 percent market share. Additionally, Fireman estimated in 1993 that the outdoor-wear division would sell $350 million worth of shoes in 1995. Outdoor sales fell far short of the goal, reaching about $110 million.

More importantly, expenses skyrocketed, increasing from 23.6 percent of sales in 1991 to 32.7 percent in June 1995. Experts say shoe company expenses typically average about 27 percent of sales. Investors blamed most of the increase on the cost of endorsements.

## Nike Late 1990s

At the same time that Reebok was suffering, Nike reported a 55 percent jump in first-quarter 1995 earnings, with revenue increasing by 38 percent. Part of the increase was from expanded international sales, with a 34 percent increase in orders from France and Germany. Sales in Japan increased by 65 percent. Nike also expanded sales of tennis shoes, partly through endorsements from tennis stars Andre Agassi and Pete Sampras. In the first quarter of 1995, revenue from tennis shoes increased by 92 percent with a 42 percent increase in orders.

At the same time sales were increasing, Nike managed to decrease its expense ratio. Selling and administrative costs dropped to 22.3 percent of revenue from 25 percent in the prior year. Much of the improvement came from an improved distribution system, including a new warehouse in Belgium that consolidated operations from 30 different facilities in Europe.

Beginning in the late 1990s, the footwear industry lost its luster. However, Nike revenue increased from $3.4 billion in 1998 to $9.0 billion in 2000 to $9.5 billion in 2001, to over $10 billion in 2003 [annual report]. In 2001, Nike installed a customized retail supply chain system from i2 Technologies, Inc. The implementation, including ties to other ERP systems, did not go well, and Nike faced a serious inventory reduction and misplacement. Nike management was disappointed in the problems, and Nike chairman questioned: "This is what we get for $400 million?"

## Reebok Late 1990s

In 1990, Nike surpassed Reebok in footwear sales. In the year ending in August 1995, Nike had $4.7 billion in sales compared to Reebok's $3.37 billion. One of the largest battlegrounds is the retail Foot Locker stores owned by Woolworth Corp. The 2,800 retail stores sell 23 percent of U.S. sport shoes, representing $1.5 billion of the $6.5 billion U.S. market for athletic shoes. Sales at Foot Locker stores account for almost 60 percent of the 1$ billion U.S. sales gap between Reebok and Nike.

Insiders note that the problems between Reebok and Foot Locker go back to the days when Reebok shoes were selling rapidly. Foot Locker wanted concessions on price and wanted Reebok to make some styles exclusively for them. Reebok was busy selling to other outlets and was unwilling or unable to alter its production and distribution systems. Nike was eager to build custom products for Foot Locker and offered a dozen products exclusively at the chain. Ex-employees at Reebok note that the company had additional problems providing samples and design plans to Foot Locker, claiming that "Sometimes the samples would come in late and sometimes not at all—which got Foot Locker mad. . . . Sometimes, fashions last less than six weeks; if you don't get it in right then, there goes a major sale."

Mr. Fireman responded by trying to improve relations with Foot Locker. He has also offered to begin building exclusive styles for Foot Locker, but the introduction of the products remains uncertain. He also noted that Reebok was working hard to cut costs and improve its order and information tracking system. One problem that remains is that the clerks at Foot Locker stores tend to push the Nike brands harder.

By September of 1995, major shareholders were getting upset with Reebok management. One of the leading outsider shareholders, Glenn Greenberg of Chieftain Capital Management, noted that "The major shareholders have no confidence in the management of this company. If it was up to us, they would have changed horses or sold the company a long time ago."

## Reebok and The Internet

Like other shoe manufacturers, Reebok relies heavily on celebrity endorsements. Signing Alan Iverson (NBA rookie of the year in 1996) and Venus Williams (tennis sensation) gave Reebok greater visibility in 2000. In 2000, Reebok also increased its visibility by sponsoring the Survivor television show with humorous ads. Their website followed these themes. In 1997, Reebok installed Radnet Inc.'s WebShare groupware system to maintain its website. The system has tools for e-mail, discussion groups, and bulletin boards. The goal was to add interactivity to the site and build a community of users. Marvin Chow, Reebok's director of interactive marketing noted that "If you just try and use the Web to sell them products, something is missing" [Cole-Gomolski 1998]. More importantly, the system makes it easy for Reebok's managers to add content. They can add data and pass it to salespeople and retailers automatically using a workflow engine.

The company used QuickTime from Apple to create CDs for its salespeople. Using Macromedia on its Internet site, the company is able to update pricing, styles, and even new photos and displays on the fly. The data is downloaded directly to the sales laptops [Dillon 1998].

Interestingly, the website is largely independent from the IT department. Roger Wood, vice president of electronic commerce at Reebok reports directly to the CEO and controls his own technology budget. He observes that "I am able to take down and build up features (of the website) without some IT overlord telling me what is good or bad" [Cole-Gomolski 1999].

In 2000, Reebok stopped selling shoes direct from its website. It was concerned about competing with the traditional retail outlets. So now the site focuses on image, technical information about products, and then directs consumers to the retail partners.

## Enterprise Systems From SAP

Income (Million $)

| Year | 2003 | 2002 | 2001 | 2000 | 1999 |
|---|---|---|---|---|---|
| Revenue | 3,485 | 3,128 | 2,993 | 2,865 | 2,900 |
| Net Income | 157 | 126 | 102 | 81 | 11 |

Facing weak sales, Reebok began focusing on reducing costs in the late 1990s. Net sales dropped from $3.6 billion in 1997 to $2.9 billion in 1999 to about $2.8 billion in 2000. Worse yet, from 1999 to 2000, gross margin declined from 38.5 percent to 37.9 percent.

In 1995, Trainer went to Eli Lilly [*Information Week* 1995]. The company ultimately replaced him with Peter Burrows as chief technology officer (CTO). Burrows knew that he

needed to replace the aging, custom software that was being used to run the company. The problem was that nothing existed. In late 1995, he sent a dozen Reebok workers to an SAP R/3 course—the goal was to show SAP that its system could not handle the complex details of the apparel industry. Most products are created by hundreds of contract suppliers, generally in Southeast Asia. Product designs change constantly, and the company has to coordinate shipments to thousands of customers. Ultimately, Burrows convinced SAP to develop a custom add-on system called the Apparel Footware Solution (AFS) module. To convince the company to spend the money, VF Corp., the company that makes Lee and Wrangler jeans, also signed on to the project. The two companies help design the specifications for the new software. The project was far more complex than SAP anticipated, and the initial version was three months late. Leroy Allen, the CIO at VF commented that "I think SAP underestimated the amount of change that had to be made to standard R/3" [Steadman January 1999].

Burrows was counting on the system to handle the major transactions at Reebok, so he could avoid the necessity of rewriting the old applications to become Y2K compliant. By May, 1999, the system was still not fully operational. Among other problems and bugs, the system was too slow to check product inventories and raw material stocks when retailers and distributors placed orders. Burrows noted that "We're not out of the woods, but SAP is responding. It's not something we're taking lightly, and neither are they" [Steadman May 1999]. In the meantime, another 60 apparel and footwear makers had purchased the system by early 1999.

By 2000, Reebok was running the system in only a couple of divisions, such as golf shoes. The company deferred implementation of the full system until at least mid-2001. Burrows noted that he was waiting for additional functionality scheduled for Release 2.5 [Steadman 2000]. Despite the problems in getting the software developed, apparel manufacturers had few other choices.

By 2001, Reebok had 115 retail stores running the AFS system. Burrows was pleased with the ability of the system to maintain accurate inventory records for the stores [Mearian and Songini 2001].

In January 2002, SAP shipped Release 3.0 of AFS. With the bug fixes and new features, Reebok continued to rollout the system in its divisions. Burrows planned to gradually implement Release 3.0 over a few years. Burrows continues to push for new features such as a Web-based system to handle business-to-business transactions with suppliers. In 2002, competitor Nike completed rolling out AFS 2.5 to its 5,000 end users [Songini 2002].

## Competition and the Future

There is no question that the shoe industry is competitive. There is also no question that it is still dominated by Nike. Yet, Reebok has made gains in the mid-2000s. The retro-trend bolstered sales for Reebok when it re-released older models. (It also convinced Nike to buy Converse.) Competition to sign new stars is also intense. Most observers believe Alan Iverson has significantly boosted Reebok sales. In 2004, Reebok struck a huge note in the international market by signing Yao Ming to market a line of shoes in China. Reebok will also market a line of Yao Ming shoes in the United States [Marcial 2004].

Somewhat surprisingly, Reebok did well in 2003 selling a line of shoes endorsed by Rap stars (Jay-Z and 50 Cent). The shoes were also popular in England [Thomaselli 2004]. On the other hand, Reebok's 2003 sales gain was also attributed to the feud between Nike and Foot Locker. In 2002, Nike pulled its top products from Foot Locker—trying to nego-

tiate better prices. In November 2003, the companies resolved their problems and Foot Locker again began carrying more Nike shoes. Foot Locker's clout grew even more in 2004 when it purchased 353 Footaction stores from bankruptcy [Cassidy 2004].

Although Nike is still the strongest seller in the U.S. market, it has struggled to find a management team. In 2006, William D. Perez stepped down after only 13 months as CEO. Reportedly, Perez often clashed with Nike co-founder Philip Knight. Knight promoted Mark G. Parker to the CEO position. The change reminded observers of the situation in 2000 when Mr. Knight returned to the CEO position to replace Tom Clarke as sales fell from 1994 to 2000 [Lublin and Kang 2006].

## Adidas

In 2005, Adidas-Salomon AG in Germany agreed to purchase Reebok for $3.8 billion. The price represented a 34 percent premium over the existing stock valuation. The sale was closed in 2006. Adidas, a pioneer in the shoe and sporting-goods industries had been struggling in the U.S. trying to find a way to compete with Nike. Adidas was largely considered the engineering leader and produced some of the technically best shoes on the market—but it lacked the marketing flash appeal of Nike. For example, the company introduced a $250 running shoe containing a sensor and small motor that enabled it to adjust the tension and support based on the terrain.

A key element in the decision was Reebok's appeal in the urban market—due to its embrace of 50 Cent and Jay-Z rappers. Herbert Hainer, CEO of Adidas noted that "we will expand our geographic reach, particularly in North America, and create a footwear, apparel and hardware offering that addresses a broader spectrum of consumers and demographics." The global market for athletic shoes is about $33 billion and about half of that total comes from America. In 2004 combined, Reebok and Adidas had about 20 percent of the U.S. market compared to Nike's 35 percent [Karnitschnig and Kang 2005].

Adidas was formed in by Adi Dassler after World War II. It gained attention by creating soccer cleats that helped Germany win the 1954 World Cup. In the 1970s, the company dominated sales in U.S. sporting goods. In 1984, the company passed on the chance to sign Michael Jordan as a rookie. When Nike signed Jordan and created a shoe and advertising campaign around him (Air Jordan), sales and market share skyrocketed. In the meantime, Adidas had been struggling. Mr. Dassler died in 1978, his wife followed in 1984. The couple's son Horst took over and began restructuring the company, but he died of cancer in 1987. By 1990, the company's share of the U.S. market fell to 2 percent. The company restructured under new management and went public in 1995, but lacked marketing strength in America. In 2003, Adidas dropped out of the bidding to sign basketball wunderkind LeBron James. Nike signed him to a seven-year, $100 million endorsement contract. Adidas said it preferred to focus on broader contracts instead of one superstar. In 2004, the company spent $100 million to sign eight NBA rookies. Adidas also signed Mohammad Ali, David Beckham, and Sean "P. Diddy" Combs; driving sales among urban consumers and soccer fans [Karnitschnig and Kang 2005].

In 2007, Adidas announced a drop in first-quarter profits, but reported a backlog in sales at Reebok, indicating increased demand [Mengewein 2007]. For the same time frame, Nike reported a 32 percent increase in profits [Casey 2007]. Adidas remains the leader in soccer (football) shoes and gear [2006 Annual Report].

## Information Technology

Adidas is learning that the sports-shoe market depends heavily on customer sentiment, and there are many ways to get feedback from customers and listen to the market. In 2006, Adidas started selling the Predator soccer shoe in Europe. Several customers complained that the colors quickly faded. But, Adidas learned about the problem almost immediately. The company pays VML to run its computer program Seer to scan Internet blogs for comments about the company. Based on the immediate feedback, Adidas told customers to treat the shoe leather before wearing them [Patrick 2007]. Adidas (and Nike) are also using new-media approaches such as YouTube and Second Life to market their products [Devaney 2007].

Adidas also beat Nike to the market with low-profile shoes. The low-price, and low-top shoes caught on quickly in Europe and were picked up by U.S. skateboarders. Sales of the shoes grew to $4.7 billion in 2006—exceeding that of basketball shoes. John Shanley, an analyst with Susquehanna Financial Group, noted that "it takes a longer period of time for them to adjust to some of the fashion shifts in the market. They want to make sure this lifestyle trend has legs and they wanted to make sure before they pursued it aggressively" [Stepankowsky 2007].

Adidas is working to integrate its supply chain—particularly creating closer ties to retail stores. Its World Class Supply Chain initiative aims to share sell-through data from retail stores directly with suppliers. The goal is to use real-time demand to pull products through the supply chain [2006 Annual Report].

In 2007, Greece surprised Europe by winning the European soccer championship. Adidas, as a leading provider of sportswear for soccer needed to respond quickly. Within days, the company delivered more than 145,000 blue and white Greece team jerseys to stores across Europe. The company used an advanced supply chain management system to synchronize orders across suppliers and subcontractors in a dozen countries [Puryer et al. 2007].

## Case Questions

1. Why is business integration important to Reebok?

2. Diagram what information is collected and how it is used in the new system at Reebok. Specify the format of the data collected at each point.

3. When problems arise with the network, or the software, how can they be identified and resolved? How do we set up an IS group to solve problems and help users?

4. How has Reebok been hampered by its information system?

5. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

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## The Internal Revenue Service (IRS)

Counting both personal and business returns, the IRS processes more than 140 million tax returns a year. Some of the returns are simple one-page forms, others run to thousands of pages of supporting documents. Overall, they handle more than 1 billion information documents a year. The IRS brings in more than $1.25 trillion in tax revenue a year. The IRS estimates that there is a $150 billion backlog of uncollected taxes. The IRS has 10 regional service centers that are responsible for processing and storing individual forms. In 1989, it cost the IRS $34 million just to store 1.2 billion tax returns in some 1 million square feet of storage space.

In 1995, the IRS had a total budget of $7.48 billion. In 2003, it was $10 billion. By any measure, the IRS is a large organization, with 114,000 full-time employees (more than 9000 in the national office, the rest in field offices). There are 7 regional offices, 63 district offices, and 10 service centers. The IS department is also large, with a 1993 budget of $1.5 billion, including more than $500 million for modernization). The IS department in 1993 had 8,868 employees with 3100 in the national office, 3462 in field offices, and 2300 in two computing centers. The main computer center is in Martinsburg, West Virginia.

Until 1990, all documents at the IRS were stored as paper records in a central warehouse. Documents were organized according to the year of filing. As a result, if a taxpayer had a problem or question that covered multiple years, the citizen had to schedule multiple meetings with IRS officials to correct problems for each of the years. In some cases, it could take weeks or months just to get the files. Occasionally, the IRS found it was faster to ask the taxpayer for a copy of the return. By the early 1990s, this problem was resolved by having each of the 10 service centers store digital images of the tax returns—making them available to agents on their terminals. Even so, the IRS knows that it needs more automation, especially the ability to scan the returns directly into a computerized information system.

Of course, automation sometimes creates additional problems, such as the situation faced by Dickie Ann Conn. The IRS determined that she owed $67,714 in back taxes. As a result, she was sent a bill for more than $1 billion in interest and penalties. On challenge, the IRS admitted that there was an error in the interest computation.

### IRS History of Automation Problems

The IRS seems like a logical candidate for improved automation. The benefits of faster processing, fewer mistakes, and easier access to data ought to save a considerable amount of money. The computer's ability to search the data, automatically match transactions, and to analyze each return presents several additional opportunities that can either cut costs or raise additional revenue. Managers at the IRS are fully aware of the potential, and they have proposed several systems over the years. The problem has been in implementation and in getting Congress to support the plans.

In the late 1960s, the IRS knew that it needed to redesign its basic systems and began planning for a system to be installed in the 1970s. Congress eventually killed the plan for two main reasons: it was too expensive, and the members of Congress were concerned about security and taxpayer privacy. The IRS then focused on keeping its existing computers running.

In 1982, the existing system was nearing capacity and the IRS established the Tax System Redesign program. It was a major redesign and consisted of three major compo-

nents. According to the GAO, changes in management resulted in the system never getting past the design stage. A new assistant commissioner in 1982 embarked designing a new system that would carry the IRS through the 1990s. Initial costs were estimated at $3 to $5 billion over the entire project. The primary objective was to replace the old central tape-based system with an online database. Eventually optical technology would be used to scan the original documents and store the data in the database. A new communication system would carry the data to any agent's workstation. By 1989, initial planning had already cost the IRS more than $70 million, with no concrete proposal or results.

The main computer systems were replaced at the IRS service centers in 1985. The change in the systems was almost disastrous for the IRS. The change delayed returns processing, leading to delays in refunds that cost the IRS millions of dollars in interest payments. IRS employees worked overtime but still could not keep up. Rumors were flying that some employees were dumping returns to cut down their backlog. Because of the delays and backlogs, the IRS managed to audit only about half the usual number of returns.

In 1986, the IRS initiated a plan to provide 18,000 laptop computers to make its field auditors more productive, with its Automated Examination System (AES). Unfortunately, the service bought the Zenith laptops a full year before the software was ready. The system was written in Pascal and was delivered to agents in July 1986. The system was designed to help examine Form 1040 returns. Its biggest drawback was that it used 18 different diskettes, requiring agents to continually swap the disks. From privatization efforts by the Reagan administration, the system was subcontracted to outside developers. As IRS funding was cut, programmers with experience in Pascal were cut. The system had to be rewritten in C.

A survey in 1988 revealed that 77 percent of the agents were dissatisfied with the software, and it was used by only one-third of them. By 1989, the IRS revised the software and managed to reduce it to eight disks. Overall, by 1989, the AES project was more than six years behind schedule and the GAO observed that it would be $800 million over the original budget. The IRS originally anticipated that the AES would produce $16.2 billion in additional revenue over nine years by making agents more productive. The GAO disputed those numbers, noting that

> *the IRS has been unable to verify that the use of laptops has actually resulted in the examination of additional returns or increased tax revenues.*

In 1990, the White House cut funding for the program from $110 million down to $20 million.

## Tax System Modernization

By 1989, the IRS knew that it desperately needed to redesign its entire system for collecting taxes and processing information. In hearings before Congress, Sen. David Pryor (D-Ark.) noted that the 1960s era IRS computers were headed for a "train wreck" in the mid-1990s. The GAO estimated the original project would cost between $3 and $4 billion. The projected date for implementation slipped from 1995 to 1998.

The overall design calls for a centralized online database, smaller departmental systems containing local information, and a nationwide network to tie them together. Tax return data would be entered with a combination of electronic filing and optical scanners.

By 1991, the estimated cost of the plan had expanded to $8 billion. Although it was anticipated that the system would cut $6 billion in costs, the plan was rapidly attacked by

members of Congress. Three studies of the plan by the GAO were released in early 1991. (1) The GAO was concerned that optical technology was not sufficiently advanced to perform the tasks demanded by the IRS. The GAO urged greater emphasis on electronic filing. (2) The GAO was concerned about management issues such as transition planning, progress measurement and accountability. (3) The GAO and Sen. John Glenn (D-Ohio) voiced concerns about security. GAO official Howard Rhile notes that

> *This is a serious omission in view of the fact that the IRS intends to allow public access . . . to some of its systems and because concerns over the security of taxpayer information helped doom the first [IRS] modernization effort in the late 1970s.*

Despite these misgivings, the IRS was committed to the plan. Fred Goldberg, IRS commissioner agreed with the GAO findings but observed that

> *We have been running our business essentially the same way, using essentially the same computer and telecommunications systems design for 25 years. [Existing systems] will perform well and achieve incremental improvements for the next few years. . . Our best judgment is that [OCR] technology will be there when we need it, by the end of the decade.*

By 1992, the situation was worse. Shirley Peterson, the new commissioner of internal revenue stated at a Congressional hearing that

> *Our systems are so antiquated that we cannot adequately serve the public. The potential for breakdown during the filing season greatly exceeds acceptable business risk . . . Some components of these computers are so old and brittle that they literally crumble when removed for maintenance.*

In December 1991, the IRS awarded a 12-year, $300-million contract to TRW to help manage the process and provide planning and system integration services.

The system was ambitious, calling for 60 major projects, two dozen major purchases, 20 million lines of new software, and 308 people just to manage the purchasing. Despite their efforts, elements of the IRS modernization plan were stalled because of purchasing difficulties. In July 1991, the IRS awarded a billion-dollar Treasury Multiuser Acquisition Contract (TMAC) to AT&T. The goal was to standardize purchasing for the IRS and the Treasury Department by routing all purchases through one vendor. The contract was challenged by other vendors and overturned. The contract was rebid and AT&T won a second time. IBM (one of the original protesters) again objected to the process, noting that the IBM bid of $708 million was less than the $1.4 billion bid by AT&T.

In 1993, the IRS acknowledged that the TSM Design Master Plan needed to be rewritten. In particular, it had to focus on business aspects instead of technology. To better coordinate technical planning with IRS needs, the agency established a research and development center, funded by $78.5 million of federal money but run by the private sector. The center is responsible for providing technical assistance and strategic planning for the TSM. The IRS also established a high-level "architect office" to evaluate technologies and their likely uses.

Through 1992, the IRS had spent $800 million on TSM. In 1993, new IRS estimates indicate that TSM will cost $7.8 billion above the $15.5 billion needed to keep existing systems running. The new system is expected to generate $12.6 billion in total benefits by 2008 through reduced costs, increased collections, and interest savings. Additionally, the

improved processes should save taxpayers $5.4 billion and cut 1 billion hours from their time spent with the IRS.

The IRS asked Congress for a 1996 allocation of $1.03 billion, a substantial increase from the $622 million it spent on automation in 1995. However, Hazel Edwards from the General Accounting Office noted that, "after eight years and an investment of almost $2 billion, IRS' progress toward its vision has been minimal." IRS commissioner, Margaret Milner Richardson, denied the GAO claims, noting "I think we have made significant progress, not minimal progress . . . but we do know we can and must do more."

The IRS situation represents a typical dilemma for Congress. The IRS claims that by spending more money, it will be possible to create a system that finally works. The GAO believes it is impossible to complete the complete project envisioned by the IRS. The GAO believes the IRS should focus on smaller projects that can be completed in one to two years.

In 1999, the IRS implemented a new network to connect computers throughout the organization. Twenty staffers were dedicated to the project and took four years to complete it. IBM's Tivoli software is a key tool to manage the 132,000 networked devices in 87 locations. The software enables network managers to continually monitor all aspects of the network. They can also push changes down to the desktop computers if problems arise or they need upgrades. Before the system was available, it took an IRS staff member 20 minutes to update each device. With Tivoli live in 2003, a single network administrator sent one update to 400 desktops in one minute. Jim Kennedy, program manager for enterprise systems management at the Austin, Texas support center estimates that the system has saved $2.6 million in the first quarter alone [Dubie 2003].

In 2001, Congress passed tax-cut legislation to stimulate the economy, ordered the IRS to send "refund" checks to all taxpayers. It took several months to create and mail the tens of millions of checks, but most of them were correct. On the other hand, about 523,000 taxpayers received notices that they would be getting a check for the full refund amount, when they were actually eligible for only part of the refund. The mistake was attributed to a programmer error, and the final checks were correct; but some taxpayers were confused by the misleading letter.

## Electronic Filing

The IRS introduced electronic filing in 1986, when 25,000 forms were filed electronically. By 1990, 4.2 million people filed for tax refunds electronically. In 1992, the number increased to 10 million filers. In 1994, about 16 million tax returns (7.8 percent of the total) were filed electronically. About half were 1040A forms. In 1995, the IRS expects electronic filing to decrease to about 15 million (7.2 percent).

The primary target of electronic filing is the millions of individual taxpayers who will receive refunds. To control the process and ensure that documents are properly filed, electronic filing is only available through authorized tax preparers. The IRS deliberately avoided providing access to individual taxpayers. As a result, taxpayers who use the system pay an additional charge to the preparer. Interestingly, the preparer does not have to pay a fee to the IRS. However, the electronic system provides for refunds within a couple of weeks.

Electronically filed returns cost the IRS one-tenth the processing cost of paper forms. They also eliminate the cost of paper storage. The IRS notes that the service is able to store 800,000 returns on one side of a 12-inch optical disk.

For taxpayers with easy returns, the IRS is simplifying the process even further—providing for filing over the telephone. In a 1992 pilot, 117,000 Ohio taxpayers filed for refunds using TouchTone phone calls. The system was expanded nationwide in 1994. It can only be used by taxpayers who qualify to use the 1040EZ form. A replacement form (1040-TEL) must still be signed and filed with the IRS, along with the W-2 (withholding) statements.

In the 1998 IRS Restructuring and Reform Act, Congress required the IRS to encourage the use of electronic filing. The IRS has made it easier for people to file electronically—particularly for those who use computer software to compute their taxes. In 1998, about 20 percent of individuals filed electronically; in 2000 the number was 28 percent; in 2001 about 32 percent (45 million). The IRS goal is to increase this number to 80 percent by 2007 [Dorobek 2001]. For the 2001 tax year (filing in early 2002), the IRS used the Digital Signature law to send PINs to several million taxpayers, enabling them to legally sign their tax forms electronically. However, the one important catch is that taxpayers who file electronically must pay an additional fee to do so. Hence, only those who receive refunds (about 70 percent of the filers) are interested in paying the fee, because it enables them to get their money faster. Most experts believe it is unlikely that the IRS will meet the Congressional goal of 80 percent by 2007.

## Document Processing System

Despite initial efforts in electronic collection of tax data, the IRS remains committed to handling paper forms. To make that task more efficient, the service is designing a new document processing system. Operators at personal computers will scan in paper documents. They will then correct and key in additional data. The goal is to move 100 percent of the data to an electronic format—compared to today's 40 percent content stored in electronic form.

## General Accounting Office

The General Accounting Office (GAO) has examined the IRS systems and development methods several times. The GAO issued a comprehensive report in 1995. Despite the progress of the IRS, the major findings were negative:

- *Despite IRS efforts to improve its tax processing, pervasive management and technical weaknesses still remain that could impede its modernization efforts.*
- *IRS does not have a comprehensive business strategy to reduce paper submissions, and it has not yet fully developed the requisite software and technical infrastructures to successfully implement its modernization efforts.*
- *IRS will not maximize electronic filings because it only targets taxpayers who use third-party tax return preparers or transmitters, are willing to pay a fee to file electronically, and are expecting tax refunds.*
- *IRS does not target the large segment of tax filers who prepare their returns on their personal computers and then submit paper returns.*
- *IRS failure to maximize electronic filings could impair its future ability to process paper returns.*

- *Other tax system modernization (TSM) weaknesses include IRS failure to fully implement strategic information management practices, an immature and weak software development capability, and incomplete systems architectures and integration and system planning.*
- *IRS should manage TSM as an investment and ensure that systems development is driven by re-engineering efforts and that IRS staff have the necessary skills to meet future IRS needs.*
- *IRS has not assigned responsibility, authority, and accountability for managing and controlling systems modernization to one individual or office.*

One of the fundamental GAO complaints deals with the overall strategy of the IRS. The IRS claims to be working toward a paperless system. However:

> *IRS's goal is to have electronic filings for 70 million individual returns and 10 million business returns by 2001. This goal of 80 million electronically filed returns represents 35 percent of all returns. On the basis of the current rate of electronic filings from individuals, IRS estimates that by 2001, only about 29 million individuals will file electronically. If 10 million business returns are filed electronically as projected, a total of about 39 million filings will be electronic. This is only about 17.4 percent of the 224 million tax returns anticipated in 2001, less than half of IRS's goal.*

**Capability Maturity Management (CMM) Levels**

| Level | Name | Description |
|---|---|---|
| 5 | Optimizing | Continuous process improvement is enabled by quantitative feedback from the process and from testing innovative ideas and technologies. |
| 4 | Managed | Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled using detailed measures. |
| 3 | Defined | The software process for both management and engineering activities is documented, standardized, and integrated into an organization-wide software process. All projects use a documented and approved version of the organization's process for developing and maintaining software. |
| 2 | Repeatable | Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on similar projects. |
| 1 | Initial | The software process is characterized as ad hoc and occasionally even chaotic. Few processes are defined and success depends on individual efforts. |

The GAO is also extremely concerned about the IRS development methods. The IRS has been criticized repeatedly for not adopting strong SDLC development controls. Carnegie

Mellon University has developed a system (CMM) for evaluating development teams, which the IRS used to evaluate its development methodologies.

> *In August 1993, using CMM, IRS rated its software development capability as immature, the lowest level. This level of maturity—CMM level 1—is described as ad hoc and, at times, chaotic, and indicates significant weaknesses in software development capability. Since that date, IRS's software development capability has not improved significantly. IRS's software development activities remain inconsistent and poorly controlled, with no detailed procedures for systems engineers to follow in developing software.*

Several problems have arisen because of inconsistencies and multiple, scattered development teams. The IRS took a step to resolve some of these problems by naming the "modernization executive" as an "associate commissioner" in May 1995. All development operations and the CIO were reassigned to report directly to the associate commissioner. The one exception was the research and development division.

The fragmented nature of the IRS TSM project has already caused several problems. These problems are especially acute in handling data. Several data definition problems were uncovered by the GAO:

- *Updated data on one system is not immediately available to users of other systems.*
- *Master data files are updated once a week, and it can take up to two weeks for data in a taxpayer account to be changed.*
- *Inconsistent and incomplete data on different systems can affect fundamental computations and can result, for example, in inconsistent calculations of interest and penalties.*
- *Data is stored in unique formats on different systems and is accessed using various techniques.*

Along with overall strategy and control, the IRS has been faulted for performing limited testing and quality control.

> *IRS also performs systems testing in operational environments, including its service centers or computer centers, rather than in a controlled environment dedicated to thorough testing.*

## Planning and Systems Development

The GAO has been especially critical of lack of strategic direction and planning by the IRS. Each year the IRS returns to Congress and requests more money for its independent projects. The IRS has also been criticized for being sloppy in estimating benefits and costs of the proposed systems. In one example, the IRS claimed the new system would generate additional revenue—but the GAO found that the revenue increase really came about from hiring additional workers for collection. To be fair, the IRS understands and agrees that it has some serious problems with designing and implementing the new systems. They have undertaken several steps to help evaluate and control the project development. For example, there are several planning documents:

- *Business Master Plan: reflects the business priorities set by IRS's top executives and links IRS's strategic objectives and business vision with the tactical actions needed to implement them.*

- *IRS Future Concept of Operations: articulates IRS's future business vision so that the Congress, IRS employees, and the public can see and better understand IRS's plans for serving the public.*
- *Integrated Transition Plan and Schedule: provides a top-level view of the modernization program's tasks, activities, and schedules and is the primary tool used for accountability for delivering the products and services necessary to implement modernization.*

Unfortunately, as of May 1995, these plans had not been completed. For example, the Future Concept of Operations was only 60 percent completed. The plans are also somewhat independent and concepts in one are not necessarily related to the other documents. In the meantime, ad hoc development continues, along with requests for more development money. Interestingly, the IRS maintains that all TSM projects have equal priority, and that they must all be completed together, or the entire project will fail. On the other hand, they have identified six areas that are critical to their operations:

> *IRS has identified 6 core business areas and defined 11 business processes that support these areas. Of these 11, 3 were selected to begin re-engineering efforts. Those selected for initial redesign are (1) processing returns, (2) responding to taxpayers, and (3) enforcement actions.*

From past criticisms, the IRS has begun to evaluate its development efforts. These evaluations are largely keyed toward appeasing Congress and monitoring the time and expenses involved.

> *IRS currently holds program control meetings to assess and control information technology. However, these meetings have generally focused on the costs and implementation schedules of individual projects, rather than on comprehensively evaluating and prioritizing risks and returns expected from these investments. Instead of using explicit criteria to measure risks and returns, IRS evaluates each project's progress using a time-line.*

The IRS has created several teams with specific tasks to help the servie design and build the new systems. The major teams are:

- The Requirements Management Team
- The Software Quality Assurance Team
- The Project Planning and Tracking Team
- The Testing Team
- The Configuration Management Team

Despite these initial efforts, the GAO notes that the teams currently are not used on all projects, and they are being held up by lack of a strategic plan, and limited customer involvement with the teams. Consequently:

> *Although the teams have made progress, their accomplishments have not significantly improved IRS's software development capability.*

In 1993, the IRS committed to an information engineering systems development methodology, which is used to create an information strategic plan that will guide future purchases and development decisions. However, in July 1993, the IRS stated that the "integrated systems architecture" will be completed as each of the TSM components is built.

## Security

The IRS has experienced several problems with security in the past few years. Most of them have arisen from problems with its own workers. In particular, the IRS's internal reviews have found several instances where IRS employees

- *Manipulated taxpayer records to generate unauthorized refunds.*
- *Accessed taxpayer records to monitor the processing of fraudulent returns.*
- *Browsed taxpayer accounts that were unrelated to their work, including those of friends, relatives, and neighbors.*

The GAO notes that current IRS controls do not adequately protect taxpayer data. In particular, the IRS has not adequately

- *Restricted access to taxpayer data to only those employees who need it.*
- *Monitored the activities of thousands of employees who were authorized to read and change taxpayer files*
- *Limited the use of computer programs to only those that have been authorized.*

At this point, plans for security in the future systems do not look much better. In its 1995 review, the GAO found several problem areas in which security was lacking:

- A disaster recovery and contingency plan.
- A security concept of operations to define IRS plans under TSM.
- A security certification and accreditation plan to evaluate and test the proposed security.
- A communications security plan to control transfer of data among distributed sites.
- An identification and authentication plan to verify user identities.

## Expert Systems

By 1989, the IRS realized that it faced an embarrassing problem: The GAO found that IRS employees give wrong answers to taxpayer questions 36 percent of the time. Admittedly, the problem facing the 5000 telephone "assistors" is challenging. If they do not know the answer to a question, they need to search 159 IRS publications, or in the worst case, search through 10 volumes of tax regulations. In 1988, the assistors answered 38.5 million questions. Each assistor handles an average of 150 calls a day.

To deal with the huge volume of data and improve the answers, in 1990, the IRS Artificial Intelligence Lab developed the Taxpayer Service Assistant, an expert system that contains knowledge from the IRS publications. The prototype could handle 50 complete tax topics and was designed to improve the performance of the novice assistors. It also helped train the novices to ask the appropriate questions and learn the answers to common situations.

By 1992, the ES was renamed as the Taxpayer Services Integrated System and had been phased into most of the IRS service centers. Henry Philcox, the IRS chief information officer, noted that it provided correct information 85 percent of the time. Although this result represents an improvement, in some cases, the taxpayer had to respond to 43 questions before getting an answer. The IRS found it could get the same accuracy by providing booklets to IRS assistors.

Another use of expert systems lies in sending IRS letters to taxpayers. The IRS annually sends 15 million letters to taxpayers, answering questions and claims. The IRS initially built a file of 300 form letters. Agents extract paragraphs and add sections as needed. Yet, the errors persisted.

In the early 1990s, the GAO estimated that 30 percent of the letters (about 4.5 million) contained errors. In response, the IRS AI lab created the Correspondex Expert System (CES). The system is based on the same file of form letters. However, it contains rules that check for nonstandard word usage, look for conflicting or redundant paragraphs, check spelling, and identify the needed enclosures. The CES also insists that each letter begin with a polite paragraph.

The IRS also has an infamous expert system that it uses to evaluate returns and decide which people should be audited. It is known as the Automated Issue Identification System (AIIS). The internal statistical rules are secret—although a group once tried to sue the IRS to reveal the rules. Ted Rogers, founding chief of the IRS AI lab, noted that in tests, the AIIS identified 90 percent of the audit issues found by IRS experts. The system can be used to either reduce the amount of preaudit labor by 80 percent or, by keeping the labor the same, to improve tax collections by $60 million a year.

## The Internet

In late 2001, the IRS announced plans to offer electronic payments by businesses over the Internet. A major portion of the money received by the IRS comes from withholdings collected by businesses. This money has to be forwarded to the IRS at regular intervals, so the IRS is trying to reduce handling costs by moving these transactions online. The Electronic Federal Tax Payment System (EFTPS) is a Web-based system that can also be used by small businesses. The system could also be used by taxpayers who make estimated quarterly payments. Using modern strong encryption technologies, the IRS is confident the system will be secure.

Relatively early in the dot-com and dot-gov restructuring, the IRS realized the importance of putting information on its website. In fact, a huge amount of information is available online. And that is a problem. In 2001, IRS executives were asked to search the site in 2001 for common tax information. It generally took 20 or 30 clicks to find any piece of information. To improve its website, the IRS hired Greg Carson in 2001, a designer from private industry who helped to launch the Priceline.com website.

The IRS also signed a contract with the consulting group Accenture to redesign the IRS websites. In 2001, the site received 80 million hits a day. Gregory Carson, director of electronic tax administration modernization at the IRS notes that "The development of an intuitive, intentions-based design will make it considerably easier for taxpayers and tax preparers, who pull forms from the site, to obtain the information and documents they need to file tax returns" [Rosencrance August 2001]. Accenture's goal is to make the site easier to use so that users can reach the desired information within three clicks. Additionally, Accenture will be hosting the site on its servers.

In 2003, more people turned to the Internet to file their tax returns. Several companies provide online systems that automatically e-file the data with the IRS. A few offer free filing. In 2003, 3.4 million taxpayers used the Free File service. In total over 14 million people used their personal computers to e-file their taxes [Mosquera May 10, 2004].

## Automated Under-Reporter (AUR)

The Automated Under-Reporter (AUR) is another component of the TMS. The AUR is a system designed to monitor returns and identify people who are most likely to underpay their taxes. The system was first installed in 1992 at the Ogden, Utah regional center. The system pulls data from the service center's Unisys 1180 mainframe. It is downloaded across a local area network to a Sequent Computer System S-81 minicomputer, and from there it is sent to one of 240 networked UNIX workstations on the employees' desks.

The system automatically matches distribution documents (such as 10-99's and W-2's) with the filings of individual taxpayers. Mark Cox, assistant IRS commissioner for information systems development, notes that in trials with the AUR "We've been able to cut down the rework of cases from 25 percent to less than 5 percent. We see this type of work enabling us to share in more of a connectivity mode" [Quindlen 1991].

The system uses an Oracle Corp database running SQL to compare the data. It also performs basic tax computation and helps agents send notices to taxpayers. Managers note that although the new system has not improved the speed of the agents, it has cut down the error rates. As agents become familiar with the system, they expect productivity to improve.

In 1991, the Ogden center processed 26 million tax returns, collecting $100 billion in tax payments. It processed $9 billion in refunds. In 1992, it won the Presidential Award for Quality for improved tax processing, by saving the government $11 million over five years.

In 2007, the IRS estimated that the compliance rate for individuals paying taxes on time was 86 percent—leading to an estimated $290 billion per year tax gap (based on 2001 data). President Bush argued [2008 U.S. Budget] that if this tax gap could be reduced, many programs could be funded without additional taxes. His budget for the IRS called for an additional $410 million for research, enforcement, technology, and taxpayer services to reduce this gap.

## Currency and Banking Retrieval System

In 1988, Congress passed a new law in an attempt to cut down on crime (notably drugs) and to provide leads to people who significantly underreport their income. Every cash transaction of more than $10,000 is required by federal law to be reported to the IRS on a Form 8300. The IRS created the Currency and Banking Retrieval System to match these forms against the filer's tax return. The system automatically identifies people who had large cash purchases but claimed little income. However, due to a programming error, the system missed forms covering $15 million in cash transactions between 1989 and 1990.

The problem stemmed from the fact that the IRS used the same code number on the 8300 forms that it had been using on other cash transaction forms. The IRS later assigned separate codes for each form. But when programmers created the new matching programs, they did not know that there were now two codes for each transaction.

The system was corrected in 1991, and by 1992 was used to process more than 1 million queries a year.

Jennie Stathis of the GAO notes that there are additional problems with the Form 8300. In particular, the filings are often incomplete or contain incorrect taxpayer identification numbers. The IRS is developing software that will allow businesses to automatically verify the taxpayer ID numbers before the customer completes the purchase.

## Service Center Recognition/Image Processing System (SCRIPS)

In 1994, the IRS awarded a $1.3 billion contract to the IBM Federal Systems Co. to design a document processing system that by the late 1990s will convert virtually every tax return to digital form. A day after the contract was awarded, IBM sold the Federal Systems Co. to Loral Corp for $1.52 billion.

The 15-year systems integration contract called for having the system online in 1996. The plan calls for scanning incoming tax forms. Special software will digitally remove the form layout and instructions, leaving just the taxpayer data. OCR software will then convert the characters (including handwritten numbers) into computer data.

The system is scheduled for initial installation at the Austin, Texas regional center in August 1995. Plans call for installing it at Ogden, Utah, Cincinnati, Ohio, Memphis, Tennessee, and Kansas City, Missouri by 1998. Despite the popularity of electronic filing, the IRS still sees a need for the OCR system. The IRS anticipates receiving 252 million paper filings in the year 2001.

SCRIPS was the first scanning project. Presented at a cost of $17 million, it was approved to cost $88 million when it was awarded in 1993 to Grumman Corporation's Data Systems unit. SCRIPS was designed to capture data from four simple IRS forms that are single-sided. SCRIPS was supposed to be an interim solution that would support the IRS until DPS could be fully deployed. However, delays pushed back the delivery of the SCRIPS project. By the time it was declared finished, the project cost $200 million [Birnbaum 1998].

DPS was the second scanning project. It has a projected cost of $1.3 billion. Interestingly, Grumman Data Systems was the loser in the contest for the DPS contract. The IRS noted that Grumman failed a key technical test. When completed, DPS was quite complicated to use. In this program, the IRS developed nine separate databases, most of which could not communicate with each other.

In 1996, Art Gross, a veteran of the New York State revenue department, was appointed to be IRS's new chief information officer. He stated that the IRS's computers didn't "work in the real world" and that its employees lacked the "intellectual capital" to transform them. When he arrived in 1996, the IRS's Year 2000 conversion project had a budget of $20 million and a staff of three; by 1998, it had grown to a $900 million project with 600 workers, many of them consultants [Birnbaum 1998] .

Gross tried to get control of the system. He ended the DPS or "Bubble Machine" project as being over budget and behind schedule. With help from TRW, he devised a new top-to-bottom computer architecture. The architecture was built around a centralized database to coordinate at the IRS.

When Rossotti arrived as the new commissioner, he proposed an even more ambitious plan. In addition to Year 2000 changes, computer updates from the 1997 tax law, and the overall modernization, Rossotti proposed to restructure the entire organization. This proved to be too much for Gross, who resigned.

In 1998, Congress passed the Government Paperwork Elimination Act, part of which forces the IRS to move to more electronic transactions. Since then, the IRS has created electronic versions of its forms that can be downloaded from its servers. In 2001, the IRS signed a contract with ScanSoft Inc. for OmniPage Pro 11 for use in its federal tax offices around the nation. The goal is to convert the masses of paper files into electronic documents. Instead of taxpayer files, the system is designed more to convert internal forms and docu-

ments so that all employees will have immediate access to up-to-date forms and policies on the IRS intranet.

## Customer Relationship Management

In late 2001, the IRS began installing customer relationship management (CRM) software that it purchased from PeopleSoft. A key element of the kinder, gentler approach is the ability to track customer issues. CRM software can collect all of the customer interactions into one location—making it easier for multiple agents to see the entire history of a particular problem. The system will also enable the agency to create Web portals for professional tax preparers, IRS employees, and taxpayers. The portals will securely provide individual information to these groups over the Web. In addition to faster service, the IRS hopes to reduce the costs of its call centers by moving more access online.

The IRS also developed the e-help system in 2002 to provide a central point for customer service. The system was designed to ensure service representatives provide consistent and accurate responses to customer questions. The Inspector General in 2007 reported that the system had made progress, but still needed improvement. Notably, the system lacked quality measures and procedures, including a failure to survey customer opinions and train employees. In a random sample of 19 employees, the Inspector found that none of them had completed required training. Michael Phillips, IRS deputy inspector general for audit noted that "ensuring assistors complete required training will be of greater important as the IRS moves forward with implementation of the next available technology" [Cranmer 2007].

## Security Breaches

In 1983, Sen. John Glenn (D-Ohio) released an IRS report indicating that 386 employees took advantage of "ineffective security controls" and looked through tax records of friends, neighbors, relatives, and celebrities at the Atlanta regional IRS office. Additionally, five employees used the system to create fraudulent returns, triggering more than 200 false tax refunds. Additional investigations turned up more than 100 other IRS employees nationwide with unauthorized access to records. Glenn observed that the IRS investigation examined only one region, and looked at only 1 of 56 methods that could be use to compromise security. He noted that "I'm concerned this is just the tip of a very large iceberg."

The IRS itself noted that the Tax Systems Modernization (TSM) program "greatly increases the risk of employee browsing, disclosure and fraud," because of the online access to the centralized databases.

Margaret Richardson, commissioner of internal revenue, notes that the system used by the perpetrators is 20 years old and is used by 56,000 employees. It meets all federal security standards, using passwords and limiting access based on job descriptions. The IRS found the problems in Atlanta by examining records of database access during the last three years. Because the system generates 100 million transactions a month, the data is stored on magnetic tape, making it difficult to search.

In 1989, the IRS arrested Alan N. Scott, of West Roxbury, Massachusetts, for allegedly submitting 45 fraudulent returns via the new electronic filing system. The IRS claims the man received more than $325,000 in refunds.

The IRS requires tax return preparers to fill out an application before it issues an access code. Scott apparently used a fake taxpayer ID number and lied on the application

form to gain the access number. The IRS claims he then submitted false returns using bogus names and taxpayer ID numbers to get refund checks ranging from $3000 to $23,000.

IRS officials note that the electronic filings actually made it easier to identify the problem because the computer could scan the data earlier than if it had been submitted by hand. Once the situation was identified, the IRS was able to immediately lock out further transactions from Scott's access number.

In May 2007, the Treasury Department's Inspector General reported that the IRS lost 490 computers between 2003 and 2006. Of these, 111 occurred within IRS offices. Most of the machines lacked encryption and strong passwords. The IRS has 100,000 employees and has issued 47,000 laptops. It was unable to identify the data that was lost because the agency has no records of what data was stored on the machines, but the audit report claims data was compromised for at least 2,300 taxpayers. Deputy inspector general Michael R. Phillips, stated that "we believe it is very likely a large number of the lost or stolen IRS computers contained similar unencrypted data. Employees did not follow encryption procedures because they were either unaware of security requirements, did so for their own convenience, or did not know their own personal data were considered sensitive. We also found other computer devices, such as flash drives, CDs, and DVDs, on which sensitive data were not always encrypted." An audit in 2003 reported similar problems, and the IRS has taken no action to change procedures [Gaudin 2007].

## IRS Records

In 1993, Congress allowed some high-income taxpayers to spread a portion of their tax payments over three years. The IRS was responsible for tracking and billing for these payments. In August 1995, the IRS issued a public notice that many of the thousands of "delinquent" notices it sent were wrong, but because of weak records, the service did not know how many might be wrong. In July, the IRS issued more than 43,000 incorrect notices.

The General Accounting Office (GAO) in 1995 cited the IRS with failure to keep proper internal accounting records. The GAO stated that the records were so bad, they were unable to express an opinion about the reliability of the IRS financial statements. For example, the GAO was unable to verify "a significant portion" of the $2.1 billion the IRS spends annually in nonpayroll expenses.

## Modern Disasters

In 1998, the message in Congressional hearings was to "Do something. Anything." The hearings into IRS dealings with the public revealed several problems within the IRS. They emphasized the negative perceptions the public has toward this important agency. After listening to these criticisms, the IRS eventually agreed to change some of its policies to improve its treatment of citizens. The 1998 IRS Restructuring and Reform Act was aimed at changing IRS attitudes and providing citizens with more control in the tax-collection process. Charles Rossotti, the new IRS commissioner, described the process of upgrading the vacuum tube-era technology as being "rebuilding Manhattan while we're still living in it." The $7 billion agency has attempted the same gargantuan task of modernizing its computers for 25 years and continues to fail. The total cost in the 1990s alone has been projected to be nearly $4 billion. [Birnbaum 1998]

In 2002, the system included 80 mainframes, 1,335 minicomputers, and 130,000 desktop boxes that were largely unable to communicate with each other. Before his appointment as Commissioner of the IRS in November 1997, Rossotti served as chairman of

the computer consulting firm American Management Systems. In early 1998, Arthur Gross, the chief technology officer, who drafted the latest modernization blueprint, resigned in frustration. Shortly thereafter, Tony Musick, the chief financial officer, resigned to become deputy CFO at the Commerce Department. [Birnbaum 1998]

Unfortunately, the IRS has been even less successful at implementing new technologies. By 1998, nearly all of the earlier systems development efforts were canceled. In late 1998, the IRS signed a 15-year development contract with Computer Science Corporation (CSC) that was worth $5 billion. By contract, CSC is responsible for helping design new systems, indicating that the ultimate goal is still to be determined. Outside experts note that the contract does not necessarily solve all the IRS problems. The IRS must still deal with the contract management issues, which have proved difficult to the IRS in the past.

In 1999, the IRS launched yet another attempt to modernize its systems. The $8 billion Business Systems Modernization (Bizmo) program was supposed to replace the infrastructure and over 100 applications. A key element is to replace the Master File system—which is an ancient tape-based system that holds customer data that the IRS has been using for over 40 years. The system runs an archaic programming language with code written in 1962. The heart of the new system is the Customer Account Data Engine (CADE) designed to run on IBM's DB2 database system. As of 2004, the project is way over budget and years behind schedule. Even the system to process the simple 1040EZ form is three years late and $36.8 million over budget [Varon 2004].

The system design actually started out well. The IRS hired CSC as the prime contractor. But, the IRS did not maintain control of the contract, and there are serious doubts that even CSC was capable of handling the complex project. Paul Cofoni, president of CSC's Federal Sector business testified to the U.S. House Ways and Means Oversight Subcommittee that "I have never encountered a program of the size and complexity as the Business Systems Modernization program at the IRS" [Varon 2004]. Several times, the IRS considered firing CSC, but kept deciding that it would not be cost effective. One of the problems is that the IRS is not providing sufficient oversight of CSC or the project. They originally planned a relatively hands-off approach to let the company use best-practices in its development. The problem is that CSC needed the expertise of the IRS agents and IT workers. The other problem is that the IRS went through five CIOs in seven years. In the meantime, CSC has gone through four managers to lead the project.

The CADE system is an impressive piece of technology—if it ever works. One the database is active, the IRS will use a customized version of the Sapiens eMerge rule-processing engine. Congressional tax laws are coded as business rules that the system applies to evaluate each tax return. The system includes an XML-based RulesScribe layer that handles changes and additions to the rules. The simplest 1040EZ tax form requires about 1,000 rules. Red Forman, associate IRS commissioner for business systems modernization, notes that "We are certain we will have tens of thousands of business rules once CADE rolls out, and that's just for individual filers" [Mosquera May 17, 2004].

In May 2003, Mark Everson was appointed IRS commissioner, and three weeks later, he appointed W. Todd Grams as the CIO. As of 2004, the project is nowhere near completion. The IRS and CSC have been repeatedly blasted by Congressional reports. Relationships between CSC and the IRS are tense. CSC has been banned from participating in additional IRS projects [Perez 2004]. On the other hand, in mid-2004, the FAA did hire CSC for up to $589 million to help build an enhanced Traffic Flow Management system [McDougall 2004].

In 2006, the IRS issued more than $318 million in refunds on phony returns because of a software failure. The IRS planned to replace the old screening system with a Web-based application by January 2006, but the organization spent $20.5 million with no progress being developed by CSC. The IRS tried to restore the old application, but could not get it running in time. In 2005, the software caught 133,000 fake returns, stopping $412 million in refund checks from being sent. Without the software, the IRS halted a mere $94 million in fraudulent refunds [Keizer 2006].

In 2007, the CADE system was operational, but not perfected. The IRS intends to use system in conjunction with its 45-year old Master File system until 2012. In 2007, the GAO accused CADE's slow processing times or delaying refunds for millions of taxpayers by several days. The CADE system also significantly exceed costs again in 2006 [Mosquera 2007].

## IRS Budget

Like any Congressional agency, the IRS budget is set by Congress and approved by the president. In 1995, The Clinton administration asked Congress to increase the IRS budget by 10 percent—allocating the money to improving the information systems and procedures at the IRS to make it more effective. Congress responded by cutting the IRS budget by 2 percent. The Clinton budget called for $8.23 billion, and the Congressional numbers cut the budget from $7.48 billion in 1995 to $7.35 billion in 1996. Congress did grant a slight increase in the budget for tax system modernization. Rep. Jim Lightfoot (R-Iowa) observed that "Without modernization, I think you're throwing good money after bad. The IRS is still working out of cardboard boxes. It's basically that bad."

## Alternatives

### Virginia

In 1991, John D. Johnson, the chief financial officer of the IRS was surprised when he contacted the Virginia state tax office regarding his personal state tax refund. On receipt of John's social security number, the Virginia tax commissioner typed it into the terminal on his desk. Within seconds, the answer was displayed on the terminal.

Mr. Johnson was shocked that the state agency could provide the information so rapidly. Attempting to obtain the same information from the U.S. IRS would take at least three days and probably several phone calls. The IRS promptly sent the chief information officer and 10 deputies to Richmond to check out the system.

### United Kingdom: Inland Revenue

In 1993, the United Kingdom decided to privatize computing for Inland Revenue, the UK equivalent of the U.S. IRS. Fueled by the success of privatizing the motor vehicle registration system, government managers evaluated the benefits of outsourcing the computer functions of the tax agency.

Inland Revenue signed a 10-year contract worth up to $2 billion with EDS subsidiary EDS-Scicon Ltd. to take over the information processing. EDS must still answer questions about security and labor/hiring practices. The arrangement calls for EDS to purchase $105 million of equipment from Inland and to hire 2000 of its 2500 workers. Inland would keep about 300 managers.

The union representing Inland information-processing workers is protesting the decision, citing security and privacy concerns as reasons to block the deal. Inland managers responded by noting that Inland Revenue and the British government "attach the greatest importance to safeguarding the privacy" of taxpayer information. They also stated that Inland would retain responsibility for confidentiality and would punish any breaches through "legal sanctions." An EDS spokesperson concurred and noted that EDS has strong safeguards to protect confidential information.

**Client Server Technology to Provide Federal Tax Collection**

The First National Bank of Chicago and NationsBank Corporation in Charlotte, North Carolina, are developing one-half of the federal government's Electronic Federal Tax Payment System. In doing so, it has nine months to put together a program that will process taxpayer data and provide online querying and batch updates on settlement transactions for customers and the IRS. AT&T is developing the telecom and voice-recognition services; ISSC is providing the data-processing services; and Intranet is providing the Automated Clearing House transaction-processing software. Because the development deadline is so short, the focus is on client server rather than a mainframe application.

According to Marybeth Anderson, manager of the project for First Chicago, the development group wanted to focus on object-oriented technology in the database work because development using DB2 would take much longer.

To construct their half of the program, NationsBank has subcontracted the project to First Data Corporation in Hackensack, New Jersey. First Data is building the program on their current base of *TaxLink*.

Once the program is completed, First Chicago and NationsBank will become the financial agents for the Treasury Department. They will develop and operate information systems that will enable the electronic handling of tax payments and taxpayer information. Treasury projects it will save $433 million through 1999 by eliminating paperwork from the collection of the corporate and individual tax payments. The two banks will each collect more than $400 million in transaction fees for their half of the total volume of tax payments.

According to John McGuire, director at Treasury's Financial Management Services, splitting the systems between the two banks will give taxpayers the best possible service and the government the best possible bargain.

## The Future

In the meantime, the IRS still has to process taxes. So far, electronic filing is probably the only thing keeping the agency alive. Yet, if anything goes wrong with the ancient Master File system, the IRS is dead in the water. The IRS, CSC, and IBM have no choice but to get CADE running correctly as soon as possible.

Talk to citizens about paying taxes and you get lots of interesting responses. Yet, a critical feature of the system is that everyone has to believe that they are being treated fairly—meaning the same as everyone else. If people somehow perceived that millions of others are getting by without paying taxes, everyone will revolt. For years, since the 1980s, the IRS has relied on a relatively simple system to automatically scan returns and identify possible tax cheats. The problem is that the rules are based on data and an economy from twenty years ago. The system is no longer catching the real tax cheats. In 2002, the IRS began collecting new data and designing new rules to identify which returns should be scruti-

nized more carefully. With a 13 percent increase in tax returns and a 29 percent decline in the auditing staff since 1995, the IRS has to rely on automated systems to analyze the returns. Charles O. Rossotti, the IRS commissioner at the time could not give details of the new rules but did note that "The fact is, people who make more than $100,000 pay more than 60 percent of the taxes, and we need to focus there" [Johnston 2002].

The electronic filing system is critical to improving productivity at the IRS. Without it, thousands of people have to enter data from the paper forms into the computer system. Yet, the existing system has several problems. Notably, it often rejects 1040 forms because of errors. The errors are anticipated, because people often make simple mistakes while entering data into their systems. The problem is that the IRS system tends to reply with cryptic messages that users have trouble decoding. The IRS is aware of the problems, but cannot decide how to fix them. Terry Lutes, associate chief information officer for information technology services notes that they cannot decide whether to fix the existing system or build a new one. He asks "It's a question of: How much money do you spend on a system that's going to be a throwaway?" But, the drawback to a new system is that optimistically, it would not be in place until 2010 [Olsen 2004].

To top off all of the operational problems, the IRS is being criticized by the GAO because of problems with its internal accounting procedures. The GAO has been nagging the IRS about problems with their financial management system for a decade. Of 100 recommendations from the 2003 audit, the IRS has implemented only 24. The IRS is planning to address many of the other problems with another part of its modernization system, the Integrated Financial System [Mosquera April 30, 2004].

The IRS reported [2008 U.S. Budget] that electronic filing has increased from 31 percent in 2001 to 54 percent in 2006. This trend simplifies data collection and processing at the IRS, but it probably has limits.

The IRS held preliminary negotiations with vendors to outsource management and maintenance of its 100,000 desktops, but canceled the plan in late 2006. The IRS also scaled back its separate plan to outsource the handling of paper returns to a contractor. IAP Worldwide Services ran two processing centers, the other five were rescheduled for transfer after the 2006 tax year [McDougall November 2006]. However, formal dates for transfers were not scheduled.

In 2007, the IRS awarded a five-year, $9.6 million contract to General Dynamics to help manage the business systems modernization project. Although details were not provided, the role appears to be implementation-oriented instead of development [Hardy 2007].

## Case Questions

1. Why has the IRS experienced so many problems developing its information systems?

2. The GAO thinks the IRS should place more emphasis on electronic filing. Is the accounting office correct, or is the IRS approach better? Write a proposal supporting one of the two sides, emphasizing costs, benefits, risks, and opportunities.

3. Why was the State of Virginia able to build an integrated system by 1991, but the IRS still does not have the same capabilities?

4. Are there any ways to speed up the development of systems for the IRS? What would be the costs and risks?

5. What would be the advantages and drawbacks to outsourcing the IRS information systems, similar to the UK approach? How does that approach differ from the methods used by the IRS?

6. Why did the IRS choose private banks to develop the electronic payment system? Could this technique be used for other systems?

7. What are the differences between the IRS proposals and the GAO suggestions? What are the advantages of each approach?

8. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

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## Nintendo

The video game market has progressed through several stages in terms of hardware and software. But it has also faced many changes in leadership. The early battles were between Nintendo and Sega, but personal computers always had a role. Microsoft pushed this role by introducing its own game box. Then consumer-electronic giant Sony jumped into the battle and captured a big chunk of the market. The battles between manufacturers sometimes depend on hardware and the ability of one manufacturer to leapfrog the others with an earlier introduction of the technology. Other times it comes down to creativity in games or other features.

In 1991, Sega was the first to introduce the Genesis game machine that used 16-bit computations for faster games and more detailed video displays. It was introduced in time for the 1991 Christmas season with several game cartridges available. Genesis also maintained compatibility with older games. With the technological lead on Nintendo, it looked as if Sega was ready to take the lead in the $6 billion dollar market for home video games. By Christmas, when Nintendo introduced its own Super NES 16-bit game, Sega held the lead in sales. Sega's gain came partly from introducing the machine earlier and partly by selling it for $50 less than Nintendo's machine. It also had more games available.

By most management measures, Sega Enterprises was ready for the huge Christmas season that began in September 1991. Its inventory system was automated, using Computer Associates' software on an IBM AS/400. Executives had personal computers loaded with Microsoft's Excel spreadsheet. Each night an EDI service bureau collected sales data over phone lines from 12,500 retail stores across the United States and passed them on to the Sega AS/400. Overnight, the computer created reports detailing sales of the Genesis machines and corresponding game cartridges that were sold the day before. Additional reports could be created by the MIS department but often took days to create.

By any modern measure, Sega Enterprises had all of the information managers needed. Yet, Sega of America executives were facing a crisis in 1991. They did not have sufficient access to the data to make correct decisions. The retail stores were furious because Sega could not deliver machines to them fast enough. To salvage this crucial selling time, Sega used air freight to ship the games directly from Japanese factories to the U.S. stores. Despite helping Sega to its best year (selling 1.6 million units), this emergency airlift is estimated to have increased Sega's costs by $10 million. To that number, according to one estimate, you can add in $75 million in sales lost to Nintendo, because customers switched to Nintendo when the Genesis machines were unavailable. Sega executives knew the cause of the problem: the corporation's internal information system did not provide sufficient access to the data. By the time managers received the daily sales reports, it was too late. Similarly, although executives could use spreadsheets to analyze the data to spot trends, the numbers all had to be rekeyed from the reports into the spreadsheets [Hutheesing 1993, Computer Letter 1993, and Halper 1993].

Nintendo was formed in 1889 to sell playing cards. Since 1949, it has been run by Hiroshi Yamauchi, who inherited the company from his grandfather. He made several attempts at diversification, but most of them failed. He found success by concentrating on toys and arcade games. The huge success of the 1980 Game & Watch provided money to invest in the video game market. The original game machine was sold at a low price (about $65), with the intention of making money later on the game cartridges. Introduced into the United States in 1985, it sold 440,000 the first year.

Nintendo strictly controls the production of games for its machines. In Japan, no other company can create games for the machine. The Federal Trade Commission disallowed that strict position in the United States. But even so, vendors must first get approval from Nintendo and pay a royalty fee for every cartridge sold—reportedly as much as $10 per cartridge for the early systems. After eight years of selling the original machine, Nintendo took a risk with the Super NES in 1990 by producing a machine that was incompatible with the earlier cartridges. Yet, in the 1990s, Sega was the dominant company in the video games market. [Nintendo.com, Halper 1993, and Calrton 1995].

Before Christmas sales in 1993, Sega of America controlled almost 50 percent of the video game market, compared to the 7 percent it had in 1990. Sales in the U.S. division reached $1 billion. According to The Wall Street Journal (June 7, 1994, p. B2), the U.S. market for video game software was growing at the rate of 30 percent a year, and would total about $4.5 billion in 1994. Sega was actively developing interactive games based on CD-ROM technology. Nintendo had announced plans to introduce a CD-ROM component, but has repeatedly delayed production.

By 1994, Sega had still not resolved all of its delivery problems. For Christmas, the company released the Sega 32X game system as an upgrade to existing systems. It provided better graphics and sound, as well as faster action. Once again, Sega beat most of its rivals to the market and demand was high. The only catch was that owners of older Sega systems needed a special cable adapter to connect the game to older televisions that do not have separate audio and video inputs. Although the 32X machines were available, the $20 cables were impossible to find. Twelve-year-old Casey Overstreet pointedly observed that "You got this great game-playing system and you're going, 'All right!' Then you find out you can't play it" [Manning 1994]. Some retailers were not aware that the cable was needed, and Sega of America simply noted that it was sold out during the holiday season.

## The Nintendo Approach

Nintendo took a slightly different approach to the distribution issue. In 1989, Nintendo had 130 merchandising representatives who traveled to retail outlets. At each store, they recorded 14 pieces of data such as sales floor inventories, prices, and allocated shelf space. The data was recorded on forms that were mailed to headquarters and entered into the central computer. It often took one to two months for the data to be compiled into a report. Mark Thorien of Nintendo noted that "By that time, the information was so untimely that it was basically worthless . . . There are real dramatic swings between what people want one day and what they want the next. You have to stay on top of it, or you get stuck with a lot of inventory that you can't sell" [Halper 1993].

In 1989, Nintendo replaced the paper-based system with hand-held computers for all of the sales representatives. As data was entered into the machine, it was automatically transmitted back to the central computer. Messages could also be sent to from the corporate managers down to the sales representatives. Reports were now created in 24 hours. Additionally, there were fewer mistakes because of misread handwriting.

In November 1993, Nintendo of America signed a contract with Unisys to provide "Fast EDI" services between Nintendo and 15,000 retail stores. With the old methods, it took an average of five weeks for a licensee of a Nintendo cartridge to ship products to the stores. The new method was supposed to cut the time down to six days. The system gained speed by allowing licensees to store their products at the Nintendo central warehouse in North Bend, Washington. The EDI ordering system tied to the stores was capable of

processing sales for 15 million cartridges a year. By centralizing the warehouse and the EDI system, Nintendo could provide faster delivery of cartridges at a lower cost than licensees could obtain on their own. At the end of 1993, 11 retail chains had signed up for the system. Almost two-thirds of Nintendo games were produced by licensees. Most were small companies. Phil Rogers, vice president of operations at Nintendo, estimates that a comparable system would cost the licensees between $20,000 and $500,000 each, which the smaller companies could not afford. With the new system, a per-cartridge fee is paid to Nintendo and a separate fee to Unisys.

## 1995 and 32-bits

By 1993, Nintendo's U.S. market share in 16-bit games had slipped to 39 percent. In February 1994 Hiroshi Yamauchi, head of the Japanese parent company, removed his son-in-law Minuro Arakawa as head of the U.S. subsidiary. He was replaced by Howard Lincoln who was chosen to be more aggressive. By 1995, with improved marketing and new games, Nintendo's market share had risen to 57 percent

However, 1995 and 1996 offered new challenges to Nintendo and Sega: the introduction of 64-bit game players capable of three-dimensional graphics. Sega and new rivals like 3DO were to have 64-bit systems ready for the 1995 Christmas season. Nintendo would not. A lack of 64-bit games held the market down for a year. The big question was whether Sega could use the six-month lead to gain a major advantage. Both Nintendo and Sega suffered in Christmas 1994 sales, with retail sales down approximately 20 percent. In October 1995, Microsoft announced a set of programming tools that would enable personal computers to function as better games machines. Microsoft's stated goal is to make the personal computer the premier video game platform.

In 1998, Nintendo introduced the Game Boy Color, selling 100 million units by 2000. The portable unit was a hit with consumers, and kids carried it everywhere [Nintendo history].

## Microsoft and Sony

In November 2001, Microsoft launched the Xbox game platform. The system had a dedicated graphics card to handle high-speed 3D images, and a high-speed processor to provide realistic action, particularly in sports games. It was also the first video game system designed to play online broadband games, all for $300 [Microsoft press release January 8, 2002]. Nintendo launched the competing Game Cube in September in Japan and November in the United States and became a top-selling game system [Nintendo history]. Sony's PlayStation 2 had launched a year earlier and quickly gained market share. Although Sega's Dreamcast system was launched before the Sony PS2, Sony quickly trounced the Dreamcast. Sony over-hyped the system and was unable to meet the high demand when it was launched [Data Monitor 2004]. However, the year lead helped overcome the initial production delays.

| System | 2004 Sales | Installed Base |
|---|---|---|
| Sony PlayStation 2 | 6.4 | 22.3 |
| Microsoft Xbox | 3.2 | 7.8 |
| Nintendo Game Cube | 3.3 | 6.8 |
| Nintendo Game Boy Adv. | 8.1 | 19.8 |

In millions of units. Source: Gaudiosi 2004.

The Sony PlayStation 2 quickly gained sales and became the leading game platform. Annual sales are only one indication of importance. To game developers, the installed base is critical because it defines the potential size of the market for the software. Sony PlayStation 2 held that lead for several years.

## 2006 Xbox 360 v. PS3 v. Wii

The 2006 holiday season was shaping up to become another battleground. The major hype was Microsoft's Xbox 360 versus Sony's PlayStation 3. Both were designed with major technical advances and targeted hard-core gamers. Both could produce high-definition TV output for the next generation of realism. The Xbox 360 had an option to include a Toshiba HD DVD player. Sony had a version with a Blu-Ray player. But, Microsoft launched first and gain mindshare and market share by launching almost a full year before the other manufacturers. Sony was the market leader in 2006 with100 million PlayStation 2 machines sold, and Microsoft was basically buying market share—losing billions of dollars on the Xbox hardware. However, Sony struggled with delays in production of the PS3—particularly the Blu-Ray player. Sony managed to deliver only 197,000 systems to the U.S. market in 2006. In the end, it never really mattered. Some people expected long lines for the few PS3 systems that made it to the market, but the rush never materialized, partly because of the high price, but mostly because the Xbox was already out and everyone wanted the Nintendo Wii [Guth 2006].

The hot seller for 2006 and 2007 was the Nintendo Wii. The Wii was radically different from the earlier Nintendo systems and the Xbox 360 and PS3. (1) The system was considerably less expensive ($250). (2) The games were straightforward and easy to learn. (3) The games used a radically new controller based on accelerometers that enabled users to control action by moving their arms and bodies, much as you would in a real sport. The launch of the Wii sold out 476,000 units in the U.S. which almost topped the Xbox 360 500,000 sales in November [Bettenhausen 2007]. Satoru Iwata, Nintendo president said that the company deliberately set out to expand the game market to consumers who rarely play videogames.

In mid-2007, Nintendo was cranking out over a million units a month—and still not meeting demand. Entirely new groups of customers were clamoring for the active games based on the controller designed by Shigeru Miyamoto. When they could get them, even elderly groups bought them—for bowling tournaments and other sporting contests. From Nintendo's perspective the news was great. Nintendo makes about $50 on every unit. Sony and Microsoft, relying on expensive state-of-the art technology, lose money on every machine sold—hoping to make a profit on the games [O'Brien 2007].

Nintendo is also efficient, with Iwata pushing cost cutting and pushing suppliers to provide better deals. With only 3,400 employees, Nintendo generated $8.26 billion in revenue in 2006 or $2.5 million per employee. Profits amounted to $1.5 billion or $442,000 per employee. In contrast, Microsoft generated $177,000 and Google, highly praised for its profitability, managed $288,000. When Iwata joined Nintendo, Sony's PS2 was king and Microsoft was battling Sony to see who could add the most advanced features to appeal to the hardcore gamers. Mr. Iwata said that "we decided that Nintendo was going to take another route—game expansion. We are not competing against Sony or Microsoft. We are battling the indifference of people who have no interest in videogames." The strategy is known as "blue ocean" based on a book by W. Chan Kim and Renee Mauborgne. Most industries have an intense rivalry in the primary market or "red ocean" (for the bloody fights). By moving

into the open blue ocean, Nintendo leads the way into a new market with minimal competition at the start [O'Brien 2007].

By July 2007, demand for the Wii was still outstripping supply. Part of the shortage was likely due to Nintendo managing the supply chain—it is difficult to ramp up to millions of units in one month and then falling back to zero the next. It is more efficient to maintain a steady production rate. But demand was still a huge factor. By July, 2.8 million Wii consoles were sold in the United States, more than double the number of PS3 systems sold [CNN Online July 2, 2007]. Some experts and Mr. Iwata began suggesting that the Wii could overtake the lifetime sales record of the PS2 of more than 100 million units. Sony cut the price of its PS3 by $100 in July, but experts did not expect the action to affect sales of the Wii [CNN Online July 13, 2007].

In July 2007, Microsoft realized that there was a hardware problem with the Xbox 360. The company had shipped more than 10 million consoles worldwide since November 2005, but several of them were crashing. Microsoft decided to support customers by extending the warranty to cover machines that were failing. The company took a $1 billion charge to cover the costs of the anticipated repairs [The Wall Street Journal 2007].

## Case Questions

1. Who are Nintendo's competitors?

2. Is Nintendo's strategy of leaving excess demand a good idea?

3. How can Nintendo know how many game systems to produce for the holiday season?

4. Nintendo has long had a policy of creating its own games. Is this idea good or bad?

5. How difficult will it be for Nintendo's competitors to build similar features in their products? How long can Nintendo maintain its advantage?

6. Write a report to management that describes the primary cause of the problems, a detailed plan to solve them, and show how the plan solves the problems and describe any other benefits it will provide.

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