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SR Corp: Decisions for an Emerging Technology

INTRODUCTION

In January 1994, Darr Hastings, vice president of Marketing for SR Corp, was flying back to Boston from a conference in San Francisco. Hastings knew that he had to deliver a recommendation to the company's board the next day regarding a major strategic marketing direction.

SR Corp was about to announce its new product, the Colloquial Speech Platform 2000, a revolutionary speech recognition system that was at least three to four years ahead of the competition. Hastings's research had shown three primary markets for the new technology: Fortune 500 corporations, telephone companies, and telephone switch manufacturers. He felt that SR Corp's products and organization were not sufficiently mature to pursue all three market niches at once, particularly since each niche would use speech recognition for significantly different applications. Even within a particular niche, Hastings believed that SR Corp could only support the systems integration activity in three companies during the first 18 months of commercialization. He thought that SR Corp's best hope for success would be to successfully install the system in a first customer, and then leverage that experience as much as possible by targeting a similar type of company as the next customer.

Making the wrong decision with respect to which market niche to pursue first would waste precious time and could cost the company its lead in technology. By working directly with end-user companies, such as Fortune 500 corporations or telephone companies, SR Corp could capture more margin on its product sales and have greater control over specific accounts. On the other hand, working through strong intermediaries, such as telephone switch manufacturers, might provide SR Corp with more rapid market penetration and help it reach the goal of becoming the de facto industry, standard for speech recognition technology.

The wrong decision could easily put the firm out of business. Much larger firms, such as AT&T, were aggressively trying to achieve SR Corp's level of technical performance. The financial resources of SR Corp, like those of most small firms, were precarious. Having been capitalized to date with approximately $10 million in venture funding, the firm's investors now needed to see tangible sales before providing additional funding.

As he leaned back in his seat, Hastings thought about all the marketing he had recently studied in an executive M.B.A. program. He felt insufficiently prepared to tackle the job ahead of him: market prioritization for an innovative, preemptive technology. He thought to himself:

> I've read Porter and many of the leading books available on positioning and competitive strategy to help in this effort. They are great for providing strategic recommendations for stable markets that contain clear distribution patterns and no real threat of predatory invasion from new technologies. However, most of the concepts do not apply to our situation—an emerging industry where no markets are certain and the threat of obsolescence is around every corner.

COMPANY BACKGROUND

SR Corp was formed in 1986 to develop and commercialize speaker-independent speech recognition, the ability of a computer to recognize and take action on the spoken word. SR Corp's mission was

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This case was prepared by Marc H. Meyer and G. Thomas Aley, Northeastern University. This case was written solely for the purpose of stimulating student discussions. All events and individuals are real but names have been disguised at the company's request.

to deploy a new generation of speech transaction technologies, products, and systems that could be easily integrated into telephone and computer networks. The company's goal was to become the leader in a new realm of human communication.

SR Corp had been financed over the last eight years through a private investor who had been a successful entrepreneur in the publishing industry in the early 1980s. By 1994, the firm had 20 employees. The management of the firm was comprised of Dr. Gary York (president and CEO), Hastings (vice president of Marketing), and Dr. Paul Schall (vice president of Engineering). The company also had a chief operating officer, Ms. Sheila Garris, who was responsible for systems manufacturing and finance. Most employees were software and hardware engineers, reporting to Dr. Schall. Dr. York was the inventor of several key parts of SR Corp's proprietary technology, and several of the firm's patents were in his name. Hastings had only one administrative assistant and knew that he would have to expand his sales force over the next several years in order for the firm to grow.

Between 1986 and 1994, the company focused on developing its core technology while working with major telephone companies and Fortune 500 corporations to find out what they wanted in large-scale speech recognition systems. On the basis of feedback from these organizations, SR Corp created a system that Hastings's competitive research had shown to be years ahead of the industry.

THE INDUSTRY

A leading market research firm's 1993 report on speech recognition summarized the common industry opinion: "Voice recognition is the least developed of voice technologies and is widely considered to be a technology still in its infancy. Industry experts agree it will be at least a decade before a mature voice recognition product is introduced in the market."[1] The power of SR Corp's systems, if successfully commercialized, could shatter this perception.

Speech recognition had a history of research long on promise but short on tangible results. Bell labs initiated work in this area nearly 30 years ago. The initial technology worked only in the most constrained situations—understanding a few single isolated words using a high-bandwidth microphone in a noise-free environment. Progress had moved slowly toward the goal: computer understanding of unconstrained conversation with any caller under difficult telephone network conditions.

TYPES OF SPEECH RECOGNITION

The most popular form of speech recognition deployed in 1993 was called speaker-dependent speech recognition (SDSR). The term *speaker-dependent* referred to the fact that the person using its first "trained" the system by loading it with his or her own voice patterns for a selected set of words necessary for the application. For example, Sprint Corporation developed a system, the Voice FonCard, which allowed users to record up to thirty names over the phone and store them in a central database at the telephone company. When someone wanted to place a call, he or she would simply speak the name of the person they wanted to call into the phone for automated dialing.

Speaker-independent speech recognition (SISR), on the other hand, would allow any person to use a system without first training it. AT&T had recently implemented a speaker-independent collect-call application in which an automated attendant instructed the person to say "yes" or "no" in order to accept a collect call.

Speaker-dependent systems were accurate 95 percent of the time, while speaker-independent systems had achieved only 80 percent accuracy. The most important factor in weighing the technical capabilities of different speech recognition vendors lay in their ability to improve accuracy levels on an annual basis. In the past decade, it had typically taken about one year to achieve a one to two percent improvement in accuracy.

[1] Rettig, Hillary, "Not Quite the Last Word." *VARBUSINESS Networking Annual*, Oct. 15, 1993, p. 4.

In 1994, speaker-independent speech recognition could be subclassified into two different types of systems: discrete and continuous. Discrete speaker-independent speech recognition was used for command and control of speech applications where users say one word at a time. Continuous speaker-independent speech recognition allowed users to speak naturally into the computer system.

Discrete speaker-independent systems were commonly referred to as "voice-buttons" because the technology replaced pressing buttons on the telephone. This technology was available in 1994, but was limited in its application because accuracy levels had reached only 90 percent. The pressing short-term challenge for vendors was to reach 99 percent accuracy. Following historical progress rates, industry experts predicted that this goal would be achieved around the year 2000.

The longer-term challenge for speech recognition was to reach 99 percent or better accuracy levels for continuous speaker-independent speech recognition. Once again, most industry experts did not expect highly accurate continuous speech systems to achieve this level of accuracy until after the turn of the century.

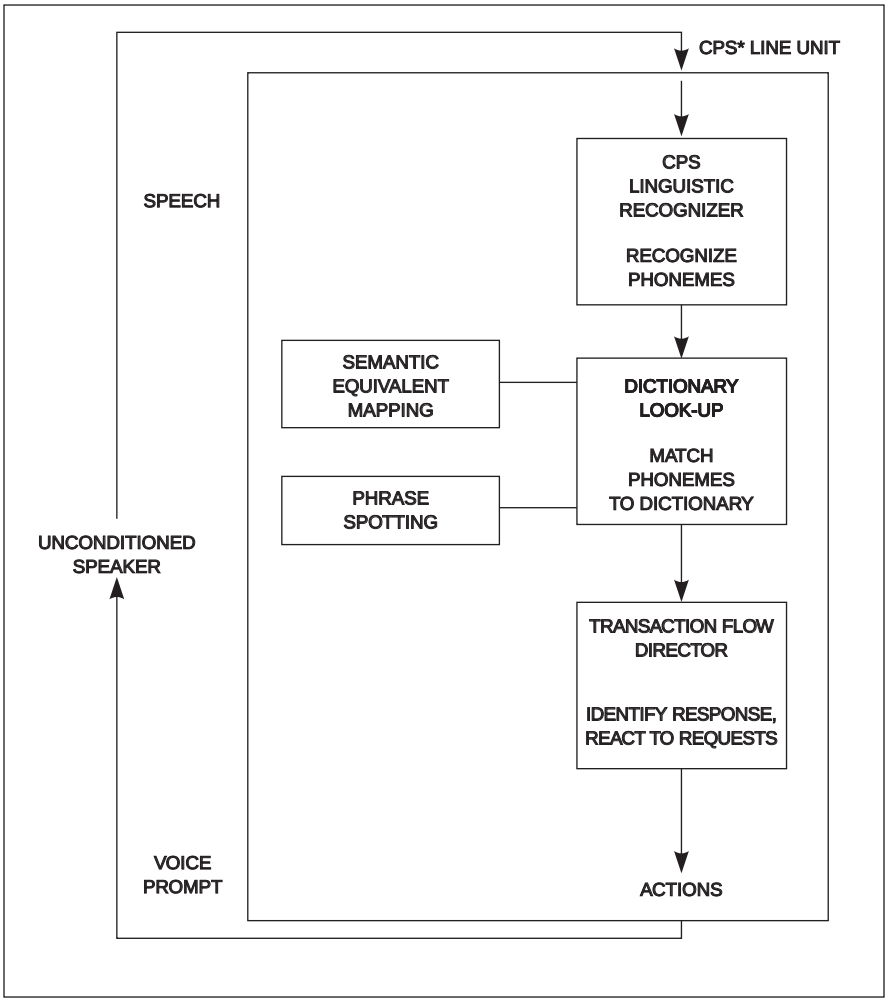
Speech recognition vendors such as AT&T and Texas Instruments (TI) used the Hidden Markov Method as the central process for algorithms in their products. Programmed into software, this method provided voice pattern-recognition based on complex statistical programming. These statistical patterns had been developed utilizing laboratory data and generic language models. The resulting systems had large processing power requirements and typically operated on workstations running in excess of 20 mips (millions of instructions per second) for the central processor. Each system needed at least one workstation per telephone line of speech recognition. In addition, an important part of any system was its ability to allow companies to build new applications. Existing systems came with very limited software development environments; users were dependent on vendors for sophisticated applications development.

SR CORP'S PRODUCT: THE CORE TECHNOLOGY

By 1994, SR Corp developed a speech recognition system that industry experts had not expected to be available until 2000: a discrete, speaker-independent speech recognition system that operated with 99 percent accuracy for numbers zero through 10, "yes" and "no," and an application-specific vocabulary of words spoken in sequence. That vocabulary could exceed thousands of words for complex applications, such as automating directory assistance in a large telephone company. Like existing discrete systems, the typical application built with SR Corp's system would have menus to guide a user's transactions. However, unlike these systems, SR Corp's technology would allow the user to speak a stream of words (with short breaks between them) to totally bypass the application menu. This was a direct step toward the highly accurate speaker-independent continuous speech recognition system that SR Corp expected to have operational within three years. The combination of accuracy and menu bypass made SR Corp's current system highly distinctive; the prospect of delivering continuous speech capability within a few years made the company even more attractive for prospective customers.

To achieve these results, SR Corp had proceeded along a different technological path than AT&T and other large vendors. It developed a pattern-recognition approach based on a neural network model, and its algorithms differed fundamentally from existing approaches. Further, the company had achieved constraint-free telephone recognition using Intel 486-based personal computers running in the 20- to 30-mips range. Seven U.S. and foreign patents for SR Corp's technology had been issued and others were pending. These patents were issued between 1990 and 1994 and would, therefore, be in force well into the next century unless successfully challenged in court. The company had also developed a Transaction Dialogue Authoring System that allowed new applications to be developed by the user in a higher level language. **Exhibit 1** is a flowchart of an SR Corp conversational transaction.

EXHIBIT 1
SR Corp's Conversational Transaction Flow



* CPS is the Colloquial Platform for Speech
Source: SR Corp Documentation

SR Corp's product was designed to be integrated at reasonable cost into any network, whether it be a central office of a telephone company or a local area network of a major corporation. The system could be delivered in a variety of configurations, with two PC boards supporting one telephone line of speech recognition. The boards shipped in a chassis; each chassis contained ten boards, and thus supported five lines of recognition. The approximate cost of goods sold for the five-line system was $3,000.

SR CORP'S MARKET

SR Corp hoped to gain a cost advantage with its technology over Hidden-Markov based systems. Hasting's research had shown that the speaker-independent discrete voice recognition systems were currently selling at an effective price of about $6,000 per line of recognition, including the cost of the workstation itself. Hastings found that, in large-volume orders (10,000 units were not unusual for telephone companies), discounting drove competitors' pricing down to about $3,000 per line of recognition.

Since SR Corp's product could handle at least two and as many as five lines of recognition per workstation (compared to the single-line systems of competitors), Hastings believed that SR Corp's product could be priced between $5,000 and $10,000, depending on the size and type of customer. Even with large-volume orders, Hastings believed that the SR Corp's cost advantage over competitors for equivalent processing process configurations would remain 3 to 1.

The 99 percent accuracy of the system would also allow many customers to apply speech recognition to applications that they had previously avoided due to the error rates of competitors' systems. Further, while existing speech recognition systems were single-application products, SR Corp's system could be used as a single platform for developing many applications. For example, a telephone company using a competitor's system would have to develop software running on two completely separate sets of workstations to implement both voice dialing and voice mail. Using SR Corp's technology, a single set of workstations could be used to perform both applications. For large users, the resulting cost differential could be considerable. For example, if a telephone company was to purchase a single unit for each application, the two-application (two line) scenario would cost approximately $12,000 with a competitor's technology. SR Corp's solution would cost $10,000 for a maximum of five lines of speech recognition, for an effective cost per line of $2,000. Therefore, the two-line scenario would be priced at $4,000, providing SR Corp with an $8,000 cost advantage over competitors. For large-volume orders, both SR Corp and its competitors would discount their prices by about 50 percent. This would still yield a full system cost of $3,000 per line for competitors versus $1,000 per line for SR Corp. This was a substantial cost advantage because large customers might purchase thousands of units for any single application.

Most companies in SR Corp's target markets had many potential applications for speech recognition. Hastings's discussions with representative customers in various market segments revealed that the typical customer would wish to buy between 100 and 500 systems for an initial speech recognition application such as automating a customer service function. This would produce initial revenues in the range of $1 million to $.5 million per customer.

By 1994, the entire U.S. speech recognition market was a $350 million industry. Its market segments included telephony, data entry, dictation, consumer products, computer control, and voice verification. (**Exhibit 2** shows the speech recognition market forecast through 1996, and 1992 revenue by market shares.) The VARBUSINESS Networking Annual, a leading industry forum, forecast that annual sales of speech recognition equipment would exceed $3 billion by the year 2000.[2]

SR Corp's product was targeted at the telephony market segment. Telephone-based speech recognition offered great potential due to the pervasiveness of voice communication and the lack of alternative methods for high-bandwidth input. It was also the largest market segment, representing 27 percent of the market. Telephony applications were expected to grow rapidly and expand to 60 percent of installed speech recognition systems by the turn of the century, according to *VARBUSINESS Networking Annual*.[3]

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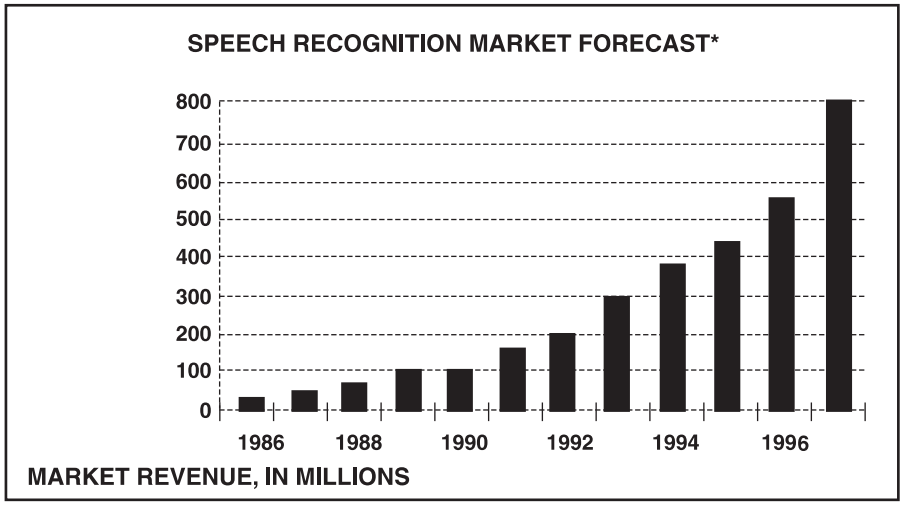
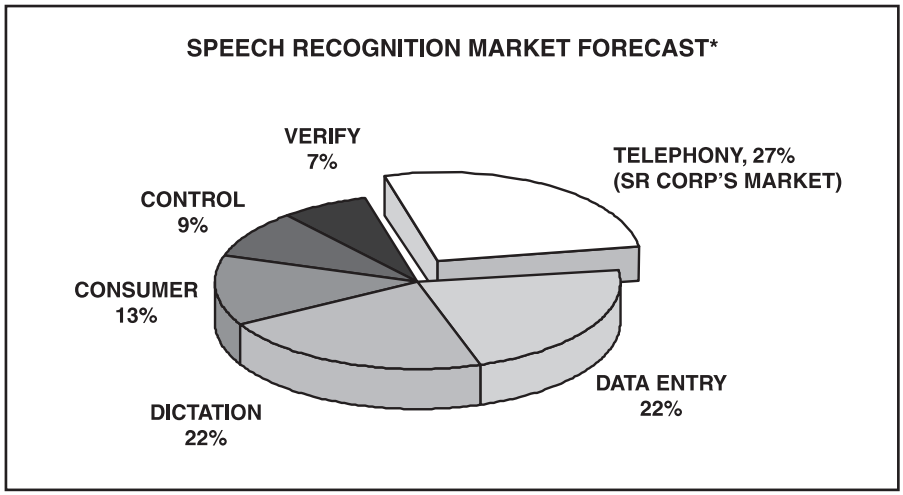
[2] Rettig, op. cit.

[3] Rettig, op. cit.

EXHIBIT 2
Market Forecast and Segments





Source: Voice Information Associates, Lexington, Mass.

Hastings divided the telephony segment into three major niches:

1. Fortune 500 companies
2. Telephone companies
3. Telephone switch manufacturers, which sold equipment to telephone companies

Hastings also realized that telephony applications could be difficult due to the lack of control over the conditions of use. Problems included a large and unpredictable user population, differences in handset microphones, the presence of channel noise, and low signal bandwidth. In 1994,

the most successful speech recognition systems used by large industrial, transportation, and financial firms, and by telephone companies, were limited to very small vocabularies (10 to 20 words spoken in a discrete, noncontinuous manner). Yet even these systems had provided substantial payback by reducing the need for telephone operators and/or customer support personnel.

SR CORP'S COMPETITORS

The major competitors in the telephony market segment included, AT&T, Texas Instruments (TI), Northern Telecom, Nynex, Bolt Beranek & Newman, Voice Control Systems, and Voice Processing Systems.

All of these companies were selling speaker dependent and limited discrete speaker-independent systems. Each competitor had approximately 10 percent market share of the telephony segment. None had achieved technical leadership with regard to accuracy levels, with all averaging 90 percent for speaker-dependent systems and 80 percent for speaker-independent systems.

AT&T, the largest and most threatening competitor, had stated that it would deliver discrete, speaker-independent speech recognition reaching 99 percent accuracy no earlier than 1998. AT&T made no claims with respect to more advanced continuous speech recognition. Although by mid-1994 SR Corp had not sold any discrete, speaker-independent systems, its internal tests proved that the system they developed was 98 to 99 percent accurate.

All the competitors had been extraordinarily secretive about their R&D. The speech recognition industry had been litigious: lawsuits had been initiated to challenge patents, intellectual property, and even the loss of scientists from one firm to another. In one case, TI had the federal government raid Voice Control Systems three weeks after two former TI scientists began working for Voice Control Systems. The case was settled out of court.

Therefore, while Hastings was ecstatic about the technological break-throughs achieved by his firm, he thought that he had to be very careful about who he talked to in this early stage of commercialization. Hastings believed that SR Corp's technology had to be kept secret until market share was secured. SR Corp had thoroughly researched existing speech recognition patents and was confident that its patents did not violate any of them. However, any large firm seeking to block SR Corp's entry into its market (be it a firm selling voice-button systems that SR Corp's technology would make obsolete, or a firm such as AT&T that was trying to develop its own advanced system) might be a problem. In Hastings's view, an intellectual property suit filed against SR Corp by AT&T or TI would consume scarce management and financial resources and could drive the company out of business.

STRATEGIC MARKETING ALTERNATIVES

The day after Hastings's return from San Francisco, an executive management committee meeting was convened comprised of himself, Dr. York (president), Dr. Schall (vice president of Engineering), and the lead investor. Together, they had to make a decision regarding which niche within the telephony segment to pursue during the coming year, e.g. Fortune 500 corporations, telephone companies, or telephone switch manufacturers.

Dr. Schall described the continued positive results of the most recent field tests of SR Corp's product. He was deeply concerned about selecting the company's first set of target customers:

> This will be a critical step in our success because we need to utilize our initial customers as references for future sales. We also need knowledgeable customers, or else we will never get past the first installation. At the same time, we must try to avoid becoming entangled and delayed by the red tape of the bureaucratic organizations of some of these customers, such as a mutual fund company or a telephone company. Time is of the essence.

Hastings concurred, and then added:

> We can't afford to pick a strategy that brings us to the wrong customers. Once we dive in with a customer, we'll be devoting most of our efforts toward integration

> and deployment. These ramp up issues are of strategic concern because if we are six months into a project and suddenly discover that a customer's lack of technical skill or bureaucratic politics will delay final implementation, we could be in serious trouble; we'll have hired 10, maybe 15 people, set up a satellite office, and the bills will have to be paid. Further, we could have been working with a better customer either in the same or some other niche in telephony.

Hastings gave examples of how the sales cycle could be lengthened by a prospective customer's bureaucratic decision making. For example, a telephone company might have more than a half dozen departments, ranging from operator services to consumer marketing, that would be users of the same integrated speech recognition system. Each department would have a separate budget for systems procurement, and therefore all would have to agree to "pitch in" resources for a major systems procurement.

He also spoke about complications that could occur after the sale was completed. For example, several telephone companies had agreed to contracts for existing speech recognition technology with SR Corp's competitors only to cancel the projects after a year of effort, even though they had already spent in the range of $1 to $2 million. The telecommunications industry was undergoing dramatic consolidation, and these project cancellations were dramatic evidence of how efforts involving exotic technologies could come to naught. Further, some of SR Corp's smaller competitors had been stalled in their attempts to market their own technologies by intellectual property lawsuits filed by larger, better established companies. The stakes were high and companies played "hardball."

Both Dr. York and the lead investor wanted to forge ahead with sales. Installing SR Corp's system at a large customer site would require allocation of a significant portion of the company's resources. While everyone believed that securing three large accounts was a reasonable objective in the next 18 months, SR Corp's limited resources would require that implementation to the three customer sites be performed sequentially. Dr. York said that the company would also have to create remote offices near each major customer to provide field support and technical training. Hastings also believed that SR Corp would have to ramp up investment in its marketing activities for direct sales and trade show exhibitions.

The lead investor indicated a willingness to supply additional funding. However, he wanted to see a clear marketing plan and customer contracts that garnered a significant portion of the total sale up front to help cover systems integration expenses.

Hastings then presented the data he had gathered from company visits and industry expert sources, addressing first the Fortune 500 niche, then the telephone company niche, and lastly, the telephone switch manufacturer niche. From these data, SR Corp's attack plan would be formed.

The Fortune 500 Market Niche

The Fortune 500 niche was comprised of large corporations in a variety of industrial, consumer products, and financial industries. More than half of these companies had already purchased interactive voice response and voice messaging customer premise equipment used for customer service and ordering applications. SR Corp's product would be marketed as the next generation of voice response and voice messaging technology, featuring greater accuracy, menu bypass capability, a multiapplication functionality, and at least a 3 to 1 cost advantage on an equivalent processing power basis.

In 1994, voice response systems only allowed companies to automate certain customer service functions. For example, callers might be greeted by menus such as "press 1 for sales, press 2 for service," etc. Callers navigated through menus by pressing the right buttons on their touch-tone phones. With speech recognition, the caller would reach a truly automated "operator," who would ask: "Would you like sales, service…?" etc. and wait for the caller to say what he or she wanted.

Voice messaging enabled callers to leave messages for employees in companies. Users pushed buttons on their phones to manage their voice mail

(e.g., they would press 1 to delete a message, press 2 to go to the next message, and so on). With a speech recognition system, users could simply say "Delete the first message," "Go to the next message," etc.

SR Corp's product was a substitute system for both voice response and voice messaging systems. Companies using voice response and voice messaging systems needed a gateway to voice services that was easy and quick to use. Users often expressed dissatisfaction with the limitations of voice response and voice messaging, and in particular, were annoyed by the long, cumbersome, and inflexible menus contained in these systems.

For example, a voice-button system in an airline might result in the following dialogue:

System: Thank you for calling American Airlines. In order to expedite your call, please press 1 if you're calling from a touch-tone phone. If you have a rotary phone, please hold the line and a customer service representative will be with you shortly.

User: Presses 1.

System: Please make your selection from the following menu:

- For flight arrival times, departure times or gate information, press 1.
- For domestic reservations and fare information in the 50 states, press 2.
- For international travel, including Canada and the Caribbean, press 3.
- For Fly Away Vacations, press 4.
- For Frequent Flier Mileage accounts and information, press 5.
- For all other inquiries, press 6.
- Press 7 to repeat the menu.

The user might then be able to press a button corresponding to what he or she actually wanted. However, if after listening to the entire menu, the user still did not know what button to press, he or she might press 6, calling up yet another automated menu, or 7, to hear the menu again.

With SR Corp's system, such a call could be greatly simplified—for either a touch-tone or rotary phone:

System: Thank you for calling American Airlines. Tell us how we can help you. Be sure to leave short breaks between your words.

User: I need to check my frequent flier miles.

System: The call transfers to the Frequent Flier Division.

Hasting's interviews with prospective customers in the Fortune 500 niche showed that they wanted a system that would allow this type of natural, conversational exchange with a high degree of accuracy. These large companies needed systems that their own customers would find easy to use for performing automated, non-human-assisted transactions. Replacing touch-tone keypad operation with speech would accelerate user acceptance, particularly if the user could skip ahead through menus once they became familiar with routine transactions. Any system would have to function accurately with "unconditioned" speakers, that is, speakers who were not trained beforehand to use an artificial protocol for interacting with the system. Companies would also require a flexible and productive software development environment so that their own computer staffs could build customized applications without overreliance on the vendor. SR Corp believed that it was well ahead of its competitors in providing this type of solution for the Fortune 500 market.

SR Corp could initially target industries that had the largest number of telephone transactions per day using voice response and voice messaging systems. These industries included the competitive access telephone services providers (CAPs), airlines, financial services companies, and catalog mail order companies. (See **Exhibits 3** and **4.**) Almost every major Fortune 500 company that completed transactions over the phone utilized some form of interactive voice processing and many used an alternative access provider rather than their local phone company to save money. In 1993, the typical CAP processed over 250,000 calls per day. The travel industry also had high volumes. By 1989, American Airlines was taking 100

EXHIBIT 3
Target Fortune 500 Industries

Industry or Company	*No. Transactions per Day*	*Forcing Function*	*Applications*
Telcos (CAPs)*	250,000	Extremely competitive with other CAPs,* local exchange carriers.† Interexchange carriers.‡ Access provision 80% of business. Adoption high (50% NYC); increase new services.	Centrex services only Voice dial Operator services
Metropolitan Fiber Services Corp.			
Teleport			
Inner Media			
Travel	1,000,000	Airlines hate paying commissions to travel agents, but they represent 90% of overall business. Volatile pricing environment, monopolistic competition.	Reservations, flight times, schedules, weather, personal flight information
United			
American			
AmEx TRS		Extremely competitive; razor thin margins.	
Banks	65,000	Rapid consolidation and acquisitions from drop in regulations. Savings from consolidations going into tech spending. Intense competition, and SR tech could give edge that would do more than just increasing CD rates by 1%. With regs dropping, new services are the rise.	Obtain checking, credit card, stock, mutual fund info. & services Loan/mortgage Acceptance ATM locator service
Bank of America			
Banc One			
Chemical			
Catalogs	200,000	Heavy competition. Immense cost for customers to hold to place order, ties up potential sales revenue; if hold is too long, customer could leave and buy product elsewhere. Heavy automation within the industry.	Preview customer info Automate order process Obtain shipment status Obtain account and billing info
Home Shopping Network			
J.C. Penney			
QVC			

*Competitive access providers (CAPs) are competitors to local telephone companies in major metropolitan areas, and primarily serve Fortune 1000 customers.
† Local telephone companies such as Regional Bells and GTE.
‡ Long distance companies such as AT&T and MCI.
Source: SR Corp Internal Document.

EXHIBIT 4
Advantages and Disadvantages of Prospective Fortune 500 Targets

Industry or Company	*Pros for Leading Company*	*Cons for Leading Company*
CAPS	MFS: Highest growth rate in switches and cities.	Not adding oper service until next year;
Metropolitan Fiber Services Corp.	Only CAP dedicated to operator services.	most money comes from providing access.
	Need SR Tech for Oper Service efficiencies.	
Teleport	Fast, driven, innovative, $, national.	Wouldn't be ready for us just yet.
Inner Media	Not as large as LEC, fast sales cycle.	
	Only CAP going after providing LDist service.	
Travel	United: 4800 operators, have skipped IVR	Affordability a major concern.
United	system because transactions are not static.	Testing would take Approximately 10–16 months.
American	Said they have been looking for effective	
AmEx TRS	speech recog, but AT&T can only do 95% on 0 through 9; if anyone could get higher, "we could keep them busy just doing hundreds of apps for our company."	
Banks	Bank of America: The Security Pacific acquisition	Any bank will need solid, large references before they purchase technology-based solutions.
Bank of America	brought a high tech focus to the company	
Banc One	operations and they are extremely committed	Very cautious.
Chemical	to technology to drive business.	
	Corporate clientele on rise with Continental acquisition.	
Catalogs	Home Shopping Network: Incredibly devoted	Potential use as a reference may be difficult.
Home Shopping Network	to technology-driven processes. In fact, their	Would Home Shopping Network be as good as an airline or telco?
J.C. Penney	Annual Report discusses their different	
QVC	methods for 6 pages.	
	Phones so important, HSN built own IVR company and later spun it off.	

Source: SR Corp Internal Document.

million reservation calls per year.[4] This translated into about 274,000 calls per day (or about 3 calls per second). Similarly, large banks, on average, processed about 65,000 calls per day.

Companies in these industries had looked to voice response and messaging systems as a way to create efficiencies and automate portions of their operations. The total 1993 revenue for the domestic voice response and voice messaging systems in the Fortune 500 niche was $1.1 billion. Vendors of these systems were also highly profitable. Their average profit before tax was approximately 23 percent.

Systems enhanced with speech recognition capabilities were available, but accounted only for $33 million in revenues, or 3 percent of the total voice response and voice messaging markets. This small penetration rate was due primarily to the existing low accuracy levels. Experts agreed that companies would feel more comfortable replacing push-button commands with voice commands

[4] "AMR Wields SABRE, Private Net," *ComputerWorld*, May 1, 1989.

once accuracy rates exceeded 95 percent. Experts further predicted that sales of speech enhanced substitutes for existing voice response and messaging systems would increase dramatically and represent $600 million out of the total forecasted $1.5 billion for the voice response and messaging markets by the year 2000.[5]

Hastings's visits to prospective customers had indicated that the typical company in this market niche might purchase SR Corp's system to support 3,000 telephone lines. He anticipated that he could price the system at approximately $6,000 per line. SR Corp would also have to hire a team of three engineers per customer for approximately one year in order to help with the integration of its system with the customer's existing equipment For planning purposes, Hastings used a fully loaded cost of $100,000 per engineer per year, a figure that had been provided by Dr. Schall.

A customer would install SR Corp's system for a single, targeted speech recognition application. To develop follow-on business and generate more revenue from each customer, Hastings planned to hire one account manager per customer at an equivalent cost of $100,000 per person per year. Both field engineers and account representatives would work out of a single field office located near the customer's central office. Hastings did not expect that customers would necessarily agree to provide office space for SR Corp's field personnel. The figures he used for planning were 250 square feet of office space per person leased on an annual basis for $10 per square foot.

Hastings had to factor in another concern. He expected that Fortune 500 customers would have a steeper learning curve, and hence a longer sales and implementation cycle, than either telephone companies or telephone switch manufacturers. MIS departments in typical Fortune 500 customers were not familiar with the application of speech recognition technologies. Because of this, Hastings believed it would take approximately 10 to 12 months to achieve full implementation of SR Corp's system for an initial application with each new customer. Customers would not see that time scale as a drawback, they measured deployment of older technology systems in years.

At the same time, because of the compelling need of these companies to reduce operating costs, he believed that SR Corp could land five Fortune 500 customers during the first two years. The current voice-button systems in industry did not allow firms to completely replace their customer service representatives. For example, a major airline found that voice-buttons could only accommodate 25 percent of a standard flight reservation transaction, and in particular, only that part where the customer needed to be directed to a particular department for human-assisted reservation making. In fact, many Fortune 500 companies had decided not to implement voice-button systems because of the limitations of those systems in handling complex transactions. Their customers were found to be frustrated and annoyed with the inflexible, "hard-wired" menus of voice-button systems. SR Corp's technology was sufficiently dynamic to handle complex transactions. For example, internal tests by SR Corp found that 100 percent of a standard flight reservation could be done through its system. Fortune 500 companies could eliminate major portions of their total human telephone operator or service representative costs.

Given the complexity and newness of the technology, the best channel for reaching this market niche was to sell directly to customers. Fortune 500 companies were more likely to buy hardware from large vendors such as IBM or AT&T, but they had shown a willingness to buy specialized software and turnkey systems from small vendors. SR Corp could expect to establish long-term relationships with Fortune 500 accounts because they would want SR Corp's continued assistance in developing a "family" of speech recognition applications for their respective businesses.

By 1994, more than half of the Fortune 500 companies had implemented interactive voice-button

[5] Rettig, op. cit.

systems to automate customer service. SR Corp would have to replace these systems, and therefore faced the prospect of counterarguments from the vendors. From the customer's perspective, buying into a new system would specifically mean replacing systems that might only be a few years old and therefore not fully amortized. SR Corp's system would have to be connected to a heterogeneous mix of PCs, mainframes, and networks. Development and maintenance software tools would also be critical.

Hastings summarized his thoughts on this niche:

> The Fortune 500 niche holds excellent opportunities with regard to potential sales volume and a solid reference base. I've already spoken to two airlines who want to start right away evaluating our technology. These two airlines have the second highest number of daily transactions after the largest telephone companies. They really want our stuff.
>
> My concern is the level of effort we'll need to provide in order to serve these airlines or large banks or mutual fund companies, during the first two years. We'll have to hire engineers and set up a field office at each customer site. These things may all put a resource drain on the company during its initial years of marketing, particularly when compared to either telephone companies or telephone switch manufacturers, who basically know what they are doing technically. The lack of knowledge in this market niche about speech recognition deployed in a local area network environment would also lengthen our sales cycle. Lastly, an airline reservation application is much more complicated than directory assistance or hands-free dialing.

The Telephone Companies

Telephone company prospects included all telephone companies in the United States that owned and maintained telephone lines. The majority of these lines were owned by local exchange carriers (LECS) and long distance providers. Telephone companies would put speech recognition systems in their central office locations where telephone lines were connected. For example, in 1994 Bell Atlantic had approximately 19 million phone lines and as many as 500 central offices in its Mid-Atlantic region.

Voice processing technologies such as messaging, speech synthesis, and speech recognition offered substantial opportunities in the operator services arena. Hastings believed that implementation of these capabilities should be worth hundreds of millions of low-risk dollars in cost containment and new enhanced service revenues to each of the local exchange carriers (including Baby Bells & GTE) and interexchange carriers (including the long distance companies such as AT&T, Sprint, and MCI).

Many large telephone companies had already made substantial investments in new operator services platforms that integrated directory assistance, intercepts and toll assistance functions. Further, some had developed voice messaging and speech controlled services for calling cards and 800 and 900 service.

Directory assistance was a compelling example of how speech recognition could save a company money. Industry experts believed that operator services enhanced with speaker-independent voice recognition technology could save telephone companies $600 million annually in equipment and operational costs. One Baby Bell shared the results of a recent internal study with Hastings that showed impressive savings through automation. The company's average directory assistance work time was 18 seconds. Eliminating just a single second would translate into $8 million in annual savings.

SR Corp was shooting for a high level of automation of directory assistance services which would include names of cities and individuals. The system incorporated alphabet recognition, so that a user could spell the last name and city if he or she needed to. The system also understood the majority of foreign accents in English. Even a speech recognition system that automatically recognized only city and state words (not name and address) could save as much as 10 seconds on average.

Even with the best technology, however, telephone companies would still provide users with the option of speaking to a human operator. With its 99 percent accuracy, SR Corp's system would

provide an effective automation rate of 98 percent (99 percent for the city words times 99 percent for the state words; in general, the effective accuracy rate would decrease by 0.99 times the number of words in the transaction). Human operators would be required to handle the remaining 2 percent of the city and state part of transactions.

The combined local and long distance carrier industry reached $150 billion in 1994. There were 130 million telephone access lines controlled by local exchange carriers in the United States. (See **Exhibits 5** and **6**.) Of the 130 million lines, only about 200,000 were trunks, where individual lines came together and provided logical targets for embedding speech recognition.

Sales of speech recognition enhanced products to telephone companies totaled $44 million in 1994. However, industry experts predicted sales would rise to $1 billion by the year 2000. Based on his own field research in several telephone companies, Hastings expected that most telephone companies would be interested in speech recognition for at least 25 percent of their trunks over the next several years and would gradually move toward 50 to 75 percent within 5 to 10 years.

SR Corp's product could be configured for any number of phone lines. Speech recognition offered a telephone company an opportunity to generate new incremental revenues from innovative applications. One Baby Bell, for example, concluded it could sell voice dialing services to seven million customers by mid-1996 at a $5 monthly charge, producing approximately $400 million in additional revenue per year. Speech recognition could also serve as a means to overhaul and automate many internal functions.

A growing subset of the telephone company niche was cellular companies. By 1994, most telephone companies had an equity interest in a major cellular company in the United States. (See **Exhibit 7**.) Revenues for the cellular industry totaled $11 billion in 1993, and the industry served a total of seven million subscribers. Cellular markets were growing at 45 percent per year versus the 3 percent annual growth of line-based telephony. New types of digital cellular technology, such as personal communications services and global mobile services, were emerging on the scene. Cellular telephony provided a strong market for speech recognition services. Hands-free command and control for voice dialing

EXHIBIT 5
Local Exchange Carrier Access Line Information and Corporate Data

	Total Access Lines Serviced				
Carrier	*1992*	*1993*	*% Growth*	*1993 Revenue (000,000)*	*Estimated Number of Calls per Day*
GTE	16,819,000	17,000,000	1.08	$ 12,400	95,119,112
Bell Atlantic	18,180,700	18,612,700	2.38	$ 10,700	104,142,559
BellSouth	18,621,600	19,296,500	3.62	$ 13,000	107,968,585
Ameritech	17,001,000	17,471,581	2.77	$ 10,000	97,757,722
NYNEX	15,700,000	15,700,000		$ 11,000	87,845,298
US West	13,300,000	13,700,000	3.01	$ 8,000	76,654,814
SNET	1,936,577	1,959,555	1.19	$ 1,000	10,964,184
Pacific Bell	14,306,000	14,600,000	2.06	$ 9,000	81,690,532
Southwestern Bell	12,700,000	13,200,000	3.94	$ 7,000	73,857,193
Total	128,564,877	131,540,336		$ 82,100	736,000,000

Source: Annual Review & Forecast, TE&M, Jan. 15, 1994.

EXHIBIT 6
Long Distance Company Information

Interexchange Carriers Market Shears 1992 (percent)					
	AT&T	*MCI*	*Sprint*	*Other*	*Total*
Toll revenues	65	14	10	11	$ 52B
Switched minutes	63				$324B
Premium minutes	64				$318B
Private line	62	11	8	19	$ 8B
Presubscribed	79	11	6	4	
Business customers	52	17	16	15	$132B

Total Market Share Long-Distance Market (percent)					
Vendor	*Total market share*	*Hospitality industry*	*Public payphone*	*Private payphone*	*Traditional*
AT&T	71.00	74.00	76.00	51.00	68.00
MCI	9.00	7.00	6.00	4.00	13.00
Sprint	6.00	5.00	8.00		9.00
Int'l Telecharge	2.20	2.00	4.00	21.00	
Nat'l Tele Serv	1.60		3.00		
Others	10.20	12.00	3.00	24.00	10.00

Source: 1993 Geodesic Network, Geodesic Co., Washington, D.C.

EXHIBIT 7
Cellular Market Information

	Ameritech	*Bell Atlantic*	*BellSouth*	*NYNEX*
Cellular subscribers	860,000	1,039,000	1,559,132	575,000
POPS (millions)	21	31	39	20
Cellular penetration	4.00%	3.30%	4.00%	2.90%
1993 growth in subscribers	47%	48%	39%	47%
Ave. monthly revenue per subscriber	$68	$77	$63	$82
Cellular's share of total company value	13.50%	11.10%	25.30%	11.40%

	PACTEL	*Southwestern Bell*	*US West*	*LEC Average*
Cellular subscribers	1,046,000	2,049,000	601,000	1,104,162
POPS (millions)	33	36	18	28
Cellular penetration	3.10%	5.70%	3.30%	3.76%
1993 growth in subscribers	41%	45%	45%	45%
Ave. monthly revenue per subscriber	$83	$63	$72	$73
Cellular's share of total company value	35.30%	28.10%	11.00%	19.39%

Source: 1993 Geodesic Network, Geodesic Co., Washington, D.C.

and messaging were two examples. These factors made cellular companies good candidates for SR Corp's marketing efforts.

Judging from telephone company buying patterns and their need to reduce operational costs, Hastings believed that a large telephone company would want to introduce speaker-independent speech recognition capability into 5,000 lines in the first year and could pay up to $10,000 per line. SR Corp's system could handle up to five lines per workstation, which translated into 1,000 systems delivered to a customer's central offices.

Given the complexity of the technology, Hastings thought that the best channel for reaching this market niche was to sell directly to customers. When compared to Fortune 500 firms, telephone companies were even more likely to buy hardware from large vendors such as IBM or AT&T because a telephone company's fault-tolerant environment required proven hardware and strong technical support. However, telephone companies had looked to emerging telecommunications firms for specialized solutions, particularly in software. SR Corp could expect to establish long-term relationships with such companies because they would want its help building new applications.

By 1994, most telephone companies had implemented interactive voice response systems as well as voice mail systems. The switching costs facing a telephone company considering SR Corp would be large. These voice response and mail systems were typically large computers placed in central offices. Not only was amortization of installed equipment an issue, but substitution with a new speech recognition system would require simultaneous replacement of old systems in numerous geographical sites.

Dr. Schall figured that he would need to hire a team of about 20 engineers per telephone company in order to help with the complex integration of the speech recognition technology into the central offices. To develop follow-on business, Hastings also expected to hire one account manager per telephone company at a cost of $100,000 per person per year. Both field engineers and account representatives would work from a single field office located near the customer's central office. Once again, the figures used for planning were 250 square feet of office space per person leased on an annual basis for $10 per square foot.

Based on his discussions with several companies, Hastings believed that SR Corp could obtain 10 percent of the typical 5,000 line sale upon contract signing. Integration would take approximately a year. He felt confident that two telephone companies could be converted into customers during the first two years.

Hastings summarized the telephone company niche for his colleagues:

> Telcos offer a high-growth market and can definitely deliver the volume for SR Corp to achieve strong profitability. Furthermore, Telcos would have the most knowledge about speech recognition and its implementation. Their learning curve would be quick. Also, because Telcos could use this technology, both inside their companies as well as outside by selling it to their own commercial customers, the technology would provide a quick payback.
>
> There are a couple of catches, though. Telcos are multibillion-dollar customers who could slow us down and drag out the sales process. I've heard of some Telcos agreeing to a contract and then, after wasting 12 months of a vendor's time, canceling the program—we cannot afford that type of a problem at this early stage. In addition, AT&T and several Baby Bells are experimenting with their own homegrown versions of speaker-independent speech recognition. We would not want to alert them to what we have already done. This would invite legal battles over intellectual property. This particular threat is a very real—they might try to hire away our best engineers or tie us up in court.

The Telephone Switch Manufacturers (OEMS)

This last niche in telephony was comprised of original equipment manufacturers (OEMs) making switch equipment for telephone companies. Telephone switches were presently digital, computer-based systems. The largest switch OEMs included Northern Telecom, AT&T, Alcatel, GTE, British

Telecom, and Ericsson. This market brought in revenues of $2.5 billion in 1993.

SR Corp's strategy in this market niche would be to license its speech recognition system to switch manufacturers who would bundle the technology into their switches. SR Corp would provide the integration of its technology under contract into an OEM's system and then receive a royalty on units sold. Switch manufacturers would most likely choose to manufacture the speech recognition boards themselves. They would also be wholly responsible for the selling of their switches, including that portion containing SR Corp's technology. They would neither demand nor expect exclusive rights to SR Corp's technology or that of any other vendor of speech recognition technology.

The average advanced switch was priced at approximately $100,000, and 45,000 units were sold in 1993 to telephone companies. Northern Telecom had 24 percent of the global market, AT&T had 24 percent, GTE had 18 percent, Alcatel had 11 percent, and other switch OEMs held the remaining 23 percent. The current "action" in this market was the development of a new generation of switches based on the asynchronous transfer mode (ATM) networking protocols—a method that allowed more reliable communications for data, voice, and video.

Speech recognition had been recently integrated into advanced switches. Switches with voice-button speech recognition accounted for 1993 revenues of $17 million, or less than one percent of the market. Industry experts believed that the market for speech enhanced switches would grow as accuracy levels increased and would represent $300 million in revenues by the year 2000. Many of the OEMs, such as AT&T and Northern Telecom, were working on their own speaker-independent speech recognition programs.

Switch OEMs always looked for new technologies that would add value to their systems. By adding speech recognition, OEMs could spare telephone companies the cost of adding the technology themselves later. Additionally, OEMs were in a strong position to help SR Corp disseminate its technology because their systems were installed in telephone companies' central offices. In fact, if SR Corp decided not to work through the largest switch manufacturers, the switches provided by those OEMs could prove tough barriers to entry to SR Corp's own direct sales.

Through discussions with several switch manufacturers, Hastings concluded that SR Corp could sell its technology at approximately $5,000 per line of recognition and could gain at least three customers during the first two years. The price per line was lower than that for direct sales to Fortune 500 firms ($6,000 per line) or telephone companies ($10,000 per line). This lower price would be required because the switch manufacturers would do all the selling of the final solution to the telephone companies. Also, OEMs would perform the actual manufacturing of the boards containing SR Corp's technology. The speech recognition portion of their equipment would only represent a small percentage (5 to 10 percent) of the overall final sale. Based on his study of their sales volumes, Hastings estimated that an individual switch manufacturer would purchase 6,000 lines of speech recognition, for a total of 18,000 lines if three OEMs became customers in the first two years. He believed that OEMS, like the telephone companies, would pay 10 percent of the contract amount upon signing.

Here again, the best channel for reaching this market niche was to sell directly to the switch manufacturers. Switch OEMs had shown a strong tendency to purchase component technologies from whatever firm had the best technology, be it a large firm or small one. Once an OEM had completed a new type of switch, contacts with component vendors were minimal.

Since SR Corp was seeking to be part of the design of a next-generation system, there would be no significant switching cost for the OEM. SR Corp would become part of a "new design." Of course, the OEM would have to retrain its own engineers so that they would understand how to use SR Corp's development environment and support the system.

SR Corp would have to put a team of six engineers with each switch manufacturer to help

integrate its technology into the new switch. Dr. Schall believed that the integration effort would take approximately 10 months. An account manager would also be assigned to each customer to generate additional revenue. Both field engineers and account representatives would be based in a field office near the customer. Labor of $100,000 per person per year and office space costs of 250 square feet at $10 per square foot per person were used for planning purposes.

Hastings reflected on this niche:

> OEMs would be a solid way to move SR Corp's technology on a mass scale, while also providing a solid reference base for future customers. In addition, OEMs are always searching for emerging technologies to enhance their offerings, and are willing to take early technological risks if the payoff is there.
>
> However, my concern is that SR Corp runs the risk of not being able to participate in either the way or how fast an OEM decides to market the technology. In addition, although OEMs have a basic working understanding of speech recognition, sales cycles in this niche have been known to approach two years due to integration and standards issues. Furthermore, we may risk getting too close to some of our competitors, such as AT&T, who hold large market shares in this industry and no doubt will do anything to protect their positions—including lawsuits.

THREE RECENT EVENTS

Hastings finished his presentation of the three telephony niches by describing to SR Corp's management team three highly relevant events that had occurred during the last 24 hours.

The first event was a new industry report on the telephone industry, the *Telco Business Report* Hastings handed out copies of the report to his colleagues.[6] It stated that "more than 70 percent of the 1,200 respondents—including RBOCs (regional Bell operating companies), independents, and long distance companies worldwide—said they plan to renew or update their operator services in the next two years with automation." This report also indicated that telephone companies in the United States wanted more technologically sophisticated software to improve and expedite delivery of regional directory assistance services. Speech recognition systems were a main interest. Technological change in this niche was moving even faster than Hastings, Dr. York, and or Dr. Schall had expected. This carried risks as well as opportunities. Once a telephone company invested in a new speech recognition platform (even if it was an inferior system relative to what SR Corp had to offer), the company's doors would probably be closed to new vendors for at least two or three years because of the need to amortize such a large investment.

Would SR Corp risk losing these customers by pursuing Fortune 500 firms or switch manufacturers? At the same time, could SR Corp afford not to pursue other customers? Hastings knew that selling to a major telephone company might take more than a year because a single speech recognition application would include up to a dozen different departments and each department head would have to agree to contribute budget resources.

The second event was a telephone call from a Fortune 500 airline executive, who had clearly stated that he would purchase SR Corp's systems right away if the accuracy claims could be proven: "We have to handle 200,000 phone calls a day. If this stuff really works, we could cut our operating costs by a substantial amount." Reminding his listeners that the sales cycle for a Fortune 500 customer was typically shorter than that for a telephone company, Hastings pointed out that this executive was someone who could make things happen fast:

> Fewer departments, and hence, decision makers would be involved. An airline deal would probably be smaller than a Telco deal. But that's okay because it will be more manageable in terms of scale and scope. I bet we could land the deal in six months. Further, once we did an airline, the other big ones would probably follow soon thereafter because the industry is so price competitive. The big catch in all this is that, from

[6] "Operator Services Slated as the Next Investment Boom for Telcos." *Telco Business Report*, PC-Plus Group, Munic, Germany, Dec. 5, 1994.

> what I have seen, their MIS departments know next to nothing about speech recognition technology. Integration would be painful.

The third event had happened the night before. Hastings had given a guest lecture to engineering managers for a former business school professor. In speaking about market strategies for emerging technologies, Hastings had used his own firm as one of the examples. After Hastings finished speaking, one of the students in the class introduced himself and indicated that he worked for a major telecommunications equipment manufacturer. The student's company was designing a new asynchronous transfer mode switch. Due to customer demand, all the large switch manufacturers were developing state-of-the-art ATM switches. Major telephone and cable companies needed to provide improved commercial data services for businesses and video on demand for home markets. ATM switches seemed the most pragmatic, workable solution to achieve this from a network perspective. The student had said, "If you've got what I think you've got, we need to build it into our next-generation switch." He wanted Hastings to visit his company the following week.

Hastings concluded his remarks to SR Corp's management team by noting the obvious: each market niche exhibited tremendous opportunity, yet each held substantial risk. After listening to Hastings's report and hearing about the three late-breaking developments, the lead investor turned to Dr. Schall and said:

> Engineering better be telling us the truth. If our gun isn't loaded, we're the ones who will end up getting shot!

On a positive note, the investor reiterated that he would provide additional funding once a single major customer showed clear signs of a successful outcome. Any delays in procurement or systems integration would mean that SR Corp would have to wait longer, not only to be paid by the customer but also to get the investment it needed to build a strong sales force. The investor also needed to see a marketing plan that showed the prioritization of the telephony niches and of the key accounts within those niches. Turning to Dr. York, he remarked:

> It all boils down to making sure the technology, is bullet-proof and getting the right customer. You better hurry though. I wouldn't be surprised if there is another 'Hastings' working for a company just like ours trying to make the same decision for his own firm's breakthrough speech technology.