

**How the Computer Became Information Technology:
Constructing Information in Corporate America, 1950-2000**

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“[information] is no more than a linguistic convenience that saves you the trouble of thinking what you are talking about.” Robert A Fairthorne, 1965¹

We live, we are frequently told, in an information age or an information society. People who say this usually mean the same thing they meant when, a few decades earlier, they talked about the computer age or the computer society. As a label, particularly within business and academic organizations, information is applied almost exclusively to things, people and institutions related to computers. Anyone whose business card includes the word information is probably a computer expert, perhaps a humble “information systems specialist” who plugs in printers and helps users when their computer crashes or an exalted “chief information officer” responsible for all corporate computers. Organizations do not spend money on computers; they make investments in information technology or install information systems. Universities have rushed to set up new interdisciplinary schools of information and informatics to explore the applications of computer technology, while departments of information systems within business or library schools train junior computer staff. The primary computer industry trade group is called the Information Technology Association of America, while Infoworld is one of the leading industry newspapers. Management experts talk about information as a “strategic resource” of business.

During the 1990s, the term information technology became so ubiquitous, and so closely associated with the computer, that even the unmodified “technology” was implicitly redefined. Taking part in an organizational “reengineering” project made historian of technology Rosalind Williams discover that her fellow MIT administrators had joined corporate managers in redefining technology so that “instead of embracing the totality of the human-built world, it just means ‘computers.’”²

How did the computer become information technology? In daily use, after all few of us would apply that term to other technologies, such as notepaper or road signs, that are more directly involved with informing. It turns out that the category of information technology was created during the 1950s to fit the computer, and only retroactively and fitfully applied to other things. As the concept spread, most rapidly during the 1980s, it gave rise to a fundamentally new sense of the word information, not found in the business world before the coming of the electronic computer. Whereas information, even as a noun, previously implied that a human was being informed of some piece of useful knowledge, the word was now used to refer to a mass of facts, and eventually to anything stored digitally within a computer system. Information was no longer the result of a process of informing. Instead it was a static quantity to be husbanded and managed.

This new concept of information developed within business primarily as a result of deliberate attempts to define the problem (information) to which the computer (redesignated as information technology) was the solution. The establishment of information as a technical

¹ Robert A Fairthorne, "'Use' and 'Mention' in the Information Sciences", in Proceedings of the Symposium on Education for Information Science, ed. Laurence B Heleprin, Barbara E Markuson, and Frederick L Goodman (Washington: Spartan Books, 1965).

² Rosalind Williams, "'All that Is Solid Melts Into Air:' Historians of Technology in the Information Revolution", Technology and Culture 41, no. 4 (October 2000):641-68.

domain fostered acceptance of information technology, in the hands of information specialists and chief information officers, as a technological fix for newly-defined information problems within business organizations. As a result, information technology became a panacea, a solution for a problem faced in every facet of every organization.

I pay particular attention to two topics. The first is the attempt to create huge, centralized repositories of facts to assist managers in their decision making. These attempts have persisted, under a range of names, from the 1960s to the present day. They are justified by a particular construction of the manager as a rational decision maker, an information processing node, who will function more effectively when fuelled with a stream of suitable information. The implicit problem is one of information shortage, and the implicit picture of the decision maker is as a computer-like being. Indeed, the very idea of information, in the senses most commonly used today, was created in the image of the computer and by proponents of computer technology. The second is the redefinition of computers as information technology, and of computer staff as information specialists and information managers. The computer was promoted as information technology, the most powerful tool for information ever to be created, and information was promoted in turn as the new currency of business. Whereas expertise in the business application of computers was relatively low-status in the corporate world, to claim expertise in information systems or information technology was to assert expertise over the decision-making processes of top management and the potential of computers to improve them.

While this began in the 1950s, I pay most attention to the 1980s because this was the period in which information technology and other information concepts truly achieved widespread use in American business. This was also the decade in which many of America's largest companies created a new executive post: the Chief Information Officer (CIO). The CIO was intended to be a kind of hybrid: the head and torso of a strategically nimble and forward-looking business executive joined to the powerful lower body of a computer expert. Just as the Chief Financial Officer was responsible for every aspect of the corporation's relationship to money (from structuring financial strategies to overseeing accounting systems), so the Chief Information Officer would be responsible for every aspect of the corporation's relationship with information. As well as overseeing the operation of centralized computer centers, this meant husbanding information itself, setting information technology standards, identifying strategic opportunities for the application of information technology and educating other top managers to see information as a resource. This conception of information as a resource represented a decisive moment in the construction of a new conception of information, quite different from anything present in business thought before the creation of the computer.

From the very start, the CIO movement was controversial and its achievements questionable. The blending of business and technology executive proved a hard thing to pull off, putting as it did so much weight on the ability of individual ability to transcend deep structural and cultural divides. CIOs struggled to gain the respect of other executives, and have never achieved the broad responsibilities they hoped for. They changed jobs more frequently than other top managers, and they earned less money. Few CIOs have gone on to lead major companies. Probably none has ever established an authority over information equal to that a CFO enjoys over finance. Yet, viewed in other ways, the CIO movement has been an enormous success. By the end of the 1990s almost every large corporation had created a CIO. Computer budgets continued to rise, and computer managers continued to ascend the organization chart. Most computer departments had been renamed to include the word information, whether they were called Information Systems Divisions or Information Technology divisions.

Information Before the Computer

The word information, when not conjoined with technology or system, is today most commonly used as a synonym for fact. Information is the factual material held in books, encyclopedias and scientific publications. While this sense of information does not always imply that anyone is being informed (we find it natural, for example, to speak of information storage), it is nevertheless frequently associated with the communication of knowledge. The putatively revolutionary power of information technology thus lies in its ability to store vast bodies of facts, to sort and process them automatically, and to disseminate them as required.

The word information is also applied, in a different but overlapping meaning, to anything stored digitally within a computer system. This linguistic usage of information has departed altogether from the implication that somebody is informed of something, or from the sense that information consists of organized facts. The computer is an information machine because it is a generalized processor of digitally encoded symbols. Once something has been encoded digitally it is stored and manipulated in exactly the same way whether it forms part of a videogame program, the complete works of Shakespeare, or a pornographic film. While we would not usually speak of a live musical performance as a stream of information, it is more common to speak of a digital audio recording of the same concert as information when stored within a computer system. This kind of thinking reached its apotheosis in 2000 when Hal Varian, Dean of the newly created School of Information Systems and Management at Berkeley, tried to quantify the volume of information in the world by estimating how many megabytes of computer disk space would be needed to store all of it.³

One cannot but help notice an unfortunate circularity in these implicit definitions of information and information technology. The computer is an information technology because it stores, processes, and communicates information of all kinds. Information is that which is stored, processed, and communicated with information technology.

As no commercially available digital computer system existed in 1950, we should not be too surprised the idea of information as a collection of digital signals processed by a computer was not then in general use. More surprisingly is that the idea of information as a general description for facts (and particularly of facts stored and received) was equally unfamiliar to the businesspeople of 1950. Similarly, the terms information technology and information system were as yet uncoined, though they have been liberally applied in retrospect to everything from books to telephones.

While the word information has a long history, its early usage was closely related to the verb “to inform.” Information was originally the act that took place when a specific person or group of persons was informed of something. Although the Oxford English Dictionary shows that its usage as a noun goes back at least to 1450, until quite recently it appears to have referred to the state of enlightenment produced in the informee, rather than the factual material itself. At one time, for example, it was common and natural to speak about getting “information of facts.”⁴

³ Peter Lyman and Hal Varian, "How Much Information?" *The Journal of Electronic Publishing* 6, no. 2 (December 2000).

⁴ In her introduction to *The History of England*, for example, Catherine McCauley wrote that individuals “only want a just information of facts to make a proper comment.”⁴ “Information of facts” sounds terribly odd to our ears, yet it was once a reasonably common expression. It seemed particularly prevalent in legal documents and may also, as linguist Geoff Nunberg has pointed out, be found in Gulliver’s Travels). Geoffrey Nunberg, "Farewell to the Information Age", in *The Future of the Book*, ed. Geoffrey Nunberg (Berkeley: University of California Press, 1997).

The phrase makes it clear that facts are not themselves information, but are something of which one might be informed. The same meaning would appear to be at work when Article II, Section 3 of the Constitution of the United States stipulates that the president “shall from time to time give to Congress information of the state of the union....” Even today, such meanings linger in concepts such as the well informed person, the police informer, or the message forwarded “for your information.” (A good parallel with earlier usage of information may be with our current use of “education.” While we might speak with pride of receiving a good education, of giving an education to a child, or even of getting some of our education from a particular book, we would never speak of education storage or education processing, or of a book as holding education).⁵

My own reading of the business literature of the early- and mid-twentieth century suggests that information continued to refer to the communication of useful facts, rather than to the facts themselves. Although some earlier references undoubtedly exist, the closest I have come to a pre-1950 reference to information storage or processing in the administrative literature is a 1940 article in the Journal of Accounting, which speaks of “information punched in cards.”⁶ Prior to the 1950s, the only job title likely to include the word information would be that of an “information officer”: someone employed to inform other people (often the public). Likewise, the only corporate department incorporating the word in its name would probably be an information bureau responsible for disseminating information externally.

It is never easy to prove a negative, and I realize that many readers will find this claim startling. Let us therefore examine briefly a few of the places in which references to information would later become ubiquitous. One of these is discussion of office technologies and administrative systems. While office management textbooks from the 1910s to the 1940s paid an enormous amount of attention to the concept of systems, and often cast the office as a paper processing machine in need of expert care, they never invoked the concept of clerical work as information processing, or spoke of administrative systems as information systems.⁷ Neither did

⁵ Nunberg has suggested that the dominant meaning of information shifted during the mid-nineteenth century to describe authoritative, objective, publicly communicated factual knowledge of the kind disseminated through newspapers, government publications, and encyclopedias. Ibid. Nunberg refers to this new sense of information as “abstract information” because its authority came from the institution supplying it, and because it was increasingly abstracted from any particular person informing or being informed. Nunberg points out that this newer sense of information is easy to misread into earlier sources, especially “when the context involves talk of ‘having,’ ‘acquiring’ or ‘receiving’ information....” As he shows, with reference to a passage from Emerson, the difference is between an older meaning of information as “the instruction derived from books” and a newer meaning of information as “the content of books.” Nunberg therefore locates the late-nineteenth century as the true “information age”, suggesting that the Internet serves instead to sever the link between form and reliability crucial to acceptance of printed reference material as information. (This, he suggests, derived from an earlier, now obscure, sense of information as a kind of moral instruction).

⁶ Leon E. Vannais, "Punched Card Accounting from the Audit Viewpoint", Journal of Accounting 70, no. 3 (September 1940):200-17. This was some time before Shannon definitively formalized this mechanical sense of information.

⁷ Major office management textbooks include Geoffrey S. Childs, Edwin J. Clapp, and Bernard Lichtenberg., Office Management. (New York: Alexander Hamilton Institute, 1919), Lee Galloway, Factory and office administration (New York,: Alexander Hamilton institute, 1918), Lee Galloway, Office Management: Its Principles and Practice (New York: 1919), William Henry Leffingwell, Office Management - Principles and Practice (London: A. W. Shaw Company, 1925), William Henry Leffingwell, A Textbook of Office Management (New York: McGraw-Hill Book Company Inc, 1932), William Henry Leffingwell and Edwin Marshall Robinson, Textbook of Office Management (New York: McGraw-Hill, 1943), Harry L. Wylie, Merle P. Gamber, and Robert P. Brecht, Practical Office Management (New York: Prentice Hall, 1937).

textbooks on filing practices characterize the filing system as a repository of information (though one 1924 book did make the strikingly contemporary claim that “files now function actively as a kind of composite memory for the organization.”)⁸

Advertisements for card file systems promoted them as stores of facts than of information. This held over into the first advertisements for business computers. The image below is taken from the cover of what may well be the first lavishly produced color brochure to promote an electronic computer for business administration. In 1950, even though Remington Rand promised an “Electronic Revolution For Business” (notice the manager inside the vacuum tube), the tiny letters under the word Univac promote this computer as a “Fact-troller,” presumably by analogy with the corporate post of Comptroller. In 1953 the vice president responsible for sales at Remington Rand suggested that, “Modern management needs and demands administrative 'Fact Power' in the form of records and reports -- which serve business as a 'Nervous System' in the operation of its economic operations.” Rand was a major supplier of office machines, the number two producer of punched card machines, and the first company to offer a computer as part of its product line. Yet its leading salesman still used the clumsy “fact power” when describing the managerial benefits of its machines.⁹



⁸ Ethel E. Scholfield, Filing Department Operation and Control (New York: The Ronald Press Company, 1923).

⁹ Al. N. Seares, "Advancements in Office Automation", The Hopper 4, no. 2 (February 1953):6-9.

Figure 1: An early Univac advertisement. Note the business manager inside the vacuum tube.¹⁰

Close examination of the work of individuals now regarded as pioneers in “information age” thinking is particularly revealing. A striking example is found in the celebrated 1945 article “As We May Think” by Vannevar Bush.¹¹ The article proposed the construction of machine, the “memex,” able to store a capacious personal “file and library” in the space of a desk. Users could add their own material, cross-reference entries from different sources, and search automatically. As a result, the memex has been seized upon as a conceptual ancestor of the World Wide Web, and Bush himself is honored as a father of the information age. According to one typical citation, it was “the earliest description of a machine designed to support the building of trails of association through vast stores of information.”¹² The article itself, however, includes the word information only four times, and in none of these instances did it describe the mass of text and pictures stored within the memex. (Instead of using information as a description of the content of his machine, Bush referred to this mass of written material as “the record.”) Even where the word was used, the modern reader is struck by the distinction Bush preserved between the data stored within the device, and the information that can be found when it is consulted: “When data of any sort are placed in storage, they are filed alphabetically or numerically, and information is found (when it is) by tracing it down...” (The other three instances of the word information all refer to the transmission of nervous signals within the human body).

Peter Drucker enjoys a deserved reputation as one of the most important theorists of the American corporation. In recent years he too has been widely acknowledged as one of the key originators of the information society concept. Yet while his 1953 classic The Practice of Management included a small section entitled “Information: The Tool of the Manager” this did not describe the need for managers to build up large, formalized collections of facts. Instead, the section was a plea for managers to develop better personal communication skills: “the manager has a specific tool: information.... No matter whether the manager's job is engineering, accounting, or selling, his effectiveness depends on his ability to listen and to read, on his ability to speak and to write. He needs skill in getting his thinking across to other people as well as skill in finding out what other people are after.”¹³ In 1959, when Drucker coined the term “knowledge workers” to describe the increasing importance of college trained technical and professional staff, he refrained from using the term information to describe what others would later seize on as a key aspect of the “information society.”¹⁴ In 1962, the first economist to attempt to quantify the importance of what we would now call information within the American economy made a similar choice when he called his book The Production and Dissemination of Knowledge in the United States.¹⁵

¹⁰ The source of this image is a 1950 Remington Rand brochure, found in the Computer Product Literature Collection (CBI 12), Charles Babbage Institute, University of Minnesota, Minneapolis.

¹¹ The original article is Vannevar Bush, “As We May Think”, The Atlantic Monthly 176, no. 1 (July 1945):101-08.

¹² James M Nyce and Paul Kahn, “A Machine for the Mind: Vannevar Bush's Memex”, in From Memex to Hypertext: Vannevar Bush and the Mind's Machine, ed. James M Nyce and Paul Kahn (New York: Academic Press, Inc., 1991), 39.

¹³ Peter F. Drucker, The Practice of Management (New York: Harper & Brothers Publishers, 1954), 346.

¹⁴ Peter Drucker, “The Next Decade in Management”, Dun's Review and Modern Industry 59(September 1959):52-53, 57-58, 60-61.

¹⁵ Fritz Matchlup, The Production and Distribution of Knowledge in the United States (Princeton: 1962).

Only with respect to the electronic computer did people begin to speak of information systems or information technologies. This was, I suggest, not a revolution in technology, or in practice, but in thought. By grouping together a mass of previously unrelated things and calling them all information, the revolutionaries tried to raise the status of existing occupations (such as librarian or computer manager), to sell products and ideas as solutions to newly-defined information problems, and to establish new areas of technical expertise within the traditional domain of general managers.

Information and the Computer Before 1975

During the 1950s, the idea of information was applied in a number of new ways. Its vogue began with the choice of communications engineer Claude Shannon to refer to his generalized mathematical description of digital communication as “information theory.” Shannon and his associates introduced the concepts of bits, bandwidth, redundancy and error correction. While some have complained that the use of information to describe this approach was misleading, because it had nothing to do with the meaning of the message sent, this choice was more in line with contemporary usage than is generally realized. Shannon’s model described the transmission of a series of encoded symbols between a sender and a receiver – in other words, the process by which the receiver was informed of something.¹⁶

Shannon’s ideas found their most direct applications in the construction of digital computers. Digital information is transferred constantly within a computer, as signals move backward and forward (for example, between arithmetic units and memory registers inside the central processor, or between a tape drive and the main memory). The creation of efficient and reliable schemes to encode letters and numbers was central to the feasibility of these machines. As the concepts of information theory were taken up and applied, with varying degrees of success, in different technical fields the distinction between storage and communication was eroded, as the ideas of information theory were applied to symbol sequences stored (for example in genes, or on computer tape) as well as those transmitted. By the late 1950s, “information processing” was being promoted as a possible name for the nascent academic discipline that became computer science. While this did not truly catch on in the United States, most European countries settled on a variation of “informatics” to describe the field. The umbrella group for American computing societies, founded in 1961, was called the American Federation of Information Processing Societies, and its international equivalent the International Federation of Information Processing.¹⁷

One book in particular, Edward Berkeley’s 1949 Giant Brains: Or Machines That Think, deserves special recognition for its role in popularizing the association of computer technology with information (as opposed to calculation, the function implied by the word computer). Berkeley presented the computer as the latest and most powerful in a series of pieces of “physical equipment for handling information” including everything from nerve cells, to writing,

¹⁶ On information theory, its relationship to cybernetics, and its use in different scientific fields see William Aspray, “The Scientific Conceptualization of Information: A Survey”, Annals of the History of Computing 7, no. 2 (April 1985):117-40. The application of information theory to genetics during this period is explored in Lily E Kay, Who Wrote the Book of Life: A History of the Genetic Code (Stanford: Stanford University Press, 2000).

¹⁷ Isaac L. Auerbach, “The Start of IFIP-Personal Recollections”, Annals of the History of Computing 8, no. 2 (April 1986). Eric Weiss, “Obituary: AFIPS”, Annals of the History of Computing 13, no. 1 (January-March 1991):100-01. Information processing is mentioned as “the phrase coming into acceptance” in Anonymous, “Is It Overhaul or Trade-In Time (Part II)”, Datamation 5, no. 5 (September-October 1959):17, 19, 21, 23, 25, 26, 44-35.

to human gestures. His book sold well, and for years to come was the standard introduction to computer technology for the interested layman.¹⁸

The novelty of this sense of information, and its connection to new technologies, was not lost on contemporary reporters. As management magazine Dun's Review noted in 1958, "only in the past dozen years has the concept of information--as distinct from the papers, forms, and reports that convey it--really penetrated management's consciousness. That it has done so is largely due to recent breakthroughs in cybernetics, information theory, operations research, and the electronic computer...." Alex W. Rathe, a professor of office management at Columbia who was among the first to develop an interest in the new topic, claimed that, "As late as 1946 there were in the combined professional, technical and scientific press of the United States only seven articles on the subject of information."¹⁹

During the 1950s, the word information was adopted in several contexts by groups of technical and scientific librarians. From 1950 onward, the term "information retrieval" was applied to research into the use of mechanical and electronic devices to automate the search and selection of records.²⁰ The first use of the term "information science" to describe specialized library work has been traced to 1959.²¹ While their direct ties to Shannon's work were tenuous, their adoption of the word was motivated in part by the fashionable and scientific aura surrounding information theory. It had gained a resonance lacking in earlier titles such as "special librarian" or "documentalist." Experts on scientific communication began to warn of a cold-war "information explosion," in which the rapid worldwide growth of science, and therefore of scientific publishing, made it impossible for practicing scientists to perform effective literature searches. All these usages were initially compatible with the idea of information as something produced when someone was informed. They did, however, clearly lend themselves to the subtle redefinition by which information became the factual content of the scientific journal, library shelf, or electronic file rather than the product of its perusal or communication.

The word picked up a similar allure within the world of corporate management and the rapidly developing subcultures of corporate administrative computer groups. It was during the 1950s that the terms information system, information technology, and even information engineer were first used. By the early 1960s, the Management Information System (MIS) was the by far the most frequently invoked concept in managerially oriented discussion of the proper function of the computer in corporate administration. Information gained the association of being something higher level, and more managerially relevant, than data. The word data was closely associated with "electronic data processing", which was almost universally used during the late 1950s and 1960s to refer to the application of computers to administrative work, the departments

¹⁸ Edmund C. Berkeley, Giant Brains or Machines That Think (New York: John Wiley & Sons, 1949).

¹⁹ The first quote is from Anonymous, "Today's Office--Room For Improvement", Dun's Review and Modern Industry 72, no. 3 (September 1958):50-51, 79-86. Similar figures on the sudden emergence of information are presented in Carlos A. Cuadra, ed., Annual Review of Information Science and Technology: Volume 1 (New York: John Wiley & Sons, 1966) The management professor is Alex W. Rathe, "Management's Need for Information", in Control Through Information: A Report on Management Information Systems (AMA Management Bulletin 24), ed. Alex W. Rathe (New York: 1963).

²⁰ See Hans Wellisch, "From Information Science to Informatics: A Terminological Investigation", Journal of Librarianship 4, no. 3 (July 1972):157-87. This mentions a common idea in the 1950s that information retrieval "could be performed only with the help of sophisticated machinery, primarily computers, and that anything done manually [in libraries] was not to be dignified with the new name."

²¹ Ibid mentions that "when the term Information Science was first used, it was clearly implied that it was the same as, or even subordinated to, Computer Science."

set up to conduct such work, the putative profession of administrative computing and the computer industry itself. But because most administrative computing work involved the simple and slavish automation of routine clerical tasks, the identity of data processing seemed constraining to the most ambitious and managerially oriented proponents of corporate computing. Data processing represented a gradual and evolutionary progression from the practices, applications and cultures of punched card machine work into the new world of the electronic computer. To many computer salesmen, administrative systems specialists and business academics the computer was far more interesting when applied to management information than to data processing.

Even the idea of MIS, however, retained the sense of information as a process of informing. The MIS would inform every manager in the corporation of everything they needed to know in order to carry out their jobs. In the early 1960s, MIS was often called the “Total Systems Approach”, because it would model the firm as a whole and inform managers of the results of their actions. One definition, from the seminal AMA conference, spoke of the system feeding the full range of managerial decisions, so that “the information needs of every level of management are met in a timely, accurate and useful manner.” The basic data would be processed in different ways, so that “every decision in the spectrum will optimize over-all company goals rather than those of any particular part or function.”²²

Most definitions implied that the MIS would work instantly (on a “real-time” basis), and that it would include elaborate mathematical models and forecasts as well as raw data. While claims for MIS were justified with respect to the enormous power of computers, technological specifics were rarely mentioned. Information itself, rather than any specific machine, was the thing being sold. One of the most dramatic examples of this took place at a 1961 AMA conference, when a senior U.S. Navy manager named Edmund D. Dwyer presented information as a cure for a nebulous yet pernicious managerial disease. “[M]anagement today,” he argued, was “plagued by an... insidious ill: management measles. Management measles is characterized by a lack of timely, accurate and complete data for decision making. Like German measles, this deficiency is readily diagnosed by the presence of the rash--the rash, impetuous decision. Fortunately, there is a miracle cure: We call it 'management information.'” Mixing his metaphors, the speaker suggested that an “intellectual radar” was needed to “forecast the future and predict the priorities of the future.” “Fortunately,” he continued, “this intellectual radar exists today.... We refer to it as automatic data processing equipment.... Harnessed to the tools of the mathematical sciences and operations research techniques, it is complex management’s potential salvation.... It’s high time we shifted out informational radar from reaction to prediction. This would take both the rashness and the risk out of our decisions and dispel all traces of management measles.”²³ Similar claims were made again and again throughout the 1960s.

²² Charles Stein, Jr., "Some Organizational Effects of Integrated Management Information Systems", in The Changing Dimensions of Office Management, ed. American Management Association. Office Management Division. (New York: American Management Association, 1960). Like much early discussion of MIS, the language used here invoked the cybernetic concept of feedback (with which information was often associated) and, with its reference to the optimization of the overall system, the then-fashionable fields of game theory and systems engineering

²³ Edmund D. Dwyer, "Some Observations on Management Information Systems", in Advances in EDP and Information Systems: AMA Management Report Number 62, ed. Administrative Services Division American Management Association (New York: American Management Association, 1961).

Information, then, was a panacea for the ills of business. And the computer (which is what he meant by automatic data processing equipment) was the technology that would supply it. With sufficient information, the unpleasant and subjective elements of decision making would be swept away. In 1962, Adrian M McDonough, a Wharton School researcher, suggested that “When complete information is available, the policy or decision may already have been made. Another way to say this is the facts speak for themselves and require only a formal acceptance and stamp of approval by the line executive rather than a decision.” Because the supply of information was therefore the key factor in improving management, it followed that the designer of the information system could assume a kind of technocratic authority over the entire organization. “Information systems will be designed simultaneously with the design of organization patterns and job responsibility. Here we will see a synthesis of organization planners and systems designers. Jobs will be described in terms of their problem content and related information needs rather than in the present jargon of authority and responsibility.”²⁴

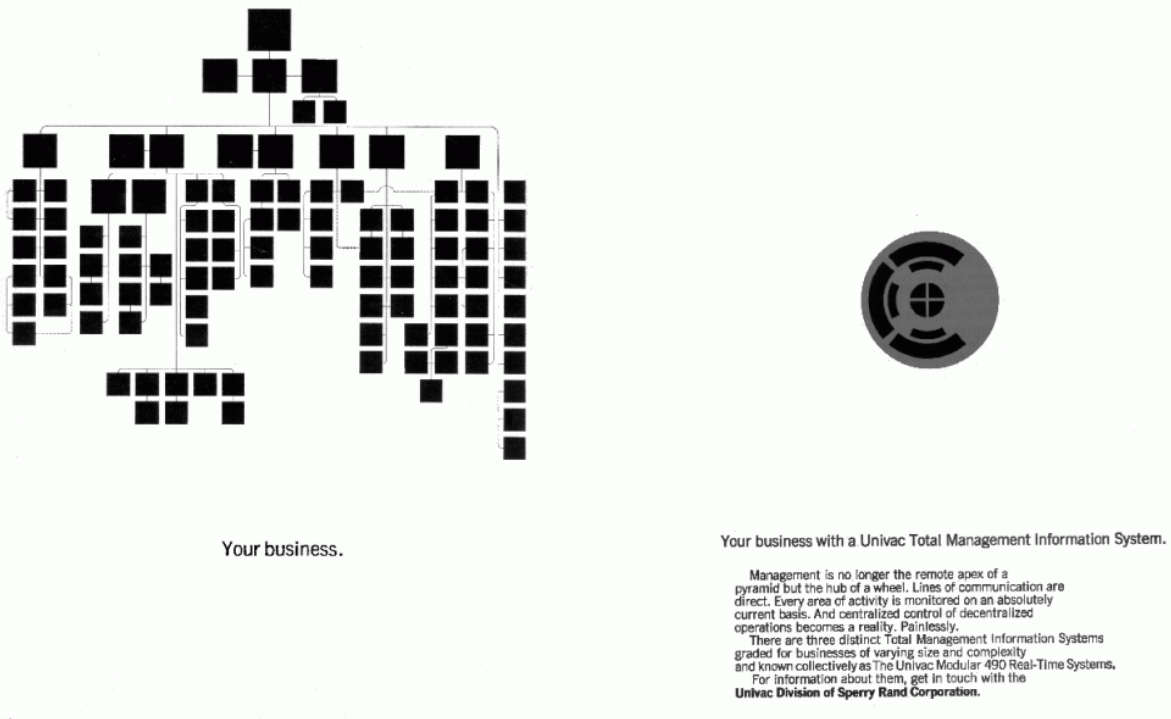


Figure 2: “Your Business With a Univac Total Management Information System” (advertisement used in Fortune, Datamation, and Business Week, 1965).²⁵

²⁴ Adrian McDonough, "The Scope of Management Systems: Past, Present and Future", in Total Systems, ed. Alan D. Meacham and Van B. Thompson (Detroit, MI: American Data Processing, Inc., 1962).

²⁵ Fortune, October 1965, pages 32-33. Text on left reads “your business”. Text on right readings “Your business with a Univac Total Management Information System. Management is no longer the remote apex of a pyramid but the hub of a wheel. Lines of communication are direct. Every area of activity is monitored on an absolutely current basis. And centralized control of decentralized operations becomes a reality. Painlessly. There are three grades of distinct Total Management Information Systems graded for businesses of varying size and

An extreme form of this can be seen in this series of Univac advertisements, which ran in Fortune and Business Week in 1965. The sprawling corporate organization chart is compressed, symbolically, into a single reel of computer tape. (Other adverts did the same with a map showing branches scattered across a map of the United States). This captures a common pitch, that MIS could reverse the trend toward decentralization and give corporate headquarters the power to rein in divisional managers. Note the conceptual slippage by which computer hardware was now promoted, in and of itself, as a total Management Information System.

In the fast growing world of business school researchers, the concept of information also had considerable appeal as the possible basis for a more scientific and theoretical approach to the study of management. Herbert Simon, a major figure in both administrative theory and computer science, provided an intellectual framework for this vision through his various attempts to show that both the computer and the organization itself were decision-making and information processing machines possessed of potentially superhuman rationality. In 1960, Simon had suggested that computers would be capable in principle of automating any managerial decision by 1970.²⁶ His work on artificial intelligence and his work on managerial decision making both addressed the question of how to make a system that could make better decisions, based on more complex information, than any of its component parts could manage in isolation. To Simon, therefore, the individual was not a source of input, but a node in a larger and more formal machine. Limited as the idea of a manager as information-processing cog may appear, it underlies a common conception in management science circles, in which managers are thought of as spending most of their time making rational, involved decisions after an objective study of the information at their disposal. This conception underlies the assumption that providing more, or better, or more up-to-date information will result in a dramatic improvement in managerial effectiveness. (Simon's specific contribution, for which he won the Nobel Prize, was to point out that decisions were not made on the basis of complete information, but represented a "bounded rationality" constrained by cognitive capabilities and the costs of gathering information).

The Data Base and the Data Resource Function

In the beginning, the Management Information System concept was seen merely as an extension of an earlier approach known as Integrated Data Processing, in which the outputs of one computer or punched card process would be reused as the inputs to another. Paper tape, telephone lines, and punched cards would integrate different systems. Early computer systems used tape to store records, and even a single task (such as a weekly payroll run) might involve the loading and unloading of dozens of different tape files. At first, many hoped that if an automation drive was based on careful examination of management's information needs then all these smaller systems could be joined together, supplemented with a set of advanced mathematical models, and used to inform every manager of exactly (no more, no less) they needed to do their jobs. This assumption mimicked the existing methods of reporting, in which figures from different sources were pulled together by clerks to produce weekly, monthly,

complexity and known collectively as The Univac Modular 490 Real-Time Systems. For information about them, get in touch with the Univac Division of Sperry RAND Corporation."

²⁶ Simon addressed this specific question in Herbert A. Simon, "The Corporation: Will It Be Managed By Machines?" in Management and Corporations 1985, ed. Melvin Anshen and George Leland Bach (New York: The McGraw-Hill Book Company, 1960).

quarterly and annual reports of different kinds. The computer, they hoped, could do this faster, cheaper, more effectively and more selectively.

This proved very much easier said than done. In retrospect, there are clearly dozens of compelling reasons that no comprehensive management information system could have been constructed during the early 1960s. Computers had tiny internal memory capabilities. Disk drives were only just becoming available, and could store only a few megabytes of data. General purpose operating systems capable of running complex real-time applications did not yet exist. Programming technologies of the era were inflexible and time consuming, making it hard to change the logic embedded in computer code when business practices shifted. Mathematical modeling and forecasting techniques proved useful in specialized areas (such as logistics), but very disappointing when applied to general economic or commercial trends..

While some of these problems could be overcome with time and more powerful computers, one issue was particularly damaging: there was no way of discovering, years before a system was finished, exactly what information a manager would need when it was operational. There was also little chance that this would stay the same for very long. By the end of the 1960s, a conceptual shift had taken place among the more perceptive proponents of MIS. If it was impossible for system designers to specify in advance the information needed by a manager, then they should focus instead on producing a shared pool of data and making sure that each manager had the electronic tools needed to extract whatever information he or she required.

By 1965, the term “data base” was used by Harvard Business School professor John Dearden to describe the core set of facts shared between different corporate computer applications. During the late 1960s others, including computer expert Robert V. Head, suggested that creation of a comprehensive, shared data base was the foundation of any successful MIS program. This idea fitted nicely with the general shift then underway from tape to disk drive as the primary storage for the current copies of key electronic records. All application programs dealing with operational and administrative tasks (payroll, inventory, accounting and the like) would work directly with this single, shared pool. Because records stored on disk were always accessible, different programs could share them. Existing application programs each maintained their own data files, usually on tape. This meant that data was stored in many different places, and that specific facts were often duplicated (redundancy), and that each file could give only a fragmentary depiction of reality. Consolidating data from several different files was a slow, expensive and sometimes impossible task. Managers were regularly issued with voluminous reports full of raw data, but getting summarized information in response to specific questions required manual analysis or special programming, while knitting together information from several different files was a major undertaking.

Head and his colleagues assumed that once a comprehensive, disk based data base had been established the creation of an equally comprehensive management information system would be relatively straightforward. As Head showed in graphical form, he believed the information needed by top managers to make strategic decisions was nothing more than a summarized, processed version of the operational data held in the database. The data base was the foundation on which the entire MIS pyramid would be erected. (By calling the data base a data base, rather than an information base, they continued to respect the earlier sense that a collection of facts was not in itself information).

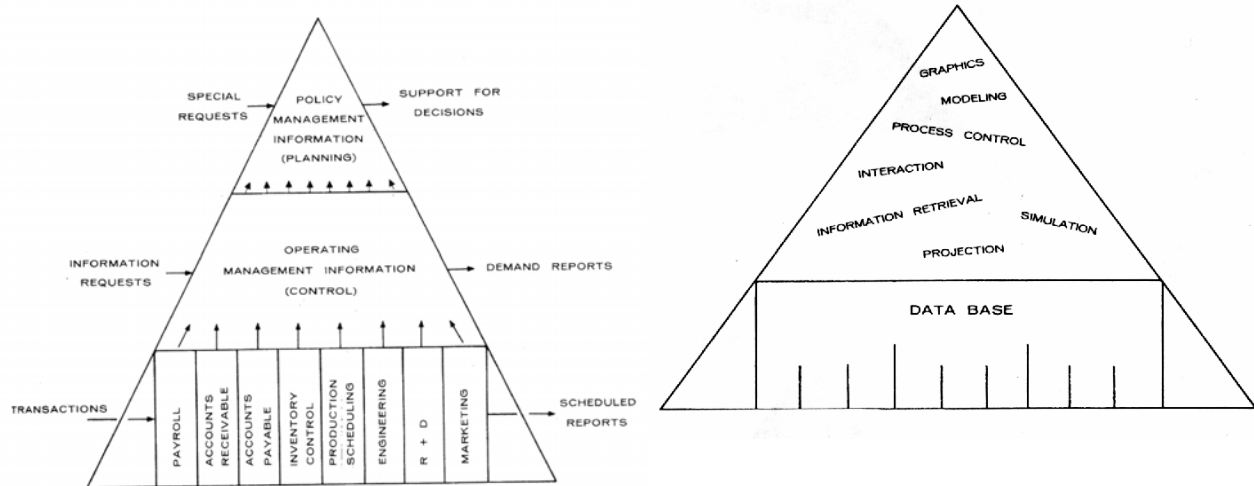


Figure 3: The Data Base was seen as a foundation upon which the rest of the MIS could be constructed.²⁷

By the early 1970s, the term data base had been adopted as part of the name of the Data Base Management System (DBMS), a new kind of software tool defined by the computer industry standards group CODASYL (Committee On Data SYstems Languages). DBMS systems made it much easier to share data between multiple applications, to maintain data files on disk rather than tape, to produce one-off reports, and to alter data formats without rewriting application programs. For the rest of that decade, DBMSs were by far the most commercially important products for the newly created packaged software industry. Today they are the foundation of almost all corporate computer applications and lie behind all large-scale commercial websites.

Publicity given to the DBMS concept gave still more prominence to the idea of a data base. A lot of discussion of the "data base" from an organizational perspective still ignored such implementational details. It functioned almost as a synonym for MIS. As Richard L. Nolan noted, "Writings on MIS have waned recently and have largely been replaced by writings on the Data Base. If the term Data Base or DB is used to replace the term MIS, the titles of recent articles are remarkably similar to the titles of MIS articles of several years ago."²⁸ Early DBMS systems were extremely demanding, requiring expensive mainframe computers with powerful processors and large core memories. Like Nolan, many managerially oriented authors assumed that a single huge centralized database could be created to integrate all computer readable data throughout the company. In a 1973 Harvard Business Review article entitled "Computer Data Bases: The Future is Now," he suggested that the company-wide data base was now a practical and necessary step for forward-thinking companies, because "Today, upper levels of management are seeking information that can be generated only from properly structured, companywide pools that include data from the narrower applications...." This, he believed,

²⁷ Robert V. Head, "Management Information Systems: A Critical Appraisal", *Datamation* 13, no. 5 (May 1967):22-27, page 24.

²⁸ Richard L. Nolan, ed., *Managing the Data Resource Function* (New York: West Publishing Co, 1974).

demanded a fundamental conceptual shift so that “the data computer programs use are considered an independent resource in themselves, separate from the computer programs.”²⁹

Nolan suggested that a new corporate group, the “data resource function” should be “carved out of the general management function” to manage this new asset. He viewed this as something distinct from the existing data processing department, going so far to urge that managers avoid handing responsibility for the corporate data base to data processing managers with a “purely technical” background.³⁰ Despite Nolan’s effort to promote the “data resource” term, including a book Managing the Data Resource Function, few others adopted it.³¹ Nolan publicized a “stage” model of computer department evolution (which he claimed to have based on Marx’s notion of historical materialism) to suggest that all computer departments moved along an inevitable (if rocky) trajectory toward a utopia in which data base technology was widely used, the computer department enjoyed upgraded status and was headed by a Vice President of MIS, who “should expect to assume a stronger role in general management councils.”³²

Academics stretched the MIS term to refer to anything concerning the corporate use of computers for managerial or operational purposes, including both computer-aided decision making and the best practices for running and structuring a computer department. By the late 1970s, at which point large numbers of companies had adopted MIS as the new name for their administrative computing departments, it was little more than a new name for EDP.

In response to this widening of scope, and to the failure of early MIS research to discover very much about the information needs and behaviors of managers, those interested in what managers actually did with information began to define their work in different ways. One of the most trenchant critics of information as a panacea was Henry Mintzberg, who established a reputation as one of the most practical and original of management theorists simply by observing real managers at work. He found that they ignored detailed factual reports, refused to concentrate for long periods on in-depth analysis, relied on social networks and gossip for their information, put a premium on information from outside their own organization, and spent most of their time talking. From this, he concluded that neither MIS nor its rationalistic siblings of decision support and strategic planning were in a position to do much for real managers.³³

²⁹ Richard L. Nolan, "Computer Data Bases: The Future is Now", Harvard Business Review 51, no. 5 (September-October 1973):98-114. For discussion of the data base as a tool for “decision support” see Andrew B. Whinston and William D. Haseman, "A Data Base for Non-Programmers", Datamation 21, no. 5 (May 1975):101-7.

³⁰ Nolan, "Computer Data Bases: The Future is Now".

³¹ Nolan, ed., Managing the Data Resource Function.

³² Cyrus F. Gibson and Richard L. Nolan, "Managing the Four Stages of EDP Growth", Harvard Business Review 52, no. 1 (1974):76-88.

³³ Mintzberg published his seminal ethnographic work as Henry Mintzberg, The nature of managerial work (New York: Harper & Row, 1973). The connections to MIS were made more explicit in Henry Mintzberg, Impediments to the Use of Management Information: A Study Carried Out on Behalf of the National Association of Accountants, New York, NY and the Society of Industrial Accountants of Canada, Hamilton, Ontario, Canada (New York: National Association of Accountants, 1975). The same basic findings and message remain standard reading in many management courses, often as [Mintzberg, 198X #2721]. Discussion of research in “decision support systems” and its emergence from MIS can be found in Peter W. Keen, "Decision Support Systems: A Research Perspective", in The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan school of Management Massachusetts Institute of Technology, ed. John F. Rockart and Christine V. Bullen (Homewood, Illinois: Dow Jones-Irwin, 1986).

Some within the academic MIS community also challenged the assumption, implicit in many of the hopes for the data base, that a sufficiently large pool of computerized data would necessarily lead to improved management. MIT's Michael Scott Morton, pioneered the term "Decision Support Systems", as a more specific alternative MIS because it emphasized the goal of helping managers make better decisions. He suggested that, "the 'integrated' or 'company-wide' data base is a misleading notion, and even if it could be achieved would be exorbitantly expensive."³⁴ Scott Morton argued that a successful information systems effort should be "virtually independent of the computer group." Managers did not lack information, but they did "have need of new methods to understand and process the information already available to them."³⁵ Within a few years his group had jettisoned the MIS tag altogether, preferring first Decision Support Systems and then – influenced by Mintzberg and his critique of the idea of the manager as a disembodied decision maker – Executive Support Systems.³⁶ These quibbles, however, did little to discourage the continuing promotion of computerized information systems as the all-purpose remedy to managerial troubles.

The Information Executive for the Information Age

Just like the late 1950s and early 1960s, the late 1970s and early 1980s saw a remarkable surge in the creation and adoption of new business-related information concepts. The earlier wave had seen the coinage of information systems, information processing, information retrieval, information science, data base, and information technology and a broad diffusion of the management information system concept. The later wave saw the coinage of the chief information officer, the information age, and the information society. In addition, the formerly esoteric terms information technology and information systems were for the first time widely used in the general business press.

The re-designation of the head of data processing, or management information systems, as the Chief Information Officer took advantage of this new vogue for information. The term "information technology" had been coined back in 1958, when a Harvard Business Review article used it to denote the combination of computers, operations research methods and mathematical simulation.³⁷ Its authors believed these were poised to revolutionize management and reshape organizations. Though the article was quite influential among researchers, the term lapsed into obscurity as it became apparent that no managerial revolution was underway. In the 1980s, however, it was revived with a different meaning: the union of computers and communication technologies. Neither The Economist nor Business Week, nor U.S. News and World Report printed the term "information technology" once in any story published in 1977. This did not reflect a lack of interest in business computing, since they included reference to

³⁴ G. Anthony Gorry and Michael S. Scott Morton, "A Framework for Management Information Systems", in Managing the Data Resource Function, ed. Richard L. Nolan (St. Paul: West Publishing Company, 1974).

³⁵ *Ibid*, 104.

³⁶ For a history of the Center for Information Systems Research, of which Scott Morton was a leader, see John F. Rockart and Christine V. Bullen, eds., The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology (Homewood, Illinois: Dow Jones-Irwin, 1986). For a good sample of its mid-period output see John F. Rockart, "Chief Executives Define their Own Data Needs", Harvard Business Review 57, no. 2 (March-April 1979):81-93.

³⁷ Harold J. Leavitt and Thomas L. Whisler, "Management in the 1980s", Harvard Business Review 36, no. 6 (November-December 1958):41-48.

“data processing” in seventy-three stories. By contrast, in 1983 the same three publications included the now-fashionable term information technology in a total of fifty different articles.³⁸

A similar upsurge took place in their use of the terms “information revolution” and “information society.” The idea of an “information age” and the association of computers with information had finally become a staple of general discussion. As Victor Millar, an Arthur Andersen consultant, put it in a 1983 article extolling the virtues of the CIO, “[t]he focus on the information age has caused some senior executives to realize that information is a competitive tool...”³⁹

Within the computer industry, the word information was being applied ever more widely. As computer departments grew ever larger, and gradually ascended corporate organization charts, they were often renamed as Management Information Systems divisions rather than Data Processing departments. This nominal upgrade did not always reflect the kind of fundamental shift called for by those who believed in MIS as a fundamentally new approach to management. It did, however, mirror an increasing sense that data processing was old fashioned and that information was futuristic. In the computer field, particularly, nobody wants to seem old-fashioned. In 1972, the leading computer magazine for corporate managers changed its name from Business Automation to Infosystems. In 1973, the Data Processing Management Association renamed its annual conference “Info/Expo” and gave it the theme “Stay on Top of Tomorrow.”⁴⁰

The eagerness of the general business press to apply terms like information processing and information technology to computers reflected the heavily promoted idea that the computer industry and the communications industry had become two aspects of the same thing. This idea was not new, even then. In 1964, a famous article in The Atlantic Monthly had proposed the construction of enormous “information utilities,” in which millions of terminals spread across homes and office were hooked into a handful of huge, centralized time-sharing computers (on the model of the telephone and power utilities). Proposed applications included catalog shopping from home, on-line editing, classroom instruction and the sale of specialized data.⁴¹ The association of information with on-line computer systems was further strengthened in 1968, when the Information Industry Association was founded to bring together companies interested in establishing on-line data base services. Information here seemed to have crossed-over from library science and scientific publishing, as the association’s name was chosen by Eugene Garfield, who had built up a successful business publishing indexes and abstracts from his Institute for Scientific Information. (Garfield recalls it having been created because of the exclusion of commercial firms from the National Federation of Abstracting and Information Services).⁴²

Although computer terminal use and on-line publishing both developed more slowly than expected, in the late 1970s the expected proliferation of home data terminals, creeping deregulation of the telecommunications industry, and arrival of cable television finally seemed to

³⁸ Only in the late 1980s did use of the term data processing really begin to trail off – for most of the decade it coexisted with information technology. IT seemed more popular in Europe, and with intellectuals and politicians.

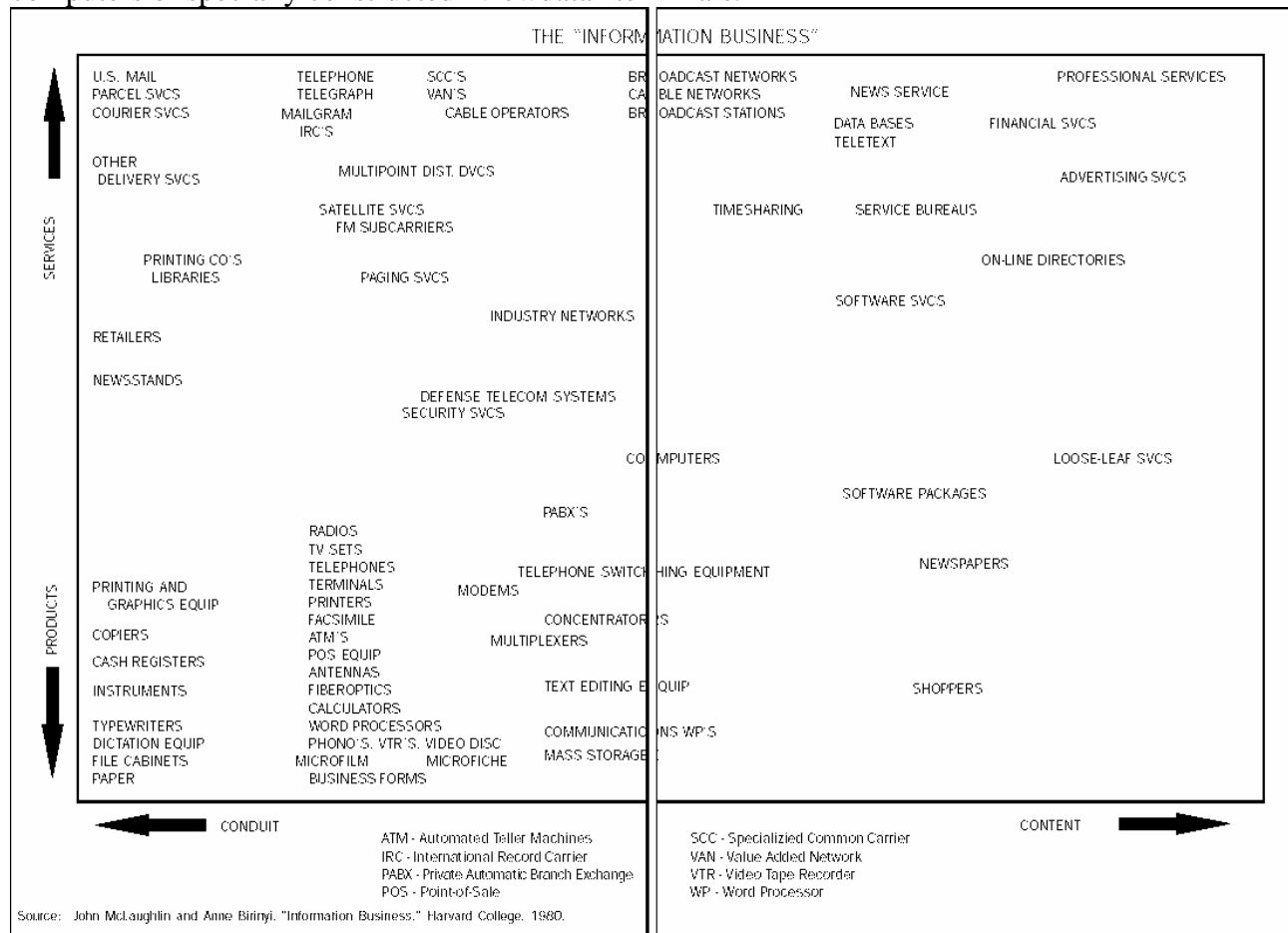
³⁹ John Rymer, “Executives to Unlock Technology’s Promise”, Computer Decisions, 15 September 1983.

⁴⁰ Anonymous, “INFO/EXPO: June 23-26”, Data Management 11, no. 12 (December 1973):38-39.

⁴¹ Martin Greenberger, “The Computers of Tomorrow”, The Atlantic Monthly, May 1964.

⁴² Robert V Williams, Transcript of Interview Conducted by Robert V Williams (Chemical Heritage Foundation, 1997 [cited January 13 2003]); available from www.chemheritage.org/HistoricalServices/eminentchemists/Garfield/Garfield2ALL.pdf.

mark the convergence of the two industries as a conceit whose time had come. In 1979 Business Week decided to group its coverage of telecommunications, personal computing, hardware and software together as subsections in a new “Information Processing” department. While it had printed this term only once in 1977, by 1984 it appeared above no less than 415 different articles. By that point, firms as respectable as Fidelity Investment, the New York Times, Knight-Ridder Newspapers, McGraw-Hill and Chemical Bank had each lost millions of dollars, invested to build new systems on the assumption that millions of Americans were ready to trade stocks, read the newspaper, shop, send electronic mail, and do their banking with the aid of personal computers or specially constructed “viewdata” terminals.⁴³



Broad definitions of the “information business”, such as the one shown above, served rhetorically to bundle an enormous variety of important products and businesses into a single new sector. The people promoting these definitions were usually either consultants or business authors claiming special expertise in this new field, or companies (such as Xerox, AT&T and Digital Equipment Corporation) seeking to persuade customers and investors that their actual field of business was information rather than a narrower and less exciting niche such as copiers or telephones.

Just as the first surge of interest in information coincided with the initial spread of computers into large corporations, the second took place as the new technology of

⁴³ Anonymous, "Electronic Publishing Moves off the Drawing Boards", Business Week (August 8 1983).

microprocessors and silicon chips brought computers into the homes, offices and classrooms of millions of Americans. Silicon chips played a starring role in a host of new consumer technologies, including video arcade games and Atari home consoles, electronic toys, digital watches, cheap music synthesizers and pocket calculators.

Anyone reading the business magazines or newspapers of the early 1980s was exposed to an endless stream of articles celebrating the success of the personal computer industry. First sold in 1975 in kit form for hobbyists, by 1977 microcomputers were being mass produced by several companies. By early 1980s, firms like Commodore, Texas Instruments, Apple and Atari were darlings of the business press and favorites of investors. Competition drove down prices at an astounding rate. To sell one and a half million of its ill-fated 99/4A home computer, Texas Instruments was forced to lower its price from \$950 in 1980 to \$99 in early 1983.⁴⁴ As with the recent Internet bubble, which in many ways it resembled, hundreds of firms rushed to enter this exciting new market, excited by forecasts of growth which turned out to be fantasy. Texas Instruments, for example, had increased production on the assumption that it could sell 3.5 million computers in 1983 alone.

These fantasies were supported with frequent reference to the idea that this new technology held the key to social transformation. Readers did not have to look far to learn about the Microelectronic Revolution, the Information Technology Revolution, the Information Society, the Computer Revolution, the Post-Industrial Society and the Leisure Society.⁴⁵ One popular book, The Micro Millennium by Christopher Evans, was published in 1979 and promoted with a quote from Playboy that it “could well be the most important book of the next two decades.”⁴⁶ Evans presented his predictions as the inevitable outcomes of the exponential growth in power of inexpensive computer technologies.⁴⁷ He predicted that during the 1980s the computer would end the monopoly of established professional groups over information, and so destroy the power of doctors and lawyers. Thanks to the impending arrival of artificial intelligence, by the end of the century the human race would focus its efforts mainly on leisure

⁴⁴ Anonymous, "The Price TI is Paying for Misreading a Market", Business Week, September 19 1983.

⁴⁵ The post-industrial society, the most academically respectable of these ideas, was proposed in Daniel Bell, The Coming of Post-Industrial Society: A Venture in Social Forecasting (New York: Basic Books, 1973). The phrase information society seems to have shown up a little later, and may have entered English language discourse via “Plan for the Information Society”, a futuristic and utopian vision produced by a Japanese group in 1972. See Joneji Masuda, The Information Society as Post-Industrial Society (Tokyo: Institute for the Information Society, 1981). The titles readers on the topic produced by Tom Forester give a nice example of changing rhetoric, from Tom Forester, The Microelectronics revolution : the complete guide to the new technology and its impact on society (Oxford, Eng.: B. Blackwell, 1980) to Tom Forester, The Information technology revolution (Cambridge, Mass.: MIT Press, 1985). An excellent critique of the information utopianism of the 1980s is given in Langdon Winner, "Mythinformation in the High-tech Era", in Computers in the Human Context, ed. Tom Forester (Cambridge, MA: MIT Press, 1991). Theodore Roszak, The Cult of Information: The Folklore of Computers and the True Art of Thinking (New York: Pantheon Books, 1986) is concerned with computers in general, but makes some relevant points. Frank Webster, Theories of the Information Society (New York: Routledge, 1995) gives an insightful summary of the relationship of major social theorists to post-industrial society.

⁴⁶ Christopher Evans, The Micro Millennium (New York: Viking, 1979).

⁴⁷ Evans anticipated much writing of the late 1990s in which Moore’s law, usually expressed as a rapid doubling in the performance/price ratio of microprocessors, was used to justify all kinds of predictions about the growth of Internet-related businesses. Although Moore made the observation to which his “law” is attributed back in the 1950s, it reached general awareness much later.

and learning, working perhaps twenty hours a week for fifteen years during a lifetime.⁴⁸ The Third Wave, probably the most influential of these books, was written by a former Fortune editor, Alvin Toffler. Toffler, who had established himself as a mainstay of the futurology business with his earlier Future Shock, argued that the economic and political instabilities of the late 1970s, were symptoms of the death of one civilization and the birth of a new one. Within a few decades, the titular wave would “sweep across history and complete itself in a few decades... Tearing our families apart, rocking our economy, paralyzing our political systems, shattering our values.” His star exhibit was computer-based communication technology. The widespread use of home terminals would move most work out of offices and into the “telecottage.” “Virtual organizations” would react flexibly to the unprecedented rate of change in a world of electronic information. Athenian democracy would be reborn when electronic referenda replaced representative democracy.⁴⁹ Similar claims were made by John Naisbitt in Megatrends, the other major commercial success for futurology in this period. Naisbitt processed his vision of the future into ten easy to digest trends. “None,” he suggested, “is more subtle, yet more explosive... than this first, the megashift from an industrial to an information society.” In this society, “we have systematized the production of knowledge and amplified our brainpower.” Information, he suggested, had replaced capital as the most important “strategic resource” of business.⁵⁰

Such thinking was fuelled by the enthusiastic reporting of the business press, and in turn these ideas fed back into business, through executive seminars, best-selling books, newspaper reports and profiles in publications like Business Week and Fortune. By the early 1980s, therefore, even business people and senior managers with no particular interest in these topics would have been well aware that computer technology was developing rapidly, that its consequences for business and society were expected to be profound, and that all of this had a lot to do with information. This was fertile ground in which to promote the computer as an information panacea.

The phrase “Chief Information Officer” was defined and promoted by William R. Synnott, who was at that time head of the Information Systems and Services division of the First National Bank of Boston. Its first documented use in print was in a Computerworld report on Synnott’s address to the INFO’80 trade conference in 1980, and the first detailed description of the CIO was provided in a book entitled Information Resource Management written by Synnott with consultant William H. Gruber the next year.⁵¹ The main argument of the book was that the

⁴⁸ Evans was a little too wild for the business press. Business Week suggested that, though “highly readable and imaginative” the book had strayed “into wishful thinking that borders on science fiction.” It did, however, review it. Margaret L Coffey, “Do We Want Machines That Can Outthink Us? Review of ‘The Micro Millennium’ by Christopher Evans” Business Week, April 21 1980

⁴⁹ Otis Port, “Riding in on a Wave: A Welcome New Age. Review of ‘The Third Wave’ by Alvin Toffler”, Business Week, March 31 1980. Business Week praised his accomplishment, saying that “in integrating the developments in communications, energy, manufacturing, biotechnology, and other fields to create a comprehensive vision of a world to come, Toffler succeeds brilliantly.”

⁵⁰ John Naisbitt, Megatrends: Ten New Directions Transforming Our Lives (New York: Warner Books, 1982).

⁵¹ William R. Synnott and William H Gruber, Information Resource Management: Opportunities and Strategies for the 1980s (New York: John Wiley & Sons, 1981). An excellent review of the early CIO literature and the origins of the concept is included in James I Penrod, Michael G Dolence, and Judith V Douglas, The Chief Information Office in Higher Education (Boulder, Colorado: CAUSE: The Association for the Management of Information Technology in Higher Education, 1990).

computer must be applied to management rather than clerical operations, and that this demanded a new kind of computer department. Upgrading Nolan's ugly sounding conception of the computer department as a "Data Resource Function," he called this the "Information Resource Management function." This department was to be headed by the CIO, defined as a "Senior executive responsible for establishing corporate information policy, standards, and management control over all corporate information resources." He admitted that no such figure currently existed in any major corporation, saying that the "CIO role does not yet exist except in the minds of imaginative leaders today. It remains to be created by information managers committed to harvesting the management of information as a resource in the years ahead."

This concept of information as a resource was at the heart of the book. As its introduction stated "A quiet revolution is occurring in the data processing industry. The computer era of the 1960s and 1970s is giving way to the information era of the 1980s." "What needs to be sold," he claimed, "is the fact that information is a valuable corporate resource that must be managed as a total entity" by a CIO "in order to exert a broad corporate perspective and a leadership role in bringing together and managing information as a corporate resource." This reflected a subtle yet extremely important shift in the meaning given to information. Whereas management information systems were originally conceived as systems to inform management, Synnott's formulation reflected the newer idea that information was a discrete quantity existing quite apart from any specific act of communication. (In other words, the same thing Nolan and others had meant by data). The job of the new department was not to inform management, but to manage information.

Information was now seen as something, like money, which could be accumulated, pooled and husbanded. Synnott himself stressed the analogy, saying that "[t]he CIO concept should not be very hard to sell. Top management certainly understands the role of the chief information officer (CEO) and the chief financial officer (CFO). Why not a chief information officer?" As a relatively new arrival in the corporate ranks, the CFO was a particularly tempting target for emulation.⁵² At the end of his book, Synnott suggested that CIOs might be as well placed to rise to the CEO position during the 1980s as financial managers had been in the 1970s.

Beyond this shift in rhetoric, Synnott's contribution was more one of synthesis and salesmanship than original thought, but he packaged the results skillful and illustrated them with stories from his own experience.⁵³ Like proponents of MIS two decades earlier, Synnott talked a lot about the need to "educate" general management in the power of computer technology, and about the need to tackle the information problems of the firm as a whole in delivering the right information to the right place at the right time. Both aimed to create a single top-level group responsible for corporate information systems. Both stressed managerial generalism over technical specialism. MIS, however, put the stress on the "system" part. While the "systems approach" was enormously powerful during the late 1950s and 1960s, its credibility had largely withered by the 1980s. Closer to home, MIS was tagged with the twin taints of failure to deliver on its original bold promises and of its widespread use as a new name for the existing data

⁵² By the 1960s, the overall responsibility for the duties of controllers (more accounting and administrative) and treasurers (more oriented towards finance) was increasingly combined in the person of the Chief Financial Officer (CFO). During the final decades of the century, the CFO emerged in many large corporations as one of the most senior members of the managerial team, as the "bean-counting" aspects of accounting were increasingly subsumed by a recognition of the vital role of financial skill in running companies, keeping investors satisfied and producing the financial results required.

⁵³ Synnott and Gruber, Information Resource Management: Opportunities and Strategies for the 1980s, 3.

processing department. Both “Information Management” and the “Chief Information Office,” in contrast, downplayed systems in favor of information itself.

Synnott’s manifesto was aimed more at ambitious data processing managers than at the general or financial managers to whom they currently be responsible. The computer managers of the 1980s would require a new approach. He claimed that, “Information managers will need a solid understanding of both business and technology in the future.... they will need to rid themselves of their technical image—not their technical expertise, only the aura of mysticism associated with the DP managers of the past.”⁵⁴ Each “must make every effort to demonstrate his or her management role, not only to avoid being stereotyped, but to avoid being overlooked when a promotion opportunity occurs for a top executive general manager.” He saw the new mantle of information as a powerful claim to broader organizational power, writing that “‘Data Processing’ is a limiting title! For example, the issuance of corporate responsibility can be a responsibility of the IM [Information Management] function. This is logical, because the issuance of corporate policy and instructions is, in fact, an information service. On the other hand, it would make no sense to say ‘Corporate policies will be issued by the data processing division.’” “Data processing,” he continued, “connotes a technical limitation.....” It was, he reiterated, “important that the right identification be established” before proceeding to consolidate control over corporate information.⁵⁵

The Spread of the CIO Concept

Despite the enormous ultimate success of the CIO (as a job title at least), it spread slowly at first. Although Synnott’s ideas received some attention on their initial presentation in 1981, the CIO term remained quite rare, even in the discussions of groups devoted to the management of computers, until the mid-1980s. From about 1986 the title moved rapidly into general usage – a vogue both reflected in and assisted by the launch of the glossy CIO Magazine in 1987. Just as Ms. Magazine raised the consciousness and shaped the dreams of a generation of women, so CIO Magazine pushed an activist and executive vision of computer specialists as powerful managers while reflecting both the vanities and insecurities of its audience. Its readers received admonition as well as affirmation.

The main idea to be picked up from Synnott’s formulation was that the CIO should think as a corporate leader first and a technician second or not at all. This was, according to its boosters, an entirely new idea. One of the earliest articles to publicize the CIO concept, a 1983 piece published in a corporate computing magazine, was titled “Executives to Unlock Technology’s Promise.” Its author, John Rymer, opened with an imaginary advertisements. “Wanted: Chief information Officer. Prerequisites: general management experience and ability to implement the latest in information technologies. Technicians need not apply.” He went on to suggest that such figures “are beginning to take their places among the most senior executives of major corporations. Their rise coincides with the recognition of information as a powerful competitive resource.” Just in case there was any doubt left in the reader’s mind, it continued “Unlike their predecessors--the chief data-processing operating officers--CIOs are business managers first.” The point was hammered home with quote after quote from corporate computing managers eager to boost their own status, who insisted that the management of information was truly an executive rather than a technical concern. Their new job was setting

⁵⁴ Ibid, 49.

⁵⁵ Ibid, 34-35.

strategy, creativity, managing people and “teaching everyone, even the CEO, how to use these weapons.”⁵⁶

According to Rymer, the CIO position had thus far been created in only a few corporations. It admitted that, “The rise of the CIO is more of a forecast than a trend,” but insisted that the concept was winning acceptance in sectors such as financial services, airline travel and insurance companies. In these areas, information was a “life-or-death” issue. However, it implied that technological change would insure that this trickle became a major trend. Until the 1960s, it suggested, the controller had been the default CIO – because all information systems had been financially oriented. The profusion of computer systems, and the more recent spread of inexpensive computers and data bases, had eroded this monopoly, bringing corporations to the edge of chaos. “No one had replaced the controller as chief information officer,” said an Arthur Andersen consultant Rymer interviewed. “Nobody is responsible for information--everyone has a piece of it...”

The power of the CIO concept also stemmed from its reinterpretation of the old dream of a single, powerful executive in charge of administrative systems (a dream which can be traced back to the office management movement of the 1910s) in the newly emerging world of data bases, office automation and “end user computing” (the idea that non-specialists would use terminals and personal computers directly). Data processing managers faced a profound threat to their traditional role as the monopoly supplier of administrative computing. The 1980s saw the beginnings of a move away from the mainframes that dominated administrative computing through the 1970s and toward what were first called “distributed systems,” then “client-server technologies.” The idea was to link together computers of different kinds, keeping large databases on centralized mainframes while using microcomputers or “intelligent” terminals to build interactive interfaces and minicomputers as departmental hubs. This concept also headed off claims made by microcomputer enthusiasts that their machines rendered centralized computing groups an expensive irrelevance.

“Above all,” Synnott wrote, “the information manager of the future must be an effective integrator....” He suggested that the traditional hold of data processing managers over centralized computing facilities was fast being eroded, but that those who could make the transition to information management would hold more influence and prestige than ever before, though their power would increasingly be shared with users. The roles he listed for the information manager included planner, change agent, information manager, proactive, businessman, politician, integrator, information controller, strategist, staff professional, manager, and futurist. He or she would work alongside executives, educating them on the power of information technology and collaborating on exciting projects. Synnott called on information managers to work more like consultants – selling their services, surveying user satisfaction and agreeing service levels with users and then monitoring the results rigorously.

Thus, while CIOs could no longer hope to exercise direct control over every computer, or even every departmental level application system, authority over information would give greater respect from fellow managers and a powerful justification for the control of key networks and

⁵⁶ Rymer, "Executives to Unlock Technology's Promise". The idea of “information as a strategic tool” was reported in Anonymous, "Business is Turning Data into a Potent Strategic Weapon" Business Week, August 22 1983.

databases. Synnott argued that, while processing power might now be spread out across departments, it remained essential to retain centralized managerial control over information.⁵⁷

The same point was made strongly in a 1983 symposium presented by MIT researcher John F. Rockart. Rockart had become an early exponent of the idea of “end user computing.” This would demand wholesale reconstruction of the corporate computing department, to serve individuals rather than departments. With this shift, the CIO would be “no longer a line head of a computing organization, but a staff person in the corporation. With ever more widespread computing, he must give up his role as the direct czar of computer resources. Rather, he must move into a role of providing staff expertise, guidelines, and policies so that almost totally decentralized computing organizations will be able to carry out their tasks and support their end users in appropriate ways.” He also believed that a “major segment” of the job would consist of giving advice to top executives on the strategic potential of information technology.⁵⁸ Proponents argued as to whether the CIO should work alone, head a small department, or command the entire corporate computer operation. But they agreed that the arrival of microcomputers and the profusion of database technology demanded a new way of dividing responsibility between different levels of the corporation, and they expected a renewed focus on the combination of business and technical skills to assist in this restructuring. As Rymer had reported, “The CIO's job is to turn a revolution into an orderly transition to a new era.”

Propelled in part by professional groups such as the Society for Information Management (as the Society for Management Information Systems renamed itself), discussion of the CIO spread rapidly through the networks of senior corporate computing staff and into the mainstream business press. In 1986, *Business Week* devoted much of the space in a special feature issue on “office automation” to the CIO. It printed three articles profiling CIOs of firms such as Firestone, American Airlines and General Foods. Many of them claimed to have boosted overall performance of the business by reorganizing sales operations or cutting production costs. Like earlier reports, it suggested that the CIO would “oversee all the company’s technology,” report directly to the CEO or chairman and “concentrate on long-term strategy and planning while leaving the day-to-day operations of the computer room to subordinates.” The CIO of First Boston Corporation suggested modestly that a job such as his own “calls for a Renaissance man.”⁵⁹

Intensive discussion of the CIO concept during the late 1980s and early 1990s exposed several areas of disagreement. Perhaps the most discussed of these was the question of how to produce a true CIO. Where might one find such a Leonardo of information? Was it best to take a computer expert and broaden him or her into a corporate manager, or should one take a proven manager with no previous computer experience? Articles pitched at computing staff, such as the 1983 Rymer article, tended to suggest that they stood a decent chance of filling the role – but only if they could break out of the technical culture that hung over data processing installations

⁵⁷ Synnott seized the then-fashionable concept of matrix management as a panacea – an “information resource product manager” would be assigned to each department within the firm. This specialist would command dedicated computing resources and a team of programmers and analysts, and would have two bosses – one in the information management hierarchy, the other the manager of the department concerned.

⁵⁸ John F. Rockart, “The Role of the Executive in the New Computer Era”, in The Rise of Managerial Computing: The Best of the Center for Information Systems Research Sloan School of Management Massachusetts Institute of Technology, ed. John F. Rockart and Christine V. Bullen (Homewood, Illinois: Dow Jones-Irwin, 1986).

⁵⁹ Gordon Bock, Kimberly Carpenter, and Jo Ellen Davis, “Management's Newest Star”, Business Week, October 13 1986.

like a toxic cloud. The article presented a long list of CIOs who had done time in the data processing trenches, but cautioned “To move into senior management, they had to transcend their technical backgrounds...” Just in case any ambitious young computer people might miss the point, he added that, “The transition was easiest for those who were not enamored of the technical details of their operations to begin with.” As a report in a drug trade magazine put it the next year, the central message of the era was “The data processing manager is dead . . . Long live the chief information officer.” It quoted an Arthur Andersen partner suggesting that the CIO would handle not just “corporate data processing but corporate strategic planning.”⁶⁰

Others, keen to emphasize the truly executive nature of the CIO role, suggested that having worked in a data processing department might actually be a disqualification for the job. Indeed, as the buzz spread it was not just computer managers who were eyeing the CIO title. A 1987 article in American Libraries suggested that, “there isn’t anyone else out there who is better qualified to meet the challenges of the CIO roles than librarians. Data-processing folks certainly don’t have the broad understanding of the problem, the user understanding needed to perform this function; nor do the business school people.” The author did, however, concede that few librarians currently had the ambition or ambition for risk needed to land the job – and this attempt by corporate librarians to sell themselves as the true experts on business information seems to have fared little better than that of their predecessors in the 1950s.⁶¹

The question remained unresolved in 1991, when CIO Magazine found that only mythology could provide a suitable image: “the CIO must be a centaur - part IS horse, galloping beside the fast-paced changes in technology, but from the waist up a savvy general manager”. It even suggested that, “Technology can be delegated, as several experts and CIOs put it - usually to MIS types who are stuck on the technical career track.” (Note that MIS was by this point synonymous with the plodding technician, rather than the capable manager). A sample of business gurus interviewed seemed divided on whether the CIO position would ultimately remain a specialist post or vanish as computer technology passed into the mainstream of management. Tom Peters, the most famous of them all, was hostile to presence of computer experts in the CIO position, saying that ‘Too many of today’s CIOs have come up through the ranks of the MIS bureaucracy, and their touch with the real world is not all it should be.’⁶²

The idea that people without computer experience might make better CIOs than would experienced computer experts was expressed repeatedly, but remained rare in practice. The 1990 Datamation survey found that only 20 percent of CIOs had shifted from non-computer positions within the same company. (6 percent had previously been operations managers, and 5 percent finance managers). 50 percent were hired from the computer departments of other companies, and the remaining 30 percent moved up internally. A different 1990 survey, carried out by a consulting firm, found that 74 percent of CIOs had risen from a background in the computer department.⁶³ The rush to garland data processing managers with the CIO title, often without even granting them a say in strategic decision-making, earned the ire of Synnott. He remarked that, “There are a lot of fake CIOs.... It’s like Santa Claus. They’re on every street corner, but

⁶⁰ Anonymous, "Chain information managers face expanded role; data processing managers will be forced to become CIO's: chief information officers", Drug Topics, January 2 1984.

⁶¹ Richard R. Rowe, "You, the CIO; Can Librarians Make the Jump to "Chief Information Officer"?" American Libraries 18, no. April (1987):297.

⁶² Thomas Kiely, "The Once and Future CIO", CIO Magazine 1991.

⁶³ Brad Edmondson, "Hail to the Chief (Chief Information Office Statistics)", American Demographics 12, no. 2 (1990):11-12.

you know they're not all real." Although Synnott probably didn't intend it to, his analogy raised another question: were any of them real?

The CIO in Practice

The concepts of the CIO and information management served to justify a rather odd combination of duties. The CIO as someone responsible for "managing information" implied a broad authority over the firm's entire stockpile of facts. How authority over information could be separated from general management authority was never entirely clear, but this was an attractive dream. In practice, this translated to the idea the CIO should make sure that data base systems were full of the right kind of information. Then there was the MIS sense, implicit in talk of the CIO as someone responsible for information systems, of the CIO as the person responsible for informing management. This justified the CIO's authority over the construction of new computer applications. Many of these had little to do with information in the grand sense, but instead automated simple but crucial business operations. Walmart, for example, used computerized inventory management systems as part of a much broader strategy to boost its efficiency. While computer executives had a part to play here, it was hard for them to take the initiative in such far reaching and integrated changes.⁶⁴

In practice, however, much of the CIO's energy went on a third topic: managing information technology. This meant choosing what kinds of negotiating with suppliers of hardware and software, setting technical standards for internal application development, and so on. The CIO was also responsible for the technical support teams, training efforts, and other services arranged for the firm's computer users. Then there were the duties common to any manager, such as hiring and training employees, managing a substantial budget, making financial projections and so on. While the strategic, visionary elements of the CIO's job received most of the hype (and were always predicted to increase in importance in the near future), these routine tasks of managing computer technology and providing basic services requested by users continued to dominate the actual work of most CIOs.

By the end of the 1980s, many were already complaining that the CIO title was simply being slapped onto existing corporate computer managers without the fundamental shift in role, attitude and executive support it implied. A 1988 editorial in Infosystems suggested that, "the push for a CIO portfolio comes from IS people and much of it seems like self-serving hype." Innovative ideas on the strategic use of IT, it suggested, were more likely to come from line managers than from specialist staff – while computer managers were still focused on the production of routine reports. Its conclusion was echoed by many skeptics in the years to come: "In an atmosphere where the ability to provide basic service is in question, perhaps the more prudent posture is to produce first and lobby for exalted status later."⁶⁵

The same year Datamation, the leading magazine of the computing field, used new survey data to lambaste the CIO as a "myth" or "cult" promoted by self-interested managers, consultants and professional groups. Very few top computer managers then held the CIO title, though the survey found that 57 percent of computer managers in major corporations considered

⁶⁴ See Sandra Stringer Vance and Roy V Scott, Wal-Mart: A History of Sam Walton's Retail Phenomenon (New York: Simon & Schuster, 1997). Because the overall strategy had shaped the whole company, including its design of stores, placement of warehouses and methods of transporting goods, competitors such as K-Mart found it impossible to replicate by installing computer systems. Michael Schrage, "Wal-Mart Trumps Moore's Law", Technology Review (March 2002). Christopher Koch, "It All Began With Drayer", CIO Magazine, August 1 2002.

⁶⁵ Wayne L. Rhodes, Jr., "It's A Long Fall", Infosystems 35, no. 3 (March 1988):8.

themselves “de-facto CIOs.” However, only 27 percent met the most basic qualification, that of reporting directly to a top level manager – suggesting most of those who viewed themselves CIOs were guilty of inflating their own importance. It debunked the idea that CIOs would follow CFOs into the top corporate spot – reporting survey results that only 7 percent of current CIOs believed they might one day head their company. It called most CIOs “toothless,” noting that they generally lacked the political skills needed to ally with line managers and get things done. CIOs, it suggested, were outsiders – having arrived in their companies to serve in that position rather than being promoted internally. Many were hired to correct the mistakes of previous computer managers and contain spiraling IT costs. They were far more likely to leave to take a similar job elsewhere than to be promoted internally. The author suggested that a combination of resentment of other managers to the sweeping mandate claimed by the CIO and an unfortunate focus of financial staff on short term returns rather than long term investment meant that this job hopping was liable to continue for the foreseeable future.⁶⁶ The problem actually worsened in 1989, during which year 13 percent of CEOs were dismissed – most commonly to contain budget growth or as a result of failure to meet promised results. This prompted Business Week to ask whether CIO now stood for “Career Is Over.”⁶⁷

In 1990, Datamation published another survey of CIOs at Fortune 1000 companies. It found that their average age was 47 and they had spent an average of 20 years working with computers. 51 percent of them had held the CIO post at three or more companies – a trend it linked to the rapid inflation in CIO salaries. It concluded that CIOs remained “their own worst enemies” – more likely to be “self-deluded outsiders” than “in-touch agents of change.” They had almost no contact with their firm’s customers, and spent more time with members of their own computer organization than with computer users or other managers. It faulted them for identifying more closely with their profession than with their companies. Yet a pop quiz on computer technology revealed that their technical knowledge was also lacking.⁶⁸

The gap between theory and reality remained to ignore for the rest of the decade. CIO Magazine ran a series of annual surveys headed “Are We There Yet?” The answer, invariably, was no. Yet it always presented reasons to hope that progress was being made and that, with sufficient effort, the goal could be achieved. The 1991 installment, for example, asked senior executives how they felt about their CIOs. The survey team discovered that executives paid lip-service, but nothing more, to the idea of the CIO as a partner in forming corporate strategy. While “a majority of the executives... said that CIOs should participate in strategy formation; at the same time, they admitted that their CIOs had not yet been offered the opportunity to do so.” They also reported that, “the number of executives who consider the CIO to be senior line-management material is actually shrinking.”⁶⁹

As John Diebold, then entering his fifth decade as a quotable authority on automation, was quick to observe: “the CIO has primarily represented a change of title rather than a change in functions. The CIO of today is yesterday's view president of IS” rather than hoped-for “broad-

⁶⁶ Ralph Emmett Carlyle, “CIO: misfit or misnomer?” Datamation 34:15, no. Aug 1 (1988).

⁶⁷ Jeffrey Rothfeder and Lisa Driscoll, “CIO is starting to stand for ‘career is over’; once deemed indispensable, the chief information officer has become an endangered species.” Business Week, Feb 26 1990. A close look reveals that their sample of CIOs was actually of top computer managers -- 19 percent of whom held the CIO title, and another 35 percent of whom held the rank of vice president. In the same vein, see “More CIO Departures Are Not Done by Choice,” Computerworld, February 18, 1991, p. 6.

⁶⁸ Robert Carlyle, “The Out of Touch CIO”, Datamation, August 15 1990.

⁶⁹ David Freedman, “Are We There Yet?” CIO Magazine 1991.

gauge information executive of tomorrow”. Diebold assigned blame equally between corporations who refused to pay more than lip-service to the notion that, “information is crucial to their success” and to introverted computer managers who had failed to develop “the skills, the knowledge and the organizational clout to wear the CIO mantle.”⁷⁰

The same complaints, made in almost exactly the same terms, dogged CIOs for the rest of the decade. Yet, weighed by other criteria, the rise of the CIO was quite spectacular. The title spread with great rapidity during the 1990s. The vast majority of major firms had granted the title, some of them quite liberally. According to the former CIO of Dell, “At some large corporations, every division (every department) has a CIO. Siemens, for example, has a global CIO, two corporate CIOs, central office CIOs, operating company CIOs and over 50 regional CIOs.”⁷¹ By the end of the 1990s, CIO Magazine boasted a controlled circulation of over 130,000. The pay and organizational rank of CIOs had also improved, though. The 2002 CIO Magazine survey found that, for the first time, a majority (51 percent) of the sample reported directly to the CEO. (As the magazine noted, this remained an obsession among CIOs, indicating continuing status anxiety).⁷²

These improvements may have been more a function of the spectacular increase in the size of computer budgets than of an intellectual triumph for the arguments of the CIO lobby. Whereas corporate computer budgets had been quite small in 1980, by the end of the century they had risen to account for a very significant chunk of all corporate spending. North American businesses spent around six hundred billion dollars on computer hardware, software and services in 2001.⁷³ According to GartnerGroup, one of the leading computer industry research groups, large corporations devoted an estimated 5 percent of their revenues to information technology, representing an expenditure of around eight thousand dollars per employee (up from three thousand in 1988).⁷⁴ This outlay supported ten million “information technology workers” in America, the vast majority of whom were employed by companies for which computers were not a primary activity.⁷⁵

As well as an increased use of computers in areas established in the earlier decades, this reflected some fundamental shifts in the areas to which computers were applied. The biggest business fad of the early 1990s, Business Process Reengineering (BRP), created new opportunities for many CIOs. The idea was that existing organizational structures and practices were often inefficient, and should be thrown away. By using computer technology to create radical new processes, and rebuilding the organization around them, massive savings would be realized. Because CIOs already claimed to have a special understanding of the potentials of information technology to transform business, BPR offered an apparent mandate to apply their

⁷⁰ Kiely, "The Once and Future CIO".

⁷¹ Jerry Gregoire, "Hail to the Chiefs", CIO Magazine 2002.

⁷² Tom Field, "The State of the CIO: Executive Relationships", CIO Magazine, 15 March 2002.

⁷³ Robert De Souza et al., IT Business Spending to Recover in Late 2003 (GartnerGroup, 2003). I have excluded a further four hundred million dollars for telecommunications equipment and services.

⁷⁴ For recent spending figures, see Kurt Potter, 2000 Spending and Staffing Survey Reports (GartnerGroup, 2000). About 6% of this figure is for voice communication, the rest is computer related. The figure from 1988 is taken from Paul Strassmann, The Squandered Computer (New Canaan, CT: Information Economics Press, 1997), 92.

⁷⁵ Tinabeth Burton, New Survey Finds Slight Increase in IT Workforce Size, But Demand Forecast Softens for IT Workers (Information Technology Association of America, September 23 2003 [cited February 8 2003]); available from <http://www.ita.org/news/pr/PressRelease.cfm?ReleaseID=1032791125>.

ideas to other parts of the company whether incumbent managers were pleased or not.⁷⁶ During the 1990s, an enormous market developed around Enterprise Resources Planning (ERP) software packages to integrate financial operations, human resources, sales and logistics on a global scale. Adoption of these packages required fundamental reorganization and retraining across the entire company, and placed enormous power in the hands of the teams installing and running them. While both BPR and ERP projects were usually overseen by teams of expensive consultants, these were areas CIOs could hope to gain authority over business.

A third major class of information system project was the data warehouse. This was essentially a revival of the 1970s dream of a single centralized database from which all information needed for managerial decision making could be retrieved. The twist was that proponents had given up on the idea of running all operational systems from a single, coherent and centralized data base. Instead, operational systems would maintain their separate data bases. Information would be loaded periodically from these disparate sources, “cleaned,” converted into a standard format, reconciled with related information from other systems, and placed into a huge centralized repository ready to be queried. Because information in a data warehouse would be read-only, it could be structured for efficiency in retrieval (duplicated, arranged “dimensionally,” or together with pre-calculated totals) rather than efficiency in updating.⁷⁷ Armed with this comprehensive data repository, firms could then use specialized “decision support” tools to retrieve whatever information was needed.⁷⁸

Data warehousing was another booming business for the consulting firms and software suppliers of the 1990s. Firms such as MicroStrategy briefly gained huge publicity and incredible stock market valuations on the promise that they could supply tools to sift through massive amounts of data and reveal hitherto unnoticed patterns of strategic importance. With data warehousing, too, many companies found that business benefits to be less impressive than anticipated, especially where the idea had been sold to a few executives by a consulting firm without building a consensus among managers about what tools might be needed or whether the system would be used. One problem was the amount of work involved in transferring and restructuring records from one system to another – something easy to overlook when speaking of information stored in information systems with information technology. Another was the lack of inclination on the part of many managers to use the output of these systems. The language of information suggested that it would fuel decisions and be piped wherever needed, and implies that more and better information will necessarily improve performance. In practice data warehouses proved useful only where the existing corporate culture favored computer use and quantitative decision making, where managers felt unsatisfied with existing practices, and where clear business objectives had been agreed before the construction of the system.⁷⁹

⁷⁶ Consolidate BPR references here. Include something from new consulting book.

⁷⁷ A clear and influential introduction to data warehouse technology was given in Ralph Kimball, The Data Warehouse Toolkit: Practical Techniques for Building Dimensional Data Warehouses (New York: John Wiley & Sons, 1996).

⁷⁸ Walter B. Schaffir, "Developing a Management Control "Instrument Panel": A Practical Approach", in Men, Machines and Methods in the Modern Office (New York: American Management Association, 1958). On EIS, see Doug Bartholomew, "When Will EIS Deliver?" Industry Week 1997. On the digital dashboard idea, see T. Austin, Are Microsoft's Digital Dashboards Perpetual Demoware? (GartnerGroup, 2000).

⁷⁹ For examples of the MicroStrategy hype, see Catherine Yang, "MicroStrategy Wants to be an Angel Whispering Data in Your Ear", Business Week (December 21 1999) and Chuck Salter, "People and Technology - Microstrategy Inc." Fast Company 2000. On the aftermath, see Anne Usher, "Still sinking: MicroStrategy retrenches, but recovery is for from assured", Washington Techway, May 28 2001. On the difficulties of data

In 1994 the Internet, hitherto beloved of computer science researchers everywhere and almost unknown by business men and the public, exploded into general awareness. By the late 1990s, its effects had spread far beyond the world of startups and into the heart of established and profitable corporations. Dozens of best selling business books promised manifestos, “rules of revolutionaries,” and the advent of a new economy in which the Internet had changed everything. As so often before, consultants and academics jumped on the juggernaut. In one of the most influential articles of the era, expanded into a bestselling book, consultants Philip Evans and Thomas S. Wurster suggested that the power of the Internet was poised to “blow to bits” all established companies, “deconstructing” their “value chains” and turning their physical assets and experience into handicaps. Only by rapid and wholesale transformation could an already successful company hope to survive the onslaught of new competitors in all directions.⁸⁰

This argument prompted firms such as General Motors to survey their business with the assumption that they would have to “concede, co-opt or collaborate” with Internet startup firms in every aspect of their operations. Jack Welch of General Electric, universally lauded by the business press as the greatest manager of the late twentieth century, viewed the Internet as the key challenge facing his empire and used his trademark methods of inspirational speaking and personal intimidation to push his subordinates into launching hundreds of projects. The announcement of an Internet initiative by a huge corporation could instantly add hundreds of millions of dollars to its stock valuation, and many rushed to set up Internet-focused subsidiaries intended for sale to the public at inflated prices. At a time when the stock market valued niche on-line travel agent Priceline.com more highly than United Airlines, Continental Airlines and Northwest Airlines combined, this was an understandable reaction.⁸¹

Talk of revolution and discontinuity marked the late 1990s even more strongly than earlier periods. As a result, the CIO risked being seen as old-fashioned, dull and out of touch – focused on the boring tasks of technology support and operational systems rather than the exciting new world of Internet technologies and the creative destruction of the existing capitalist order.⁸² One report warned them that “companies are leaving CIOs and the IS department out of the loop altogether and choosing to outsource e-business initiatives because of the perception that IT is too slow.”⁸³ CIOs had spent many years working assiduously to present themselves as serious, mature, financially responsible business managers who viewed technology as a means to an end rather than a romantic adventure into uncharted territory. Suddenly, saturation coverage

warehousing see Peggy King, "Decision Support Grows Up... and Out", *CIO Magazine*, November 15 1999 and David Pearson, "The Hidden Cost of Data Integration", *CIO Magazine*, May 1 1999. For a review of similar concepts in the 1960s, see Richard G. Canning, "The Corporate Data File", *EDP Analyzer* 4, no. 11 (November 1966).

⁸⁰ Evans and Wurster presented their ideas in the widely influential Philip B Evans and Thomas S Wurster, "Strategy and the New Economics of Information", *Harvard Business Review*, no. 5 (September-October 1997). Expanded into book form, Philip Evans and Thomas S. Wurster, *Blown to Bits: How the New Economics of Information Transforms Strategy* (Boston: Harvard Business School Press, 2000) was one of the business best sellers of 2000.

⁸¹ On General Electric's reaction to the Internet, see Marianne Kolbasuk McGee, "Wake-up Call: GE and GM Pumped Up E-business Efforts and Overhauled Their Old-line Businesses to Aggressively Counter Competitors.", *Information Week*, September 18 2000. On Priceline, see Saul Hansell, "Priceline.com Stock Zooms in Offering" *New York Times* 1999.

⁸² Mindy Blodgett, "The Wolf at the Door: Worried About the Rise of the CTO? Well, Maybe You Should Be. The Trend Represents Both Threat and Opportunity for Sitting IT Executives", *CIO Magazine* 2000.

⁸³ Eric Berkman, "Why We're Still Talking about Alignment", *CIO Magazine*, January 1 2001.

of startup firms in the mainstream press and in a rash of fat and glossy new publications such as Fast Company and Business 2.0 suggested that the fame and money CIOs had longed for were being lavished on firms made up of strangely dressed twenty-somethings with no real business experience, erratic work habits and a deep-seated faith that youth and technology made conventional managerial training a handicap. Everyone involved with the application of computers to business was expected to possess vision, passion, and ability to speak a strange new jargon full of value propositions, clickstreams, business models, and disintermediation. Still, the fads and fantasies of the new economy years did at least convey to top executives the idea that computer technology could change the very shape of their businesses, something CIOs had been pushing for years with limited success.

In most firms, the CIO remained a manager of computer technology rather than a strategic visionary or board member. Critics continued to fault them for their technical mindset, and point to widespread problems in controlling computer costs and delivering promised systems. Few had a realistic chance of rising to head their companies.⁸⁴ Even during the Internet boom, CIO Magazine warned its readers that “users root for their IS departments to get outsourced” and that “CEOs don’t see the organization adding any value.” A survey of chief executives claimed to show that only a quarter of them felt their CIOs were doing an average or better job in contributing to business results.⁸⁵ By 2002, many CIOs complained that Internet hype had made executives more skeptical about the claims to technology to transform, or even provide value to, their businesses.⁸⁶

Beyond Information

By the end of the twentieth century, the increasingly tight association of information with the routine use of computer technology led many of those arguing for novel and managerially oriented applications of technology to seek new terms. Its very ubiquity had robbed it of its power to differentiate an idea as futuristic. Its intimate association with information technology and information systems had begun to stigmatize it as too low level, too technical. In other words, it had become a victim of its own success as a technological fix. When it comes to business jargon, we may be entering the post-information age. In twenty years, the CIO will probably be as out of date as the data processing manager would today.

“Business Intelligence” emerged as a new term for the provision of improved information to boost business performance. This concept of intelligence was frequently associated with the output of data warehouse systems – indeed, when the magazines DBMS (standing for Data Base Management System) and Database Programming & Design were merged they were renamed Intelligent Enterprise. As always, the new buzzword was promoted as the response to a sudden change in the business environment. According to the computer industry newspaper InfoWorld, “What’s driving interest in BI services is the pace of Internet business. Companies no longer have the luxury of figuring out what went wrong or right with the business three months to nine

⁸⁴ David Pearson, “Trail to the Chief: A Question For Those Whose Careers Have Plateaued at CIO: Could You Run the Business?” CIO Magazine, August 1 1999. Tom Davenport, “The Other Digital Divide: Battle Lines are Drawn as IT Managers and E-Managers Face Off”, CIO Magazine, July 1 2000.

⁸⁵ Tom Field, “IS at the Crossroads: Back from the Brink”, CIO Magazine, 15 June 2000.

⁸⁶ Abbie Lundberg, “Courage”, CIO Magazine, March 15 2002. With the recession of 2002, CIOs faced particular problems as they attempted to reduce costs and deal with the disappointments incurred by many Internet, ERP and CRP initiatives. See Alison Bass, CIOs Between a Rock and a Hard Place (CIO Magazine, October 17 2002 [cited October 25 2002]); available from <http://comment.cio.com/crm/101702.html>.

months after the fact.”⁸⁷ By an interesting irony, this term had actually been popular during the 1950s. In 1961, James D. Gallagher, the McKinsey consultant and key promoter of the MIS concept within the American Management Association, wrote that, “Such business intelligence systems will go far beyond the limits of classical accounting information to process and analyze a broad range of data--non-financial and financial--that are needed by top management to run the business.”⁸⁸ The spread of information as the preferred designation of managerially relevant computer use appears to have edged out discussion of “intelligence” for most of the next forty years.

“Knowledge” has likewise made a comeback. By the mid-1960s information had largely edged out knowledge in business discourse. Nobody talked about knowledge processing, or the knowledge industry, or knowledge processing, or business knowledge systems, or the knowledge revolution. In the 1990s, however, knowledge management became a hot new topic. Whereas information now seemed to designate the use of computers for routine administrative tasks and highly structured quantitative and numerical data, knowledge was the new term for less structured material such as the best ways to tackle a particular design job, or consulting project. (This may have been an outgrowth of the older concept of organizational learning). Knowledge management was soon the subject of many articles, books, lavish conferences, trade shows, and consulting assignments. The term was used increasingly broadly, and applied to database systems and other software tools intended to build “knowledge repositories” where knowledge workers could deposit their knowledge for others to tap into. Salesmen promoted their packages as instant solutions to knowledge problems. As they had done earlier, when discussing information management, the more thoughtful experts decried this rush for the technological fix, and instead focused on the need for cultural change, executive support and the careful identification of business needs to create an atmosphere of knowledge sharing.⁸⁹

Along with knowledge management came the Chief Knowledge Officer (CKO). Despite early hopes that the data base administrator could be responsible for data of all kinds, and that the chief information officer would hold a mandate over all corporate information, both positions had soon developed an exclusive focus on computer technology and highly structured computerized records. The CKO, therefore, was a new attempt to succeed where these had failed and create an executive responsible for the kinds of hard to formalize information vital to effective management. A 1999 article by Michael Earl, formerly one of the MIT promoters of “decision support systems”, suggested that the CKO was concerned with “20% technology and 80 percent cultural change” and included quotes from CKOs such as “I spend 90 percent of my time creating markets for conversations.” He glorified his small sample as entrepreneurs, environmentalists, self-starters, risk-takers, strategists, “eclectic change agents” and “unusual

⁸⁷ Michael Vizard, "Yahoo and IBM head for a collision on the road to business intelligence", InfoWorld.com, 16 February 2001.

⁸⁸ James D. Gallagher and Douglas J. Axsmith, "Data Processing in Transition: Can Management Manage EDP of the Future?" in *EDP: The First Ten Years. Highlights of Management Experience and a Look Ahead*, ed. McKinsey & Company (Chicago: American Society for Public Administration, 1961). See also Ray Eppert, "A Central Intelligence Program for Management" (paper presented at the Systems and Procedures Association of America, 1956) and Francis Bello, "How to Cope with Information", *Fortune* 62, no. 3 (September 1960):162-67, 80-82, 87-89, 92.. On the more recent use of business intelligence, see Vizard, "Yahoo and IBM head for a collision on the road to business intelligence".

⁸⁹ For discussion of knowledge management, see Thomas H. Davenport and with Laurence Pursak, *Information Ecology: Mastering the Information and Knowledge Environment* (New York: Oxford University Press, 1997) and Erick Berkan, "When Bad Things Happen To Good Ideas", *Darwin Magazine*, April 2001.

and arresting people.” “The qualities required of the CKO,” he concluded, “are an unusual and perhaps rare mix....” The CKO must combine the “technological, systems, and informational perspective of the CIO” with the “softer, organizational, and process-oriented perspective of the human resources specialist” and the “strategic, integrationist, and enterprisewide (sic) qualities of the CEO.”⁹⁰

It is as yet unclear whether the CKO will prove a passing fad or a permanent feature of the corporate landscape. It is, however, clear that its popularity reflects the idea that information is too closely associated computer technology and the CIO to continue to serve as a more general description of organization knowledge. Advocates of knowledge management cast information management as narrow and technical, just as advocates of information management and management information systems had cast data processing as narrow and technical. As one article put it, “information management is a subset of knowledge management,” concerned only with finding information and moving it around, rather than the broader questions of creating and using it.⁹¹

The Internet gave rise to a proliferation of ugly neologisms in which e- (standing for electronic) and cyber- were appended to words such as commerce, marketplace, university, and management. Whereas information had been prominent in the new terms of the 1980s, in the 1990s the information superhighway was the only main new piece of information jargon. Interestingly, both electronic (in electronic data processing) and cyber (as in cybernetics) had been widely used in the neologism of the 1950s. While their allure of modernity had quickly worn off, by the 1990s it had evidently regenerated itself.⁹²

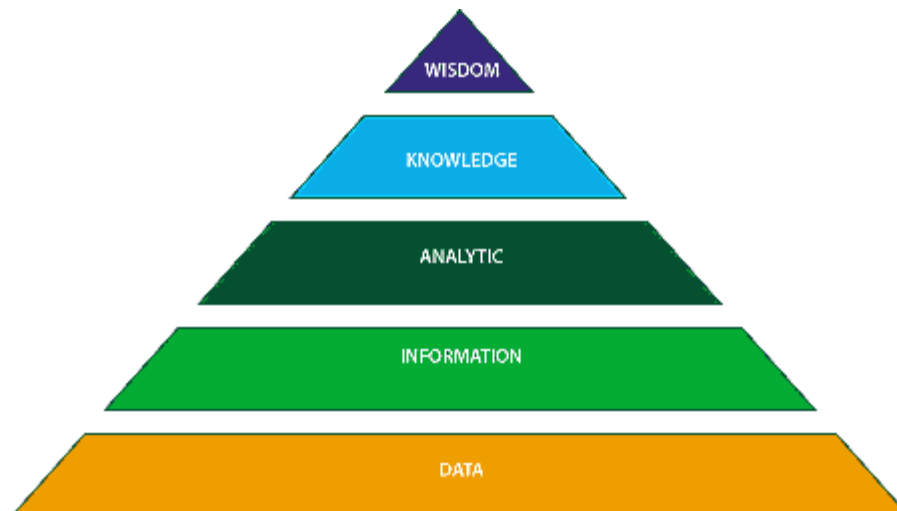
Academic theorists, and consultants keen to appear insightful, have tried to formalize the distinctions between knowledge, information, and data. These definitions generally use data to refer to the bits and bytes stored within computer systems. Data is then turned into information when extracted from a database and summarized to give averages, totals and so on. Most models add additional levels. One consultant, for example, proposes that data is turned into “analytic” by discovering trends and relationships, that knowledge is “the next level of elevated understanding” and that “wisdom is the utilization of accumulated knowledge.” The same author paired each of these “levels of understanding” with a particular technology. Information, for example, corresponded to “ad hoc query and reporting applications”, whereas knowledge was the province of “data mining applications” and wisdom the sole domain of the human mind. The technological fix is clearly alive and well. Other models omit analytic and include alternatives, such as the insertion of intelligence between knowledge and wisdom. As with the process of advertising one-upmanship that made the 14-speed kitchen blender a standard, there would seem no inherent limit to the number of different levels one might propose.⁹³

⁹⁰ Michael J. Earl and Ian A. Scott, "What Is a Chief Knowledge Officer?" Sloan Management Review 40, no. 2 (1999):29(1).

⁹¹ Wendi Bukowitz and Ruth Williams, "Knowledge Pool", CIO Magazine, July 15 2000.

⁹² The revival of all things cyber can be traced to the adoption of this piece of dated futurism to describe the work of a school of early 1980s science fiction writers, the cyberpunks. William Gibson, the most prominent of these authors, used to prefix to coin the term cyberspace. The revival of electronic took place as a generalization of the term email, a contraction of electronic mail.

⁹³ Jonathan Wu, Business Intelligence: The Transition of Data into Wisdom (DM Direct, November 2000 [cited 26 June 2002]); available from http://www.dmreview.com/portal_ros.cfm?NavID=91&EdID=2524&PortalID=17.



These particular definitions made remarkably little sense, and indeed any attempt to draw coherent distinctions between, say, knowledge and information is unlikely to succeed. One must contend not only with the slipperiness of these concepts, but also the long history of overlapping and contradictory usage. For an example of this, it is hard to beat the definition given in a 1957 report produced by accounting firm Haskins & Sells: “Data originated in the human mind. Data is information -- a piece of intelligence.”⁹⁴ They suffer particularly from the problem that information theory describes data, and that the word information is used to describe both a single level and the entire pyramid. Such schemes do, at least, have the virtue of suggesting that information is something produced when computerized data is processed in some way, rather than using the term for the raw data itself. On the other hand, they reserve a term such as wisdom for what we used to call information, the useful facts communicated to a human mind. (One is also faced with the problem that data cannot be gathered or stored without the guidance of human wisdom in the first place, and hence is not as neutral as the model suggests, a point made recently by Ilkka Tuomi).⁹⁵

Conclusions

As scholars such as Alfred Chandler and JoAnne Yates have shown, the rise of large industrial corporations from the 1880s onwards involved the creation of a new class of professional managers and the creation of new administrative technologies such as written procedures, vertical files, and organization charts.⁹⁶ Expertise in this new approach to business, often referred to by historians as systematic management, was the hallmark of the modern manager. The manager exercised control through mastery of systems. While mechanical technologies such as bookkeeping machines and addressing machines were in widespread use by the 1920s, these were not hard for non-specialist managers to understand.

⁹⁴ Haskins & Sells, Introduction to Data Processing: An Outline of Basic Data-Processing Operations and Methods (New York?: Haskins & Sells, 1957).

⁹⁵ Ilkka Tuomi, "Data Is More Than Knowledge: Implications of the Reversed Knowledge Hierarchy for Knowledge Management and Organizational Memory" (paper presented at the Proceedings of the 32nd Hawaii International Conference on System Sciences, Maui, HI, January 5-8 1999).

⁹⁶ JoAnne Yates, Control Through Communication: The Rise of System in American Management (Baltimore, MD: Johns Hopkins University Press, 1989). Alfred D. Chandler, The Visible Hand: The Managerial Revolution in American Business (Cambridge, MA: Harvard University Press, 1977).

With computerization, in contrast, few outside the rapidly growing community of corporate data processing specialists had any real understanding of how the machines worked, what their capabilities were, or what opportunities they opened up. Keeping current with changing answers to these questions was something close to a full time job. As a result, the execution of ever larger swathes of business administration, such as stock control, order processing or payroll processing, vanished inside a black box. All that general managers knew was that computer systems were very hard to change, were usually delivered late, and gobbled up ever increasing amounts of money. This created something akin to C.P. Snow's famous description of two cultures, each seeming alien to the other.⁹⁷ From the very beginning, non-specialist managers complained that computer staff were overpaid technicians, spoke a foreign language, and were more interested in playing with the latest experimental technologies than working out ways to improve profitability. As Ellen Ullman was later to put it, immersion in the culture of corporate computing brought its adherents "close to the machine."⁹⁸ Executives, in contrast, saw an understanding of these technical areas as something to be delegated.

Any computer specialist eager to rise into the higher levels of corporate management faced this stigma, and would struggle against the perception that his or her expertise lay in an area that was technical rather than truly managerial. The same problem applied to consultants trying to gain the interest of top management in broader applications of computer technology, to academic looking to establish the study of business computing as a legitimate sub-discipline, and for computer vendors eager to sell more and more elaborate systems.

Information promised to solve all these problems. Whereas expertise in data processing or in computing appeared purely technical, expertise in information appeared to bridge the chasm separating these two worlds. Information blurred all kinds of boundaries. Technical expertise in information systems or information technology appeared to be, in itself, a claim to managerial authority. (Remember Synnott's claim that "issuance of corporate policy and instructions is, in fact, an information service.") As we have seen, from many viewpoints it was a spectacular success. Computer-related work supported a massive increase in the size of the consulting industry during the late 1980s and 1990s. MIS achieved respectability within business schools. Computer managers received their new title of CIO, and rose up the organization chart.

Information remains a technological fix so powerful that the exact problem it fixes need never be defined. Promises to pipe better information to more decision makers, current to the millisecond, seem as compelling today as they did around 1960, when MIS and total systems concepts first enthused the systems men. In 2002 Vinod Kholsa, venture capitalist, and co-founder of Sun Micro Systems, addressed an industry forum. His Silicon Valley successes had made Kholsa one of the celebrities of the new economy, earning him a reputation as a technological visionary and business genius. His speech was full of references to the latest and greatest software technologies: "componentized" applications, web services, and a new "meta architecture" to couple business processes to computer logic. Yet all these hot new buzzwords were applied in service of a concept that would have seemed familiar to any attendee at the 1962 meeting of the Systems and Procedures association. This new concept was "the real time enterprise" (enterprise being a fashionable term for a large company). According to Kholsa, "In

⁹⁷ C P Snow, The Two Cultures and the Scientific Revolution (New York: Cambridge University Press, 1959).

⁹⁸ Ellen Ullman, Close to the Machine : Technophilia and its Discontents (San Francisco: City Lights Books, 1997).

the real-time corporation, as you remove costs you migrate quality because information becomes more current and because you are eliminating steps of inefficiency in the way the company works.” His assertion that, “Because information comes in real time, senior people get to make more decisions” suggests no apparent intellectual evolution had taken place over the intervening decades.⁹⁹

There have also been some problems. Systems and approaches aimed, in broad terms, at building stockpiles of information or improving managerial decision making have not as a whole been particularly successful. While a spirited debate continues, it is by no means clear that computers have boosted overall economic productivity, or that firms spending more on computers have been more successful than those spending less. Though some computer systems have undoubtedly paid for themselves many times over, these may have been cancelled out by the large numbers of failed or misconceived applications of computer technology. The language of information, which appears to imply a clear link between “information technology investments”, “information resources” and improved decision making, has undoubtedly played a role in legitimizing some of these more dubious applications.¹⁰⁰

As a bridging device, information’s success has been limited. It has tended to crumble when computer managers have tried to cross it, and enter the world of executive management beyond. The information executive was supposed to be a centaur, “part IS horse, galloping beside the fast-paced changes in technology, but from the waist up a savvy general manager.” To revise the objection attributed to Churchill when faced with a similar proposition, “what if it got my brains and your body?” Too often the CIO, intended to blend in with technical staff and general managers alike, seemed like an outsider to both camps: the intellectually challenged head of a horse on the panting body of a manager. To technical subordinates, the CIO might appear a creature of corporate politics, entirely ignorant of the current world of technology. (Think, for example, of the satanically coiffured “pointy haired boss” in the Dilbert comic strip). To executive peers, on the other hand, the same manager might appear an introverted technician concerned more with machines than with people, unable to keep promises, and without a real feel for executive culture. Indeed, all the discussion of the CIO as a manager first and a technologist second seems to have had an unexpected effect. While few non-technical managers shifted into CIO careers, ambitious computer managers did learn to disparage the importance of technical knowledge.

The concepts of information as a collection of facts, information technology and information systems have spread far beyond the corporate and managerial settings in which they gestated. The ubiquity of information talk in recent decades can be attributed, more than anything else, to the conceptual ambiguity of information. The sense of information as that which informs, as the communication of useful facts, co-exists with the sense of information as

⁹⁹ Jack McCarthy, Sun Founder Touts 'Real-Time Enterprise' (InfoWorld.com, April 9 2002 [cited April 10 2002]).

¹⁰⁰ On the so-called productivity paradox, see Jenny C. McCune, "The productivity paradox: do computers boost corporate productivity", Management Review 87, no. 3 (March 1998):38(3) and Pam Woodall, "Survey: The New Economy -- Solving the Paradox", The Economist, 23rd September 2000. Strassmann, The Squandered Computer, written by a former computer manager with extensive corporate and government experience, includes some excellent discussion of the techniques used to justify computer spending. A rather mild critique of information hype, notable for its co-authorship by a technology celebrity and head of Xerox’s famous PARC laboratory, was delivered at the height of Internet mania as John Seely Brown and Paul Duguid, The Social Life of Information (Boston: Harvard Business School Press, 2000).

the bits and bytes manipulated by a computer. One does not have to say which sense one is using. Thus when Al Gore and his allies in the computer industry spoke of the information superhighway in the early-1990s, they appealed to our sense that information was power, that freedom of information was a virtue, and that, in the words of James Madison, “a popular Government, without popular information, or the means of acquiring it, is but a Prologue to a Farce or a Tragedy.”¹⁰¹ President Clinton called for action to address the so-called digital divide in access to “computer and the Internet” because “access to these Information Age tools is becoming critical to full participation in America’s economic, political, and social life.” What this meant in practice was that computers and computer networks must be spread throughout America as evenly as possible and in the greatest possible number. At around the same time, business leaders received a similar message that only by raising computer spending to unprecedented levels could they reap the benefits of the e-business revolution. Support for the public provision of computer hardware and training seemed more broadly based than that for other entitlements such as food, shelter or healthcare. At this particular moment in history, the connection of information to computers and networks appeared obvious. Computers were, after all, information technology. Information was their essence.

Yet historians have so far shown little awareness of the recent genesis of the idea of information technology, information systems, or as information as a synonym for fact. Scholarly work exploring the history information technologies or information revolutions, the subject of many recent books, has shown little interest in where the concepts of information, information technology, or information system came from.¹⁰² Instead, these information-based concepts been

¹⁰¹ James Madison, "Madison to W.T. Barry, August 4, 1822", in The Mind of the Founder: Sources of the Political Thought of James Madison, ed. Marvin Meyers (Indianapolis: Bobbs-Merrill, 1973).

¹⁰² Scholars approaching the pre-history of the information age from the viewpoint of books and reading include James Joseph O'Donnell, Avatars of the Word: From Papyrus to Cyberspace (Cambridge, MA: Harvard University Press, 1998) and Michael E Hobart and Zachary S Schiffman, Information Ages: Literacy, Numeracy, and the Computer Revolution (Baltimore: Johns Hopkins Press, 1998). Historians of business and economics have shown an increasing interest in using information to explain historical behavior (motivated in part by a renewed theoretical concern with the internal structures of firms and work on transaction cost economics and information costs). See Margaret Levenstein, Accounting For Growth: Information Systems and the Creation of the Large Corporation (Stanford: Stanford University Press, 1998) and the collections Peter Temin, Inside the Business Enterprise: Historical Perspectives on the Use of Information (Chicago, IL: University of Chicago Press, 1991), Lisa Bud-Frierman, ed., Information Acumen: The Understanding and Use of Knowledge in Modern Business (New York: Routledge, 1994), Naomi R. Lamoreaux and Daniel M.G. Raff, eds., Coordination and Information: Historical Perspectives on the Organization of Enterprise (Chicago: University of Chicago Press, 1995). Historians exploring topics such as telegraphy and the postal system have framed their work in terms of information – as in Richard R John, "Recasting the Information Infrastructure for the Industrial Age", in A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present, ed. Alfred D. Chandler and James W. Cortada (New York: Oxford University Press, 2000), Greg Downey, "Virtual Webs, Physical Technologies, Hidden Workers: The Spaces of Labor in Information Internetworks", Technology and Culture 42, no. 2 (2001):209-35, and, in the journalistic sphere, Tom Standage, The Victorian Internet (New York: Berkley Books, 1999). With the exception of Geoffrey Bowker, "Information Mythology: The World Of/As Information", in Information Acumen: The Understanding and Use of Knowledge in Modern Business, ed. Lisa Bud-Frierman (New York: Routledge, 1994), none of these works includes any critical examination of the concept of information or information technology, or of the historical development of these concepts. Correspondingly, analysis of information as a concept, such as Albert Borgmann, Holding on to Reality : The Nature of Information at the Turn of the Millennium (Chicago: University of Chicago Press, 1999), has not been performed within the disciplinary framework of history. The promisingly titled Ronald E Day, The Modern Invention of Information: Discourse, History, and Power (Carbondale: Southern Illinois University Press, 2001) is a work of critical theory, exploring the

taken as neutral and timeless categories. Consider a recent, well-received work by a respected historian: Daniel Headrick's When Information Came of Age.¹⁰³ Headrick's thesis is that the information revolution should properly be dated to the eighteenth-century, and that historians have unfairly privileged the printing press, telegraph and computer over other information systems and technologies such as maps, taxonomies, statistics and postal services. In his introductory chapter, "Information and Its History" he defines information as "data organized in a systematic fashion" and suggests a taxonomy of information gathering systems (such as censuses), information classification systems (such as taxonomies), information transformation systems (such as statistics and cartography), information storage and retrieval systems (such as dictionaries or museums), and information communication systems (such as messengers).

Neither here, nor in the body of the book, does he devote the slightest attention to what the idea of information itself might have meant to his historical actors, or how it might have changed over time. This is not to imply that Headrick fails to prove that the things we would now call information systems have a long history. We should, indeed, welcome this challenge to the techno-libertarianism and millennial utopianism of much popular writing on the subject. Headrick implicitly rejects the attempts of radical information enthusiasts such as James R. Beniger to blur the lines separating human's conscious use of information from cellular processes or cybernetic feedback loops.¹⁰⁴ It is, however, startling that an author intent on challenging the blinkered perspectives and short historical memories of computer enthusiasts should adopt so unreflexively the historically specific conceptions of information and information systems recently created by those self-same enthusiasts. By naturalizing these concepts, historians risk obscuring their actual origins. We have, as yet, nothing approaching a social history of information.

Computer enthusiasts have been quick to proclaim the final decades of the twentieth century as the Information Age. When future generations of historians have assimilated this era into their broader understanding of America's history they may choose to retain the term, at least for the period from the end of the Cold War to the start of whatever they call our war on terrorism. In a mature historiography, however, their understanding of what information has meant over the last twenty years will be just as removed from that of the typical information enthusiast of today as our present understanding of the discourse of progress is from that of a Progressive Era reformer. After we are all dead, and historical distance is thereby established, information may emerge as the defining ideology of a society that briefly thought itself to have passed beyond the grip of both history and ideology.

texts of Paul Otlet, Suzanne Briet, Claude Shannon, Pierre Levy, Walter Benjamin and Martin Heidegger. It has little to say about broader changes in the use of information concepts.

¹⁰³ Daniel Headrick, The Tools of Empire: Technology and European Imperialism in the Nineteenth Century (Oxford, UK: Oxford University Press, 1981).

¹⁰⁴ James R. Beniger, The Control Revolution: Technological and Economic Origins of the Information Society (Cambridge, MA: Harvard University Press, 1986).