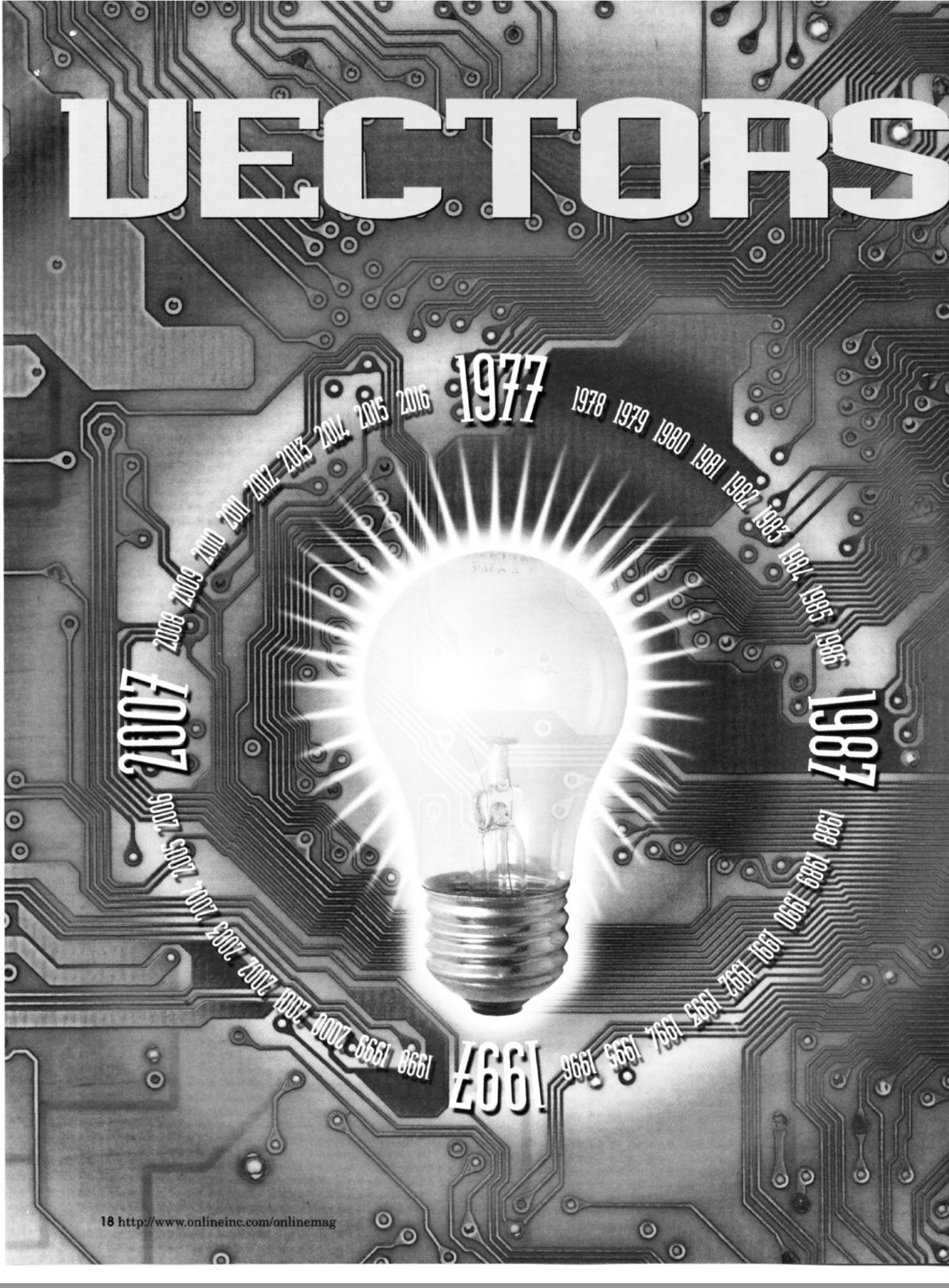
VECTORS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# of CHANGE

Electronic Information from 1977 to 2007

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Many of the assumptions, technologies. and business models of the first thirty years of online and electronic information are now inapplicable.

Online began with bleats and whimpers in the mid 1970s. In 1987, customers recognized the efficiency and competitive advantages of electronic information in various guises, but there were cries of anguish. The services were difficult to learn, often expensive, and "technologically challenged."

Then in 1994, a shout of joy echoed in entrepreneurs' cubicles. Electronic information and the dreary text-in-ASCII "online" morphed into the World Wide Web. In a matter of months the shackles of the past were broken, and the millions with PCs, modems, and a desire to explore digital realms built a new digital world.

And for the foreseeable future, the vectors of change driving electronic information promise to move rapidly and produce some significant financial payoffs for those who can master the new environment.

Electronic information has a number of interesting characteristics. Among them is its ability to seep into the nooks and crannies of everyday life. Companies expand their networks, link to the Internet, and invent new business processes. Examples that fall readily to hand are the emergence of First Security National Bank for online banking, Amazon for book lovers, and Starburst for General Motors' automatic updating of its dealers' parts catalogs. There are thousands of other examples.

The process is what the Japanese call "*informationizing*" in various White Papers and government reports written in English. Their coinage, dating from the 1960s, reflects a prescient understanding that information and its wiser brother knowledge are the engines of economic power in today's business world. The Internet is simply a catchphrase, almost a metaphor for people with personal computers to become the digital Kit Columbuses or Sir Frank Drakes of the digital world. In point of fact, the Internet is a technology construct that facilitates networking among people and their ideas.

VECTORS OF CHANGE

This article-really a checklist of ideas-identifies what we call vectors of change. These vectors are a convenient way to talk about events and activities that have magnitude, direction, and force. When applied to networks and electronic information, the word vector is a misnomer. No one knows exactly what happens when you take computer literate people, add access to all sorts of digital treasure troves, and stir in human ingenuity. The digital environment is being invented as much as it is generating itself. But vector conveys a useful idea-something moving on a path and has some oomph. Our selection of these nine vectors is somewhat arbitrary, but each is representative of forces that appear to have no clear path. We cannot predict the future, but we think the vectors we have identified point to some fairly certain developments that will explode before us in the next two to four years.

As enthusiastic as we are about electronic information and the Internet, we have learned that not everyone is or can be "informationized." Electronic information draws a line between those who "get" the electronic fever and those who do not. Stated another way, people are broken into

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two distinct groups: one group of information haves, the other of have-nots. We have identified many organizations that have not yet realized that the Internet (whatever it is believed to be) changes some business rules without warning. We believe that the impact of these vectors will be vastly different in different contexts.

Words are needed to explain this new digital environment. We like the term "*datasphere,*" which connotes an immersion in an electronified world. Other new terms have been coined on which we can hang revolutionary new products (PointCast's or Marimba's "push" technology) and services (InCommon's "cybercasting" or Digicash's "digicash"). Other coinages include "intranet," "Java," "browsing," "e-zines" and dozens of others that *Wired* magazine catalogs each month.

Many people believe that making sense out of our networked world is an almost impossible task. As soon as one fixes on a company, product, or technology, the pieces are mixed up. It is like working on a 1,000-piece jigsaw puzzle while some genie makes the pieces transform themselves or fly out the window.

Newcomers to electronic information, online, or the Internet will think that the digital world they see is the one that has existed for many years. For those with some historical perspective, remarkable changes have recently occurred. We are talking about more substantial changes than a pretty graphical interface on personal computers (although that is an important factor). The change to which we are referring is more substantive; it cuts deeper.

Many of the assumptions, technologies, and business models of the first thirty years of online and electronic information are now inapplicable. One company seems to have, for the present moment, branded the Internet. Netscape Communications became in a matter of days a synonym for the pot of gold at the end of the digital rainbow. Another firm, America Online, garners headlines that would have been inconceivable five years ago. America Online's network capacity is now the stuff of the daily paper-not trade magazines.

We have watched these changes with fascination and the viewpoint of one person with more than twenty years of experience in traditional online. The other co-author of this paper has watched today's events from the perspective of a twenty-something who has not known life without a computer. We have pooled our ideas about the major vectors of change and identified nine forces that warrant brief commentary:

1. The Business Climate
2. The Electronic Information Environment
3. The Markets for Electronic Information Who Buys Electronic Information)
4. Marketing Factors (How to Sell Electronic Information)
5. The Computing Infrastructure
6. Methods of Producing or Manufacturing Information
7. Workers
8. Network Delivery Mechanisms
9. Content

The balance of this article reviews some of the major factors in each of these classifications in the period between 1977 and 1997. By way of conclusion, the reader can examine a few speculations about what the next ten years will bring.

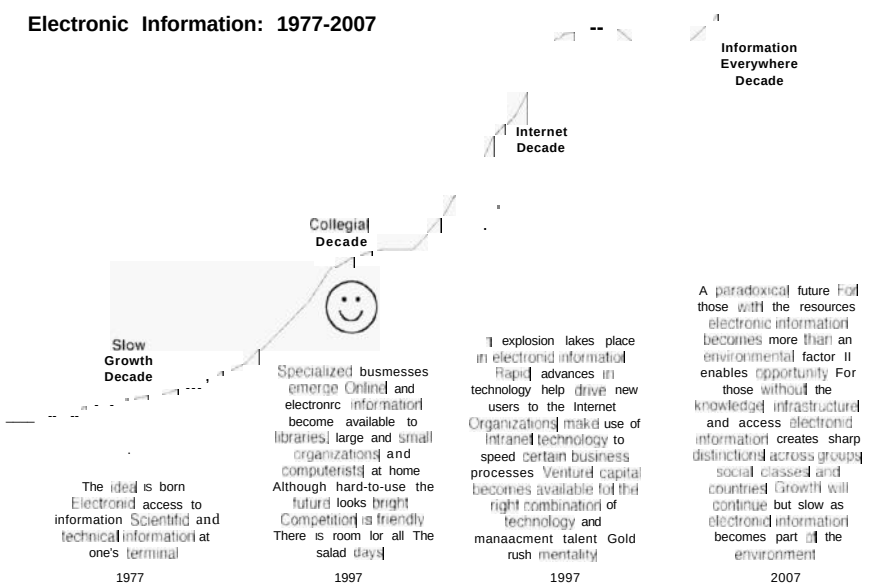
I. The Business Climate

In 1977, arguably the dawn of the commercial online world, the general business climate for information was stable. Innovation came in predictable ways. Scientists and engineers developed the fledgling technologies, and government funds moved the innovations through the commercialization pipeline.

By 1987, some major shifts had taken place. Marketing was of the missionary variety. Experts in online taught potential users about online. The database producers formed a tight, almost exclusive, club. The competitive arena remained collegial. The overall atmosphere was that "there is room for all." Leading database companies like Dow Jones, Dun & Bradstreet, Predicasts, Disclosure, and Investext cooperated by giving joint seminars.

By 1997, the general business climate had changed, not on the geological time scale, but on what we now know as the Internet time scale. In this new yardstick, one year of Internet time is equivalent to seven years of "regular" time. Change has a poignant meaning when a company or person operating on regular time confronts a competitor running on Internet time. Microsoft Corporation realigned itself in less than 12 months. Many traditional information companies, including many established names in database publishing, have not yet determined if they should change to respond to the Internet.

FIGURE 1
Electronic Information: 1977-2007



Other changes in the general business climate for electronic information in 1997 warrant mentioning:

- Innovation is driven not by a search for limited specialist markets but for broader consumer markets.
- Customers are estimated in the millions, not thousands.
- Marketing has shifted from traditional techniques of direct mail and brochures to interactive experiences at mega-trade shows.
- Financing is no longer the exclusive preserve of the government or the Fortune 500 firm. Money flows in from specialized venture capital firms eager to turn a few million into billions in a matter of months.
- The database producers are no longer scientists. They are people who know how to leverage the new technologies. Adverworld, one of the fastest growing Internet companies in history, relies upon a technology vice president who was 18 the day he was hired.
- The competitive arena has shifted from the collegial and tolerant to the present-day equivalent of a Darwinian microcosm. The number of competitors in virtually each market segment has changed from two or three to an unknowable number. Each buy-out triggers a fresh wave of innovation, not a stagnation as in many aggregations in more traditional business sectors.

What's the outlook for the general business climate? Predictions and forecasts are always suspect, including ours. But the changes between 1977 and 1997 seem to point toward a continuing of the current environment of rapid change and aggressive entrepreneurship. In addition, brand identity will become more important. Information is destined, in some sectors at least, to follow the laundry detergent model. There will be a handful of high profile brands or products that garner the lion's share of the market. Professor Arthur Ehrenberger pegs the number at seven per sector [1]. Whatever the number, the economical viability of dozens of similar information products is limited.

Barriers for entry will remain. Technology will be available to anyone who takes the time to learn it. The freedom to enter a market and capture customers will be more difficult. Competition will eventually become routinized among the dominant companies.

2. The Electronic Information Enuironment

If' we narrow our focus to the environment specific to electronic information, the changes are like beacons illuminating the information highway.

In 1977, usage of online services was limited to people directly involved in academia, defense, government research agencies, computer systems development, and a few brave customers scattered among leading organizations.

Commercial access to numeric data was almost nonexistent. A few innovators like William Manning, founder of Manning & Napier Advisors, and one of the fathers of the automated transaction business, had ideas. These financial services were done the old-fashioned way-but with a dollop of teletype and some clumsy mainframe customer information and control systems.

The Internet was in existence but limited to a handful of research institutions and users who found the cryptic interface and sluggish response useful for file transfer and electronic messaging. At the Internet's inception, users wrote software to solve problems and enhance services.

Niche information was the exclusive domain of the consulting firm. When specific information was needed about a narrow slice of the business world, industry and government turned to firms like McKinsey & Co. or Booz, Allen & Hamilton, and a handful of others.

Software innovation was possible only by a fraction of the engineering and scientific and technical community. At one author's alma mater, computer science was a unit of engineering in the late 1960s and early 1970s and special permission was required to take a programming class.

In 1977, the cost for developing a commercial database was high. Remote terminals, client server computing,

The majority of people will prefer information applications that are closer to the television, motion picture, and entertainment model-not the pure information model.

and user friendly debuggers, if not science fiction, figured modestly in the fledgling online industry.

The pace of innovation was rapid when compared to developments in, for example, the steel industry. The Orbit service attracted a competitor: Dialog Information Services. Print indexing products took tentative steps toward electronification. A low file number on DIALOG (now Knight-Ridder Information Services) translated for many years to the manager's prescience about online information.

By 1987, the world had changed, and in not too surprising ways. Usage was expanding. Local online services—the bulletin board systems-had an impact. Commercial services numbered more than 300, with about 1,200 commercial databases. Ten years ago there were fewer than one million users of online services. The Internet had embraced most of the major colleges and universities. Niche information was available in electronic form, but only a small percentage of the high value information was in electronic form; for example, the analyst reports via the Investext service.

Entrepreneurial software companies had begun to appear. CMC Research, founded by Chris Kitze, blended software invention with medical information on CD-ROM, foreshadowing the look and feel of many Web-based data services today.

The most dramatic changes occurred between 1987 and 1997. Worldwide usage of online services exceeded 35 million, up 35 times in a decade. Commercial access to textual and numeric data had moved from the monied domain of the largest firms to most commercial enterprises. Internet usage spread into the consumer arena with the advent of Web TV and "channels" of information, games, and a range of services like Christian Science Monitor audio newscasts.

Software innovation exploded. Powerful development tools entered the market, dropped in price, and made drag-and-drop programming a reality for those with a knack for programmatic thinking. Concomitantly, the cost of database development dropped. Entrepreneurs could use the Internet as a distributed editorial environment. The new product ABCompass, from Business Compass in New York, New York, typifies the blend of powerful personal computers, robust database technology, and the Internet.

Not surprisingly, the pace of innovation moved from more rapid than traditional businesses to very fast. The database producers themselves expanded beyond the established abstracting and indexing community and embraced virtually any organization or person with content of value in electronic form.

What seems reasonably certain is that the pace of innovation will continue to accelerate and then begin to flag.

The reach of electronic information will also slow. In a population, the majority of people will prefer information applications that are closer to the television, motion picture, and entertainment model-not the pure information model. It is almost certain that audio, video, and other types of multi-object information structures will prevail.

A challenge lies ahead. Most of the easy-to-do information products and services will be in the market. Making electronic information gets easier each day with intelligent software like Microsoft's Front Page. Funding will be available. There will be millions of potential consumers for the next blockbuster product. But the catch is that each winner becomes more difficult to craft. Costs rise; customer expectations creep up; and the amount of time available to hit the window of opportunity shrinks.

3. Markets

In 1977, the market for electronic information was composed of the people building databases and developing systems, and researchers who needed to keep pace with technical developments. The market would have filled a hotel ballroom in most Holiday Inns.

We believe that the early pioneers like Dr. Carlos Cuadra had an instinct that "if we build it, they will come." The "we" consisted of the market as defined above, and the "they" was various governmental researchers, graduate students, and a few visionary companies like AT&T. Then and now, only a few wizards have the technology and market instinct to craft winners. The fellow travelers follow a path that leads to building a competitive product.

By 1987 distinct markets existed. The principal ones were the library market (consisting of public, academic, special, medical, financial services, and legal), the academic market (K-8, secondary public and private, high school, junior college, four-year, graduate, medical, and other specialties), the Fortune 100 market (strategic planning, marketing, administration, and finance) and a handful of other specialized entities like archives, records management, governmental and scientific research libraries.

By 1997, these once-beefy markets became hamburger. The Internet was the grinder. The monolithic, proprietary approach to online information was converted into a tasty new dish. Bloomberg clawed to the peak of financial information and branched into radio, television, and magazine publishing. CompuServe, once the king of consumer online, faded. America Online rose and fell like a hot air balloon with a faulty heat source. Neither of these companies created markets of the size, scope, and reach of companies like Budweiser, Levi's, or Colgate-Palmolive. As super-charged as electronic information has become, it remains small potatoes in terms of how many eyeballs and fingertips it brings to the monitor and keyboard.

New niche markets did spring into being, largely in response to the magnetic appeal of the new technology and the promise or hope that the technology would yield a substantial payoff. Some potentially lucrative segments are the small office/home office, or SOHO, market, the association market, the middle market consisting of companies with revenues of $100 million or more, and dozens of others. The problem with each of these is that it requires resources to sell products that generate a profit in these segments.

In the next two or three years, the electronic information consumer market will become an increasingly significant force. It is unlikely that the "consumer market" for electronic information will be congruent with the consumer market for products like McDonald's Big Macs. This has to do with the fragmentation of the online market into a number of distinct and fluid communities. Many people will be members of numerous communities, although some communities may consist of very few people. Making money from these customers has been difficult since the mid 1970s. In 1977, the market was small and the total information package was too esoteric for all but the most persistent. In 1987, the markets were well defined and characterized by tightly defined budgets and computing resources. In 1997, the markets are comparatively big when compared with 1977 or 1987, but dwarfish when measured against a true consumer product market. The customers that exist are price sensitive and devilishly hard to locate, educate, and sell.

Marketing Factors

Selling electronic information has gone through a rapid transition from a few bishops and priests converting the select few to the razzle-dazzle of Microsoft's re-launch of the Microsoft Network with video tossed in for added sizzle.

In the beginning, electronic information was behind walls. It was not easy to get into an online system. It was not easy to get information. Interfaces required asterisks, backslashes, hyphenated switches, and slavish observance of syntax. Many looked and decided that the learning curve was too steep and the costs were too high. So selling electronic information was more of an act of conversion and faith than business acumen. "Customers" were partially converted; otherwise, they would not have known there was such a thing as electronic information.

By 1987, electronic information was friendlier. Dow Jones News/Retrieval experimented with several graphical interfaces. But for most users, even of consumer-oriented systems like CompuServe or The Source, users had to memorize commands and arm wrestle software.

By 1997, ease of use is still important, but clearly secondary to the information experience. Windows put a happy face on most basic functions and a happy face on Mr. Gates as well. The Internet browser seems to be what people want to use to interact with electronic information.

Three selling factors benchmark the change in the last few years:

First, with thousands or even millions of users, marketing has become very expensive. Consumer services must reach prospects quickly and with a compelling message. Facts are helpful, but not an attention grabber. Niche marketers must fight voice mail and the barriers that make it almost impossible to find out who is responsible for a particular service at a particular organization. In 1987, it was easy to direct mail all prospects in a segment; for example, special librarians in New York, California, Ohio, and Illinois. Not in 1997.

Second, information, and most things computer, change with ever-increasing rapidity. In a crowded marketplace whipped by change and me-too products, the business of creating a product is secondary to getting visibility, capturing mind-share. Life was slower a decade ago. There *was* more time, although marketers in the sunny '80s thought their lives were hectic.

Third, paralleling these market changes, pricing has become a marketing weapon. Sawy consumers watch for prices outside of their channel, also described as "channel envy." When a better price is located, the customers will argue for the lower price or switch vendors. The once-lofty prices of certain commodity information services have come down or are under continued downward pressure. Prices clump at two ends of the spectrum. There are quite a few expensive services: Thomson's First Call is an example. There are many low cost or free services: the Internet Web page is an example. In between, there is a pricing no-man's land.

For high value services that have unique content, prices have and will remain high. Bloomberg, Investext, and other purveyors of information that customers perceive as "must have" information, have been able to maintain certain prices. In libraries, often strapped with resource shortages and byzantine adoption processes, prices have gone up for services that allow the library to derive substantive benefits. For commodities like encyclopedias and maps, digital alternatives have been commoditized and rendered bargains. The "nice to have" information is among the first to feel the bite of price cutting.

Not surprisingly, pricing in 1977 was very hard to fathom. Who really understood central processing units? In 1987, pricing was tricky because there were many models, and information companies tinkered with them to find the magic revenue bullet. In 1997, prices are crazy. Companies offer the same product under different names in different channels for different prices. Others have no price, just a commitment to negotiate, like BBN Planet's Internet Service Provider unit. The pricing matrix has many boxes, dimensions, and variables. Prices for

A **Savvy** consumers watch for prices **outside** of their **channel...when** a **better** price is **located,** the **customers will argue** for the **lower** price or switch uendors.

Thirty Years of Electronic Information

YEAR 1977	YEAR 1987	YEAR 1997	YEAR 2007
1. General Business Climate			
Only the visionaries could explore online and electronic information. A tough sale.	Interest picks ups, particularly in financial, legal. and full text. Referenced products arc lackluster.	The gold rush is starting to cool but online has entered the mainstream as a "good thing."	Becomes a basic business tool. The cnvironmcnt is a "datasphere." Hard to escape.
2. The Electronic Information Environment			
Cryptic, complex, limited.	Hundreds of' thousands of users with special training. Not for everyone dcspi te PC boom.	More than 35 million users worldwide. Online becomes a must-have service for the affluent and forward-looking.	Within the educated segments of a population, almost total penetration. Have-nots are left out of many opportunities.
3. Markets			
Severely limited.	A handful of niched. Consumer markets of sorts emerging around BBS systems and CompuServe.	Anyone in a developed country with a PC, modem, and service provider. A new consumer market.	About 40 percent of a population. Particular markets are easily fragmented, transitory, and fluid.
4. Marketing Factors			
None. Few choices. Invention required for most tasks.	Price less a factor than content, coverage, timeliness. Brand identity emerges; e.g., ABI/INFORM	Consumerization of information. Brand, price, features, value. etc. in various combinations make marketing more important than information.	Microcash plus today's options.
5. Computing Infrastructure			
Mainframe, glass house.	Mixed cnvironmcnt. Client server becomes available.	PCs become more powerful. Client-server architecture and mainframes flourish as servers.	Environmental computing. Fully distributed. Wide range of' system types available from most locations. Significant computational power available.
6. Production or Information Manufacturing			
Hand-crafted information.	Database production systems emerge. Crude automation in financial and news services.	Automation proliferates. Hand-crafting still practiced for technical and special purpose services: e.g., artistic Web pages and chemical and mathematical information	Automation becomes a standard component of environmental computing. Handcrafting in specialized applications. Information factories on desktops and in network devices.
7. Staffing			
Scientists and engineers.	Librarians.	Anyone with a computer.	Anyone with knowledge of' information applications.
8. Networks and Delivery Methods			
Proprietary with some limited Internet access for scientists and engineers in government and academia. People structured queries.	Value-added networks link proprictnry networks. Some Internet access for government contractors and academicians. User friendly Boolean syntax.	Public Internets, value-added networks available worldwide, proprietary networks, plus virtual networks. Pull, push, point-and-click, plus Boolean.	Wireless access to many types of networks. Secure networks available for special applications as well as many high-bandwidth options. Natural language, agent-bawd retrieval, visualization. and learning-based retrieval.
9. Content			
Numbers and limited text.	Text, numbers, and some graphics for high-end applications.	Text. plus various objects; e.g.. sound, animation. etc.	Information environments thnt arc highly realistic.

information products are fluid and often impossible to determine by looking at a one-page price sheet.

Sales tactics have undergone a transformation as well. Until the late 1980s, the sale of information was a courteous business. A number of firms marketed in a cooperative fashion. Dow Jones, Dun & Bradstreet, Investext, and Disclosure were among the most prominent in this effort. By 1994, the competitive arena had intensified substantially. Strategic alliances replaced cooperative marketing arrangements.

Since electronic information has entered the mainstream, sales tactics follow fashion: infomercials, discounts, special offers, bundling, free services, and dozens of other attention getters make information marketing a colorful, entertaining bazaar.

5. Computing Infrastructure

In the beginning there was no infrastructure. Digital dirt roads abounded. Cramped rooms were filled with many big, unstable devices that performed specific functions for those who knew how to operate them.

In 1994, the Internet emerged as a communications revolution—after 25 years of playing in Peoria.

By 1987, value-added networks linked virtually all major cities in the United States and several developed countries. Although the Internet existed and performed essential duties for scientific and research communities, the commercial online world was generally disinterested in it.

In 1994, the Internet emerged as a communications revolution-after 25 years of playing in Peoria. Even with the Mosaic graphical interface, the Internet was neither new nor particularly user-friendly. But it was the genius of linking pages and hyperjumps in digital space that turned the trick. The next revolution was unleashed. The Internet became *the* computing infrastructure, the definitive metaphor for electronic information, and the new medium that promises to remake how we live, work, and play. In 1987, online *included* the Internet. By 1997, online *was* the Internet.

The suddenness, size, and persistence of the Internet revolution has transformed how millions of people think about infrastructure. The computing environment contains elements of yesterday's glass house computer center. Proliferating rapidly are powerful desktop machines with multimedia and connectivity capabilities. Computers today link almost seamlessly into a variety of networks. Sun Microsystems' slogan "The network is the computer" describes one of the arteries of the datasphere.

In just about every category of technology, the vectors of change have moved from completely unique and

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island- or fortress-like isolation to standardized, less proprietary devices, services, and functions. Please note that many companies, even in an open environment, still have proprietary tricks up their sleeves. But in general the direction of movement has been clear: in 1977, glass houses and no direct interactivity; in 1987, online interactivity but achingly slow access and limited graphics; in 1997, speed, content, change, graphics for computerists at home, in the basement, on the beach.

Network speed has increased at about the same pace as the capability of microprocessors. A new automobile has more computing power than some of the earliest computers of the 1970s. A new desktop machine has more computational power than most mainframes and minicomputers shipped in the mid-1980s.

The shift in technology has allowed innovators to move more and increasingly diverse types of data to users. In 1977, a monochrome monitor displayed text. In 1987, personal computers could show crude graphics in a handful of colors. Today the standard personal computer available at a discount store can handle sound, hundreds of colors, and certain types of video.

For the past two years, database technology has been integrating network functionality into its very architecture. Companies like IBM, Oracle, and Informix are designing software tools that mesh with the networks feeding the data tables.

The network infrastructure has become a key enabling technology for information services and products. From 1977 to 1987, networks were not public. Between 1987 and 1997, public and private networks began to get equivalent attention and merge. Network infrastructure now captures headlines when online services suffer brownouts or service drops. Networks have entered the public conscience.

6. Methods of Producing or Manufacturing Information

In 1977, humans created electronic information with their fingers. Programming did nothing to make this keyboarding task less onerous or less costly. The device of choice was the punch card machine and the dumb terminal. By 1987, one of the first commercial uses of PC-based database production took place at Information Access Co., using Apple II computers. By 1997, personal computers were the *de facto* standard in keyboarding.

As practical as the shift from archaic manual to PC input methods, more substantive changes were taking place. Optical character recognition systems allowed certain types of electronic publishing products to be created from existing paper documents. However, for large-scale commercial conversion projects, the highest quality documents come from double keying of the source text.

In the last 24 months, Internet surfers have relied upon products like Lycos, Infoseek, and AltaVista. Each of these is a directory service, often with indices and abstracts. The difference between traditional abstracting and indexing operations circa 1977 and the spiders of 1997 is that the majority of the work today is done by software, not human indexing and abstracting staff.

For certain types of information manufacturing processes, automation pays two dividends: increased speed and some cost savings.

Because information manufacturing makes use of other technologies as building blocks, new automated information services are appearing rapidly. Intelligent databases and enhanced agents add value for customers.

The gulf between the Internet indexing companies and the traditional online database producers is very large. As stated, the new Internet companies rely completely on software for the indexing and abstracting, and the traditional database companies still have a complete human indexing and abstracting system.

As time goes on, information manufacturing will be a mix of these two different approaches. As the content of the Internet reaches unimaginable levels, the need for humans to parse the information will grow more and more important. Information companies will then use technologies to maintain the data for their use. Machine-generated abstracting will come into play only when the content has been approved by someone on the editorial staff. The Internet spiders don't yet have this rein imposed on them, but they will, because the Internet navigation companies will go broke if they try to collect all the data available on the Internet. There just isn't enough money for the computers, bandwidth, and storage. The most popular Internet navigation service currently is Yahoo!, the only one providing human indexing to the Internet.

The traditional online companies need to enhance their products as quickly as the new Internet companies do. Yahoo! aggressively licenses leading technologies that will enhance their database for their users: the AltaVista search engine and the Firefly agent software for My Yahoo are two examples.

As these two still divergent practices merge, traditional database users will demand the functionality now present on the Internet navigation companies' Web sites. Should Yahoo! decide to index and abstract Internet content instead of just their one sentence descriptions, would you call them a traditional database company or an Internet company?

7. Workers

Demographically, information companies should reflect the same population changes as other industries.

In 1977, information technology was a young discipline that attracted researchers, scientists, and engineers in college. The make-up of electronic publishing environments was usually a blend of people with experience in traditional abstract and indexing or publishing, with a handful of technologists, often with several years of experience. The best hires were often from the hardware manufacturers who provided the hardware for the electronic publishing company. College students or recent graduates would be used to handle some special tasks for the specific computing environment.

By 1987, many publishing companies were looking to supplement their existing systems with various subsystems to handle specific tasks more efficiently. A number of firms provided specialized equipment to allow publishers to gain more flexibility when producing print directories and creating a tape for one of the commercial online services. Companies like

Datalogics, Hyphen, XyVision, and Interleaf served this niche effectively.

Between 1994 and 1997, the publishing industry found that the newer systems required programming skills and knowledge sets that were not part of the traditional computer specialists' profile. Established sellers of hardware had staff who could work effectively in the new hardware and network arena, but many of these professionals carried large salaries or were not interested in working in an electronic publishing environment that was not up to the potential employee's salary standards.

In 1997, staffing paradigms expanded to accommodate many new ways of getting workers who could do a particular job. Information companies of all types make use of full time professionals. Some have chief information officers or vice presidents of information technology to help ensure that decisions consider new approaches.

Contract, part-time, and teleworkers can now be found in companies of all sizes. An employee with a highly specialized, valuable skill may be given employment contracts. Other companies fund promising employees, emulating the Japanese *bunsha* approach [2]. If staff cannot be located close to home, companies half a world away stand ready to provide services. Staff can work on site on a temporary basis, provided that the firm can arrange appropriate work permits.

Many fast-growing firms turn to other fast-growing firms and recruit talent. One exploding Internet company recruited a teenager from Microsoft, which had lured the brilliant youth from high school. In 1977, high school prodigies were the exception. In 1987, programming wizards were the stuff of Apple Computer. The canny manager with a thorny programming or database problem relies less upon academic background than at any other time in the short history of the information industry.

The new database-building front end of the future will be the Network PC with a Web-based front end. This is low cost: workers don't even have to come into the office. With a Network PC at home they can log into the company intranet or extranet and their work will be there waiting for them. They can index and abstract or edit everything in their queue, and if they do not finish, a manager can instantly tell at the end of the day. Because this model is inexpensive, it may bring back within U.S. shores much of the database building that now takes place in other parts of the world.

8. Network Delivery Mechanisms

In 1977, network technology broke into two parts. On one side were the proprietary network architectures. Firms like IBM viewed networking as one more part of providing a single-source solution. Interconnectivity was a thorny problem. The vendors, in a sense, liked it that way.

On the other side were the research-oriented professionals involved in the Internet. The Internet protocol was open-designed to allow those with a computer to link it to another computer. Electronic mail and file transfers, then as now, constituted the majority of the traffic.

The two clumps persist today. Many organizations use a different network architecture behind their firewall. A special system running on a machine outside the firewall links employees to the Internet.

Despite the deployment of thousands of miles of fiber optic cable, slowdowns occur. Bottlenecks typically occur when traffic must be routed from one place to another. Routing technology has relied for many years upon software. Advanced switching technology is many times faster, but it is not widely deployed in the public network at this time. The result, not surprisingly, is the likelihood of a network meltdown.

Network meltdowns occurred in 1977. At the dawn of electronic information, problems could crop up almost anywhere in the complex chain of systems. The only way to be certain a problem could be found relatively quickly or at all was to keep the system as homogeneous as possible. IBM, General Electric, and others sold end-to-end solutions.

In 1987, networks became a bit more heterogeneous. But for many major companies, the diversity of hardware, network technology, and other systems was a headache.

By the end of 1996, even companies that had long advocated a single brand throughout a network system had begun using other vendors' equipment. If the hardware or software was particularly promising, the company with the need acquired the other firm. The acquisition of promising hardware, software, and network systems companies continues at a demanding rate.

A similar transformation seems to be gaining momentum in shifting from the well-known Internet protocol to a variation called IP Multicasting or Internet Protocol Multicasting. With this technology, programming can be sent to specific computers on the Internet. Then data packets will not flood the system, placing stress on the weak links like the routers. IP Multicasting schedules transmissions and targets them. The result is more bandwidth from the existing network.

Networks designed to move packets of text that could be reassembled into proper order now have to move packets of data that must be synchronized. A clever manipulation of Internet Protocol, Multicasting promises to make "push" technology ubiquitous. "Pull" searching will not disappear, but new models can be constructed from the hard and soft network infrastructure.

As part of the network infrastructure, it is now possible for virtually any computer to conduct secure transactions over a public network. For decades, value-added networks had this lucrative arena to themselves. The public Internet can now perform many of the functions of the private network.

9. Content

In 1977, content was mostly numbers and some text. Making the mainframe squeeze text into fixed length fields was difficult. The exercise did not push the electronic information industry into overdrive. Text is widely variable. The early systems were not.

Not surprisingly, content in the early systems did not sing or wiggle. For those experimenting with putting information online, early information products picked up established reference formats. Through clever programming that stitched text in fixed length fields together, combined with

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Those who have the ability to invent and manipulate the information environment will have unlimited opportunities to work.

some slick report writing, information displayed on the screen in a crude representation of a paragraph of text. Numbers were numbers without graphical or typographic embellishment.

By 1987, some online systems were adding to legibility by using upper and lower case alphabets, clever tricks for giving text some font variations, and color. The breakthrough was color, enabling different parts of the screen and data displayed to be more easily identified.

Macintosh users had access to software that could produce page replicas. But typographic variety, graphics, and enhancements such as text combined with streaming financial data were high-end workstation applications for computer laboratories or niche online applications.

At the start of 1997, online information had moved closer to several different presentation models. Those that have captured the greatest attention are the graphical presentation of streaming information, various two-dimensional and three-dimensional graphic environments, and presentations that blend snappy typography with audio, animation, and streaming video.

Content has gone through a singular transformation. In addition to a way for branded information providers to capture customer attention, individuals and small businesses now have a new information dissemination medium. The large publishers and information aggregators have a major opportunity to extend their franchise.

Perhaps more importantly, new companies with clever new applications and technology can stake out new markets or create niches within established markets.

The delivery of content has come full circle. Online began as a semi-exclusive club, first within a company or research community. Then online access spread to a few upscale niche markets. After a decade of effort, online became feasible for certain types of applications where money, talent, and need came together. Now any organization or individual can make use of online access for a wide range of applications. These include the now consumerized Internet, the intranet applications within an organization or virtual organization, and the extranet applications that are for-fee, specialized services that run on private or public networks.

From one point of view, content has become too plentiful. Excess information means an impossibly large job of finding out what is important, correct, or meaningful. On the other hand, there is a wealth of useful information that individuals and organization provide in the hopes that users will become customers or form a brand impression of the service.

Online today is not precisely television. It is something new. Nor is online today simply textual information retrieval, electronic mail, chat groups, or real-time news services that push data to the user's desktop. The new online is a blend of different information objects.

WHERE IS "ONLINE" ELECTRONIC INFORMATION GOING?

There is a great temptation, after looking at some major trends in 1977, 1987, and 1997, to take the next step to 2007. However, working in the information industry does not make one an astrologer, a futurist, or an accurate forecaster. Predicting that electronic information companies will lose money works most of the time and will for the next few years.

Nevertheless, let's take each of the nine vectors of change and play a harmless game of looking for indications of what will be unfolding over the next decade.

The Business Climate

The climate will undergo a cooling trend and then recover. Knowledge is going to command a premium. Although the amount of data and information will grow exponentially, knowledge is in frightfully short supply. The outlook is bright for information services that enrich this scarce resource.

Hyperactivity in the online world will slow, but it will not stop. Online information will become less a "hot technology" and more of a "building block." The consequence of this integration of new technology will be a radical re-engineering of certain business processes. Without information technology, it will be increasingly difficult for any competitive organization to maintain its edge.

The forces of globalization, disintermediation, networkization, and digitization are going to gain momentum before the bubble bursts.

The Electronic Information Environment

The working and leisure environment is "informationized." Because we are immersed in a datasphere, the environment itself becomes more and more difficult to discern. Like advertising in a typical U.S. airport, the messages are ubiquitous. Similarly, electronic information will be everywhere, embedded in other devices. Many of these embedded information products will become invisible to average users. The only way to escape the emerging world of electronic information is to pull the plug, turn off the telephone, and eschew any device that has a computer in it. This might be fairly difficult for certain segments of a society to take.

Organizations will spend a larger percentage of total revenue to sustain the information component of the organization. To lead the market, the organization will have to be a successful information innovator.

Markets

Markets will expand, fragment, coalesce, and reshape themselves with dizzying speed. Stable markets will emerge, but over time, like large weather systems, they too will weaken and dissipate.

It is likely that a typical developed country's population will stratify itself according to its information literacy.

Those in the upper strata will become distinct, highly desirable upscale markets. Those in lower strata will become consumers of embedded information technologies. Markets will be sharply delineated between strata but very blurry within a stratum or between immediately adjacent strata.

Value comes from the customers' viewpoint, not the information producers. As the informationization process filters through a society, customers become more and more powerful. Customers want to connect and have everything else out of the way.

Marketing Factors

Price, ease of use, cleverness, novelty, function, form, and fashion will sell information. No single marketing technique will work all of the time. Information will be free in certain contexts and simultaneously command a high price in other contexts.

Information is the new resource, and like the use of any "natural" resource, value changes depending upon the use of the resource. People pay more for a cotton dress with a designer label than they will for a cotton dress crafted by a student working in a high school sewing class.

Computing Infrastructure

The computing infrastructure for those with access to money, learning, and tools will be flexible, controllable, and inherently interesting. For those without these assets, the computing infrastructure will be part of the day-to-day environment. Countries, cities, homes, institutions, and individuals without a computing infrastructure will find themselves unable to participate fully in certain aspects of the world.

Methods of Producing or Manufacturing Information

Over time, applications of information technology to production will accelerate new ways to build or fabricate product and services. This vector of change will be an accelerator to the re-engineering that will become a major thrust of some organizations over the next few years.

Workers

Unfortunately information technology divides people between some very thick lines. Those who have the ability to invent and manipulate the information environment will have unlimited opportunities to work. The options available to these people will proliferate. For those without the knowledge and skills, other types of work will be valuable until information technology makes more substantive inroads. At that point, becoming information literate will make the difference between who gets what opportunities.

No single approach to work will cover the multiple demands and opportunities that lie in the very near future.

Network Delivery Mechanisms

For those with resources, network delivery mechanisms will become richer, more powerful, and more enabling than at the present time. Low-cost services may provide basic functions. For people and organizations that are driving aggressively toward an objective, basic functions are not likely to be sufficient. Although information technology will be ubiquitous for certain segments of society, access to the advanced selective mechanisms will give others a decided advantage. This vector reinforces the sharp lines between information haves and have-nots.

Content

Content will become richer. The high-end applications will drive toward digital virtual worlds. Low-end applications will become more capable of handling various types of information objects. "Choke points" for certain types of high-value content will emerge. These are less likely to be related to copyright and more likely to be directly linked to the user's ability to pay to get the necessary information. Branding content will be increasingly important as the volume of no-name content expands more rapidly than it can be located, indexed, or processed.

CONCLUSION

The world in ten years will be reshaped by electronic information's transformational forces. Short of pulling the plug, the informationization of life and work and play cannot be stopped.

We believe electronic information is likely to bring us a world much like today's, with one big difference: electronic information destabilizes. The future will be move faster, be more confusing, and be much more volatile than what information professionals experience today.

Electronic information is a new substance. It is one that we do not fully understand or know how to manage. What we do know is that it is self-renewing, plentiful, volatile, and valued only within a specific context.

So grip that mouse. We are shifting into the world of hyperdata. To reword a proverb, we live in informationizing times.

REFERENCES

[1] Andrew Ehrenberg is the author of *Television and Its Audience*, *A Primer in Data Reduction*, and *Repeat Buying*. Professor Ehrenberg is the Head of the Centre for Research in Marketing at Southbank University (London, England).

[2] Bunshu is a term that translates as "dividing companies before they grow too big." In many cases, smaller units can move more rapidly and serve customers better. Small Internet start-ups can out-maneuver many larger organizations. The Bunshu approach to business management is documented in a series of books by Kuniyasu Sakai and David Russell. The three titles in the series are *Bunshu Lives in the Making*, and To *Expand We Divide*. The series is published by Intercultural Group, Inc. A good overview of the concept appears in the third book in the series: *To Expand We Divide: The Practice and Principles of Bunshu Management*, 1993. ISBN 1-881267-06-7.

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