Developing an Historical Tradition in MIS Research

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Abstract

MIS as a discipline has not yet developed a tradition of historical research. Historical analy-

ses broaden our understanding of the processes by which information technology is intro-
duced into organizations and of the forces that shape its use. Paramount among these
processes are those Schumpeter called "creative destruction." These are events that
change entire organizations and industries. The end product of a Schumpeterian process
is called a "dominant design," a new configuration of an organization’s technology, strategy,
and structure. A dominant design is manifest-
ed in several ways: a new organizational infra-
structure, new functionality, new products, new
services, new production functions, or new
cost structures. By changing the basis of com-
petition in the industry, a firm that institutes a
dominant design secures an initial competitive
dge. Although the understanding of these pro-
cesses is central to the concerns of many
researchers and practitioners in the field, the
information systems research literature con-
tains very few examples of historical analyses of
this type. A contingency framework is de-
veloped for conducting a class of information
technology-based historical studies that focuses
on innovation and competition within an
industry.

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Histories make men wise; poets, witty; the
mathematics, subtle; natural philosophy,
deep; moral, grave, logic and rhetoric, able to
contend.

Francis Bacon

A Brief History of the Role of History in MIS Research

In his various works, the economist and histori-
an Joseph Schumpeter has stressed the
notion that any field of inquiry which justifiably
earns the distinction of being called a “disci-

1Robert Zmud was the accepting senior editor for this paper.

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pline" must provide to the world four kinds of knowledge: (1) empirical data, observations and facts, (2) theories and paradigms, (3) ethics, and (4) history. A study of history is necessary to provide a temporal and contextual meaning for each of the other three forms of knowledge. Most contemporary MIS research addresses the first two forms. Active work is also currently underway in ethics. To date, however, the field has generally lacked an historical perspective. MIS researchers, for the most part, have not sought to identify fully the broad socio-economic conditions of continuity and change that accompany the use of information technology. This stands out as a deficiency in an otherwise robust field.

We believe that if MIS is to continue to evolve into a mature discipline, and if MIS is to enjoy the theoretical and professional recognition that academic maturity bestows on a discipline, MIS professionals must begin also to record and examine its history. A moral duty underlies this belief. As members of this field, we have an ethical obligation to understand what has been changed in our society as a result of our activities and how and why, and we must identify those things in society that have persisted in spite of our concerted efforts to change them. This is among the challenges we face as an academic field today. Meeting this challenge is why an historical tradition in MIS research is called for at the present time.

MIS research, during the last three decades or so, has established several important methodological traditions. Much of the early research in the field took the form of case reports: important observations about the use of computer-based systems in organizations, but usually not conducted with much in the way of systematic rigor. They contained neither very complete documentation of the social and economic forces that led up to the adoption of the new systems nor of the patterns of continuity and change that evolved around them. The "case," of course, was a deeply ingrained instrument of management education at the time, drawing its heritage from the collaboration of Edwin F. Gay, an economic historian and founding dean of the Harvard Business School, and Arch W. Shaw, co-founder of Shaw-Walker and a Chicago publisher. Their efforts around the turn of the century resulted in Harvard’s case method (Chubb 1995). Indeed, as Alfred D. Chandler observed,

The heart of this school’s curriculum has always been the case study, and the case study is precisely what a historian does, what a historian is trained to do (quoted in Kanter 1996).

While they were excellent as teaching devices, these early cases often lacked theoretical development and analytical rigor, a failing pointed out by Gordon and Howell (1959) in their classic critique of management education. As MIS emerged as an academic discipline during the 1960s, there was a strong need for the application of more scientific methods and these were subsequently developed and used.

Some early studies took the form of economic analysis or mathematical model-building exercises in which deductive logic was used to analyze problem situations. This had the advantage of bringing more rigor to the task of uncovering the structure of situations, but often did so at the cost of reductionism. Researchers were inclined to explain very complex phenomena by means of just a few relatively simple principles and assumptions. The Minnesota Experiments, reported on in 1977, introduced the method of controlled laboratory experimentation (Dickson et al. 1977). Experimental designs afforded a great deal of control over one or, perhaps, several variables. This made some types of causal analysis possible, but it forced researchers to reexamine and distill the real world environment to such an extent that was often difficult to make, or especially to substantiate, inferences to actual practice. The use of sample surveys overcame some of these limitations. Survey data are derived from real world responses that are amenable to rigid statistical analysis, but being in essence snapshots, they are usually stenographic in nature and are limited to acquiring data on just a few variables. Surveys permit modest, if any, treatment of complex interactions. Field studies, in which coordinated case studies are used to compare the similarities and differences between phenomena in a vari-
ety of well chosen settings, potentially provide more external validity than surveys or experiments, but they, too, tend to palliate the complexity of underlying social, economic and managerial processes. Individually and collectively, research conducted using these methods (or a combination of them) has served to develop a growing body of theoretical and practical knowledge about MIS and its functioning in organizations. Nevertheless, it can be argued that the discipline is methodologically incomplete; it has yet to embrace historiography as a method.

By the time the First International Conference on Information Systems was held in Philadelphia in 1980, the MIS literature contained only one major study, other than teaching cases, in the historical tradition. The events surrounding the introduction of electronic data processing equipment into a large electric light and power company had been described (Mann and Williams 1960). Data was collected on the effects of the new technology beginning six years prior to its implementation and continuing five years afterwards and used to detect patterns of diffusion and the delay of effects. Yet, while each of the other research methods mentioned above were discussed at the conference and are referred to in the Proceedings (McLean 1980), no mention was made of either the Mann and Williams study or of any other historical study. The need for history may not have been evident to researchers in so young a field at their first international conference. Subsequently, during the academic year 1983-84 the Harvard University Graduate School of Business Administration celebrated its seventy-fifth anniversary. One of the events was a research colloquium entitled The Information Systems Research Challenge (McFarlan 1984b). The absence of historical studies was noted and lamented at the colloquium and this spurred concern that eventually led to the establishment of the Harvard MIS History Project. The project's intent was to add a new dimension to MIS research. A few years later, one of the first complete MIS historical studies, "Airline Reservation Systems: Lessons from History," appeared in the MIS Quarterly (Copeland and Mckenney 1988).

The process of methodical completion was begun.

The role for history as a means of finishing out a body of knowledge finds precedent in the philosophy of Francis Bacon, one of the founders of modern science. As the paper's theme quote suggests, Bacon believed that the writing of history is required to round out the practice of other forms of inquiry. And, as modern day scholars Richard Neustadt and Ernest May (1986) argue, history helps endow knowledge with wisdom so that it can be used effectively by leaders and decision makers. Neustadt and May's justification is only one among several reasons for including historical methods in the MIS research arsenal. There are others.

Why an MIS Focused History?

MIS is an instrument of economic change, a specific case of what Schumpeter called processes of "industrial mutation."

[It] necessarily revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating the new one. This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in. . . . Every piece of business strategy acquires its true significance only against the background of that (organic) process and within the situation created by it. It must be seen in its role in the perennial gale of creative destruction; it cannot be understood irrespective of it or, in fact, on the hypothesis that there is a perennial full (Schumpeter 1942, pp. 83-84, emphasis in original).

The Bank of America story recounts "creative destruction" in action and, thereby, provides some insights into a more general phenomena.

Among the most forceful sources of creative destruction in the twentieth century is a revolution in communications and computation which has been brought about by new developments.
in information technology. Information technology is much more than just a set of machines and procedures. It is also a social force. As Steven Lubar notes,

We are surrounded by new machines, new devices, new technologies that let us—or make us—deal with more information than ever before. We are also surrounded by new economic and social and cultural systems which support and make possible these machines, and which, in turn, are supported by them. Together our information culture and our information machines shape the way we live, work, and play, and change the way we think about the world around us (Lubar 1993, p. 3).

They also have changed the way businesses do business, the way they are organized, the products they offer and the methods they use to market them. The Bank of America story provides one small aperture through which to see how one major societal change in our "infoculture"—electronic banking—evolved and gives us a glimpse of the process by which other social changes have materialized.

Arguably, information technology has become the most influential force leading to the restructuring of business and of the political economy as a whole. MIS and IT are the latest in a long chain of potent historical—and creatively destructive—factors affecting the shape and conduct of business. Chandler (1962, 1977, 1985, 1990), for example, has identified several key innovations which during previous eras materially changed corporations and their economic environment. Among them are the rise of the railroads, the concentration of urban markets, the emergence of mass-production technology, the coming of electrification, the introduction of the internal combustion engine, and the rise of scientific research and development. Chandler's carefully documented studies describe how these innovations led to the emergence of a new bureaucratic form—the vertically integrated multi-divisional corporation—which facilitated a concentration of economic power. This new power is guided, as he aptly put it, by a "visible hand."

Today major corporations such as American Airlines, Baxter Travenol, U.S.A.A., Bank One, FedEx, Frito-Lay, and Wal-Mart, among others, rely on information technology as a key element in their strategies. These firms are using MIS and IT to radically change their production functions, cost structures and delivery systems to their customers. In the process, they are creating a new bureaucratic form—the "information based organization" (Drucker 1988)—while, at the same time, realigning the entire competitive structure of their industries. Staying in the lead, however, requires constant vigilance and investment.

The case of the Bank of America is illustrative. As the accompanying article describes, the bank achieved an early dominant position in the banking industry, in part by means of the effective use of information technology, only to forfeit this lead later on by failing to innovate rapidly enough as new technologies became available. The Bank of America's innovations during the 1950s and 1960s set the entire banking industry on a new course, one which most other banks had to follow. Later, other banks took the lead. Today, as a result of this technological competition, it is virtually impossible for any bank to be a major player in the global banking arena without making a substantial—and effective—investment in information technology (McKenney et al. 1997).

All of these new developments, and more, cry out for answers to some of the overarching questions Chandler posed at the beginning of his path-breaking research: What is the past has given business the opportunity, or created the need, for them to change what they were doing or the way they were doing it? What did business leaders know at the time? Why did the change come when it did? Why did it take the form it did? What was the result? To these we add: And what role, if any, did information technology play in the process?

These are relatively new questions for MIS researchers but, as will become clearer in the sequel, MIS researchers are uniquely qualified to address them because arriving at productive answers requires a knowledge of technology, organization, management, and systems appli-
cations, a knowledge generally grounded in the results of scientific and other forms of research. Significantly, these new questions are different from those that historians of technology have addressed.

**MIS Histories Differ From Technological Histories**


Still other researchers have recorded the evolution of software. Early histories such as John Manchly's "Short Order Code" (1951) and Betty Holberton's "Sort-Merge Generator" (1951) have been followed by histories of the development of operating systems and higher level languages (see Wexelblat 1981). These studies provide a valuable tracing of the developments that have led up to the current state of the technology. They have shed light on some of the fascinating personalities and circumstances that helped create our new technological era; but they have not revealed how these forces changed businesses, organizations, and industries.

IT-based business histories, in contradistinction, show how entrepreneurs and executives sought to use these technologies for economic gain, how they used them to destroy the old and bring in the new. They provide an account of how major investment and other business decisions were made. And they reveal how the operations, structures and functions of organizations changed as a result. A full historical analysis, of course, goes on to show how these changes served to redistribute wealth, influence, and status among economic entities. Providing insights into these processes surely must rank high on the MIS discipline's research agenda. MIS researchers are uniquely qualified to carry out this line of research for two basic reasons: we have a deeper understanding of organizations and people than most computer scientists do and we possess a fuller understanding of information technology than most business policy, strategy, and organization behavior researchers typically do.

The histories of computer technology, such as those noted above, are primarily stories about artifacts and how they were shaped and molded. These processes and the people who conducted them are of considerable interest to MIS researchers but they do not capture the great impact the technology has on businesses and organizations. IT-based business histories, however, describe and interpret the social changes that were induced by information technology and trace their effects on organizations and industries. Consequently, these histories tend to begin where the aforementioned histories of technology leave off. In an IT-based business history, information technology is viewed as a reservoir of potential power, a metaphorical fount from which change can spring. (This is also one of the possible ideological biases MIS researchers bring to the work.) It makes some significant kinds of social change possible. Furthermore, it establishes the constraints of feasibility and possibility within which other kinds of social change can take place. The enduring story of change, however, centers on the leaders and innovators who take the available technology and use it as a tool to create new businesses and societies. These purposeful agents are the prime movers of the historical process. Some of these key figures come alive in the Bank of America story and their actions form another lens through which we can view the story.

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IT-Based Business Histories: A Contingency Framework

We sought to understand how some firms were able to establish leadership positions in the use of information technology while others were not. This methodological assumption influenced the choice of sites and, thus, the findings. We chose to study firms that had established the dominant design in their industries and looked for explanations as to the managerial processes they used.

In this context, three key historical roles have been uncovered: the leader, the maestro, and the supertech. Incumbents of these roles guide an organization successfully throughout the phases of an historical process called the "cascade." The phases include experiencing a crisis, searching for a technological solution, testing an initial solution, realigning the organization to fully accommodate the advantages of the technological innovation, generating surplus economic rents which force competitors to respond, and establishing a new industry equilibrium centered on the dominant design. The concepts of dominant design, roles and cascade serve as Weberian ideal types that may be used to guide future MIS historical research. They are discussed in more detail in the following sections.

Innovating toward a dominant design

The Bank of America story recounts one firm's quest to secure a "dominant design." A "design" is a combination of the firm's resources that results in a certain pattern of its strategy, organizational structure, products, services, operations, and a certain pattern of its relationships with customers, suppliers, business allies, and government agencies. It is the result of "thinking behavior which conceptually selects among a set of alternatives in order to figure out which alternative leads to the desired goal or set of goals" (Churchman 1971, p. 6). A "dominant design" (DD), according, is a design that yields superior results for the firm. A DD is generally the result of a radical—as opposed to an evolutionary—innovation in an industry. Abernathy and Utterback (1978) cite Douglas' DC-3 and Ford's Model T as examples of DDs in products:

[The] DC-3 was in fact a culmination of prior innovations. It was not the largest, or fastest, or longest-range aircraft; it was the most economical large, fast plane able to fly long distances. All the features which made this design so completely successful had been introduced and proven in prior aircraft. And the DC-3 was essentially the first commercial product of an entire firm (the C-4 and DC-2 were produced by Douglas only in small numbers). . . . [B]ut the DD changed the character of innovation in the aircraft industry for the next 15 years. No major innovations were introduced into commercial aircraft design from 1936 until new jet-powered aircraft appeared in the 1950's (p. 144).

Throughout its life, airline operating costs were cut in half through development and improvement of the DC-3.

During a four-year period before Henry Ford produced the renowned Model T, his company developed, produced, and sold five different engines, ranging from two to six cylinders. These were made in a factory that was flexibly organized much as a job shop, relying on trade craftsmen working with general-purpose machine tools not nearly so advanced as the best then available. Each engine tested a new concept. Out of this experience came a dominant design—the Model T, and within 15 years, 2 million engines of this single basic design were being produced each year (about 15 million all told) in a facility then recognized as the most efficient and highly integrated in the world. During that 15 year period, there were incremental—but no fundamental—innovations in the Ford product (p. 148).

Nevertheless, the Model T changed the automobile market forever. During its lifetime, a price reduction from $3,600 to less than $1,000 (in 1958 dollars) was realized (p. 40-41).

The Bank of America achieved a dominant design for banking operations during the period 1958 to 1964. The path they followed to get there is analogous to the DC-3 and Model T
(see the article on the Bank of America in this issue). The process through which they reached their DD is called the “cascade.” Successful completion of the cascade required that three roles be fulfilled: leader, maestro, and supertech (see Figure 1).

**Three essential roles**

**Leader**

An impending crisis requires somebody to respond. Each of the histories in this paper centers around a few key protagonists, the agents who innovate and who manage the change. These people perceive information technology as a solution to the crises their organizations face. In the cases here, these managers were insiders looking out and not outsiders, such as vendors, rushing in with a “silver bullet” solution. For the most part, the prime movers are experienced members of the industry who are aware of the impending crisis and are seeking new solutions. S. Clark Beise at Bank of America was such a leader. He knew that the bank could not cope with the anticipated glut of transactions and had a vision of his business in which IT played a prominent role. Once committed, he continued to use his power and prestige to support further technological innovations. Although he was fully dedicated to carrying out the bank’s strategy, he, himself, was not a full fledged technological innovator or a technological entrepreneur. For this, he turned to a person who understood technology as it affects the organization and industry, someone who would champion IT’s introduction on a daily basis. This role is called the “maestro.”

**The Maestro**

The maestro is a manager of technological innovation who understands both the business and the technology. He or she must have the competence to plan for and to implement the firm’s new technological infrastructure and to carry out concomitant shifts in organizational processes. Importantly, a maestro maintains the company’s momentum for developing IT-based systems by forming a close alliance with high level executives and other key business managers. These affiliations are used to ensure the on-going adaptation of the organization to new procedures and roles. Success in this role requires that the manager of technological innovation build credibility for the IT innovation effort by delivering effective systems on time and within budget. It also requires the building of a team of capable individuals who can manage the subtle, interdependent details of the technology and of the business. The maestro must also ensure that the team is dedicated to producing a quality result.

Al Zipf initially played this role at Bank of America. He built a strong influential team in his organization—it evolved over about a 20 year period—and he helped to determine the general strategies for the Bank’s businesses. As his team grew and matured, he expanded the scope of its ventures and focused on developing economies of scale in his organizations. Zipf became responsible for an important part of the Bank’s business systems research and development effort. As a manager of technological innovation, Zipf was totally devoted to the success of the technological products his teams engineered and he controlled the team’s activities by setting strict time schedules and continuing to demand practical, economical, workable solutions.

Maestros are able to achieve exceptional results because their team members respect them and trust their business and technological judgment. High level executives also trust their judgment. Arthur Squires coined the term “maestros of technology” in his book on managing technological change: _The Tender Ship_ (1986). Squires maintains that many successful technological projects, such as the Manhattan Project, were led by such maestros. He also observes that many failures, such as the U.S. Army’s M-16 rifle, can be traced to the fact that no one played this crucial role. It is the role that, increasingly, high level chief information officers play today.
Figure 1. Three Key Roles.
Supertechs

The third key role is fulfilled by the team members themselves. It includes those who do the detailed managerial, technological and systems analysis necessary to bring a major innovation to fruition. A well-functioning team unfreezes old thinking and develops new procedures and functions that take advantage of the speed, reliability and other attributes of emerging technologies. These teams frequently are comprised of several unsung players who, in the process of searching for a DD, make many important contributions to the firm’s technology and systems. They form new concepts and ideas, develop subsidiary innovations, and solve many new technological problems as they are encountered. These various and sundry solutions—evolutionary innovations—are necessary to bring a radical innovation into being. In successful organizations, these managerial and technological practitioners are committed to achieving the vision of their leaders. All of the firms studied developed effective MIS organizations or, as they were frequently called then, “data processing” departments. The firms populated them with competent technological personnel. Every so often, however, one or two stood out and came up with particularly inventive solutions to what appeared to be “show stopping” technological problems. Jim O’Neil at American Airlines calls these exceptional technicians “supertechs.” Each of the organizations studied had one or more technological people who at crucial moments contributed significant technological solutions, concepts, and ideas for their organizations’ systems. Harry Kahramanian at the Bank of America stands out especially.

One of the crucial roles maestros play is to recognize the talents of their team members and to value the ideas and innovations originated within the team. Effective managers of technological innovation support the development of these ideas and weave them together to form an overall vision that is understandable to senior executives. This vision is grounded in a sound technical design, one that can produce cost-effective systems and major business innovations. This vision then becomes part of the executives’ strategic vision.

Negotiating the cascade: phases of IT innovation

Executive champions and maestros work together to formulate or to recast the firm’s strategy and specify its goals and objectives. The Bank of America’s original business philosophy, for example, was based on A. P. Giannini’s “pushcart marketing” principles and resulted in the first major retail bank. This meant that the bank handled a lot of small accounts with comparatively high check and deposit volume per account. Faced with explosive growth forecasts for the post World War II California market, leader Clark Beise foresaw a crisis. He and maestro Al Zipe, working together, were able to translate this philosophy into a new, viable business strategy, one that included automation as a solution to burgeoning volumes of transactions and mounting problems of hiring and retaining a young, predominately female, clerical labor force. These opportunities and crises are the starting point for an historical pattern called the “cascade.”

The cascade is a conceptual framework developed to describe recurring events across the six histories. As suggested earlier, historians are faced with a methodological dilemma. On the one hand, the evidence, and not an a priori theory, must drive their inquiry. On the other hand, some minimal theoretical concepts are required to focus questions and to gather and organize evidence. In our view, the evidence must ultimately dominate, but a few initial concepts—“ideal types” to use Max Weber’s term—can be extremely useful as the research proceeds (Shils and Finch 1949).

The concepts of the dominant design and the three roles and the five steps of the cascade are Weberian ideal types. They were constructed hypothetically from empirically observable or historically recognized component elements and then used to make comparisons and to develop theoretical explanations. They are used primarily to reveal the similarities and
differences between the historical case and the ideal type. It is important to note that ideal types are not capable of proving a model from historical facts, but they are very useful for suggesting motives and forces that were influential in historical processes.

The provisional framework that follows emerged during the research and evolved as it proceeded. It has been used to help identify the roles people played in the studies and to understand some of the dynamics at work. The broad outlines of the framework begin with a simple premise: Business histories—and hence MIS innovation histories—of the use of information technology in organizations can best be understood in terms of the actions taken by one or more purposive agents—especially leaders, maestros, and supertechs—operating within a socio-economic environment. These agents’ actions, working in conjunction with other factors, help to produce the effects observed. As long as the environment is perceived by these agents as beneficial, they will see no need to change. When they perceive the business environment as threatening—that is, management crisis is imminent—or when they see it changing in important dimensions which create new opportunities, these agents will be motivated to innovate and seek a dominant design. This quest generally unfolds in five steps (see Figure 2).

Crisis or Opportunity

A lack of beneficence can arise from the agents’ perception that they will fail to meet their goals and expectations, creating a sense of urgency. They may then become Schumpeterian entrepreneurs and destroy the present organizational arrangements by adopting new technological innovations. In the process, some of the firm’s existing markets likely will be cannibalized as the industry as a whole is launched on a new course. These innovators begin by examining various alternative technologies with the intent of replacing those that form the organization’s existing technological core or infrastructure (Thompson 1967). They seek new designs that take advantage of the improved information processing capability provided by new information technology. Adopting these designs requires creating a new infrastructure, a new organization, and an overall plan to cope adequately with the perceived management crisis. Implementation of the new design initially changes the internal structure of the organization and then its effects are promulgated into the external competitive environment. If they are successful, they will eventually arrive at a dominant design.

Several factors can influence this sense of urgency including (1) anticipated rapid growth in markets beyond the handling capacity of existing organizational technology and infrastructure, (2) shifts in consumers’ tastes, (3) increased competition due to oversupply, and (4) the anticipation of radical changes in process technologies. The impact of these factors will be felt in many different ways. Among them are:

- increased competitive activity,
- increasing volume of transactions,
- a greater number of distinct organizational entities to manage,
- more activities distributed over a greater geographical area,
- increased variety and complexity in the business,
- demand for faster and more timely operations, and
- demand for increased quality, accuracy and precision in operations.

Solving any or all of these problems requires better information systems.

Each of the historical cases begins with a situation that might be described as a management crisis. The business environment at the
CRISIS

1. SEARCH FOR TECHNICAL SOLUTION

2. INITIAL TECHNOLOGICAL SOLUTION

3. ADJUST ORGANIZATIONAL STRUCTURE

4. ASSETS FORMED WHICH RESOLVE CRISIS
   → COMPETITIVE ADVANTAGE

5. DOMINANT DESIGN

Figure 2. The Cascade
time posed a threat but it simultaneously offered an opportunity. In banking during the late 1940s, the crisis stemmed from the growth in volume of check writing and other banking services. This resulted in a rapidly growing cost of transaction processing, increased labor costs, and substantial turnover problems. There was also a need for better management information to control loans and deposits. This was the crisis to which the Bank of America responded with its innovation: ERMA.

Initial Technological Solution

The availability of new technological opportunities can either be rich or limited depending on two things: (1) the state of scientific research and technological development available to the firm and its industry and (2) the connections the firm has made to these sources of technology. (In many contemporary organizations, this later role is often played by a firm's emerging or advanced technologies group.) In each of the studies, the industry's traditional vendors were not offering products and services that adequately satisfied the company's needs. Consequently, these firms sought out and entered into agreements with other organizations in order to develop mutually the technologies necessary to help them solve their managerial crisis.

Just like Douglas and Ford, executives at all six of the firms studied tried many different kinds of technological solutions to the problems they faced. The Bank of America engaged in extensive research with SRI and internally in order to identify potential solutions. Each of the successful firms studied invested heavily in developing its body of competence. The typical time span for building a reservoir of IT competence at Bank of America was three to five years. The bank had to nurture the invention of a new means of sorting checks before they could move ahead with the innovation. It required at least five years for the Bank to develop the total competence necessary to move the firm beyond its existing paradigms. Sometimes it was necessary to develop or import new complementary assets in order to make the IT innovation work. The Bank of America and SRI, for example, had to develop new kinds of paper and ink in order to make their checking and sorting equipment work effectively. A key outcome of this "trial and error" period was that they came to understand their business problem and its technological dimensions more deeply. This prepared them to embark on a radical innovation.

Typically, in the case of IT innovations, the initial system will undergo several mutations over several years before a robust and dominant design emerges. A firm's ability to select an appropriate option from among its set of possibilities is conditioned, in part, by its financial status, its cash flow, its ability to raise capital by means of debt or equity financing, and its willingness to take risks. Consequently, capital investment decisions and policies with respect to technology are also important themes in a firm's IT history. At Zipf, had to prepare and defend IT proposals for major capital investments to the Bank of America's board of directors. These financial considerations materially affected the contents of the projects he proposed. But the most significant factor is that, at the point at which crucial investment decisions had to be made, the leader—Beise—found a way to come up with the substantial funds required.

Adjust the Organizational Structure

Leaders must also seek alignment between the strategies they formulate, the technologies they deploy, and the organizational structures they create. The full realization of benefits often requires a major reorganization. To cite one example, the introduction of ERMA eliminated 30,000 clerks while, at the same time, creating 12,000 new computer-related jobs and 15,000 new marketing service positions. The total training cost was never fully measured. It was estimated, however, to reach at least a third of the total expenditures made for computers. Similar organizational changes and expenditures were required at each of the sites. All of these changes must be managed effectively. On the surface, the design appears
to be simply an installation of hardware running newly developed software. But these are ineffective unless they are accompanied with new business policies and procedures and major changes in job definitions, authority and responsibility relationships, and other key dimensions of the organization's structure.

Assemble the Complement of Assets Necessary to Solve the Crisis and Thereby Generate Surplus Economic Rents

The collective state of the firm's assets at the beginning of an historical episode—including its knowledge, practices, collections of information, technology, people, and structure—forms a kind of socio-technical web which describes the reality of the business at that point in time. The compactness of the web determines the level of corporate coherence. Either the factors are in tight alignment and working well together—that is, they are highly coherent—or they are loosely and tangentially related, in which case the firm is in poor alignment (see, for example, Dosi et al. 1990). The web also provides continuity and stability to the firm's product portfolio and to its operations, administration, and image. This is both a source of strength and weakness because the tightness of the web is a source of the firm's natural tendency toward "dynamic conservatism," as described earlier. If a new strategy is to be realized or if new technology is to be adopted and utilized, the entire web must be manipulated and changed in a logically consistent, coordinated, and compensating way. The leaders and maestros in this study intuitively understood this. All of the organizations studied achieved a DD because their leaders were willing and able to creatively destruct their old webs. They accompanied this radical technological innovation with substantial, if not radical, organizational redesign.

A statement of the state of overall coherence of a firm at a particular point in time becomes the launching point for historical analysis. At this point, the analysis turns from static to dynamic. The histories presented here then describe the actual or impending intrusion of new information technology into the web and trace the unfolding of change as new situations are encountered and as fresh ideas are generated. As change is initiated, a range of resistance is met as members of the organization strive to maintain the status quo. This inertia must either be overcome or tolerated, otherwise the project will fail. This is especially true of IT innovations which profoundly change the organizational structure and reconfigure its infrastructure. Whether the change is successfully implemented or not, the firm's state of coherence is irreversibly changed. Once a firm has reached this point, the benefits of its innovations begin to be realized. In classical economic terms, the innovation becomes a factor of production that cannot be reproduced at will by the firm's competitors and, therefore, it is in imperfectly elastic supply. This state results in surplus economic rents or profits, the presence of which gives the firm a competitive edge and encourages competitors to adopt or imitate its design.

Reach the Dominant Design

If a firm successfully negotiates the first four phases of the cascade, it should reach the stage at which it has a dominant design. Its DD becomes the industry standard and its competitors rally to develop comparable systems. Competitors "can and will follow [the DD innovator], first as individuals and then as whole crowds" (Schumpeter 1934, p. 81). Sometimes, as happened with the Bank of America, the competitors are eventually able to exceed the performance of the original innovator and push the industry toward an even newer DD. In other cases, such as the computerized reservation systems business, a hard fought battle ensues in which the leader must continually innovate in order to maintain its initial DD advantage.

Applying the Provisional Framework

The various ideal type concepts in this provisional framework suggest one possible, broad plot line for presenting an IT-based business
history. The story line is a description of the actions and decisions made by the leader, maestro, and supertechna as they design, introduce, and consolidate a new IT infrastructure. The plot line goes as follows:

A group of purposive agents—leaders, maestros, and technologists—face a managerial crisis in their environment. They start out with an existing infrastructure of business practices, information flows, information technology, people, and organizational structure. The firm also has an initial collection of competencies. The firm’s initial infrastructure is the base of competencies that must be employed to implement and operate successfully in the new environment. The team of IT innovators are motivated and empowered to question all aspects of the existing dominant design and infrastructure. A set of roles is developed which includes a senior group that has an ongoing discussion on the vision and maintains and communicates that vision throughout the organization. There is another group led by the maestro that marshals resources and competent individuals to design, test, and accumulate experience on the potential of IT for the organization. When sufficient experience has been obtained and the design formulated, this group must then develop a program for development and training in order to create the new system and to prepare the organization to operate employing the IT infrastructure.

One role of the visionary group is to frame alternative approaches to implementing the proposed system and to pose innovative options to the leader. The tradeoffs typically turn on the amount of resources to allocate to each of the varying functions and the setting of attainable delivery dates. The final choice is influenced by the firm’s selection process for identifying and financing new investments. Typically the leader conducts this discussion on tradeoffs and investments and sets the pace and form of development. The final result is a set of complementary assets, technological opportunities, and selection processes that shape and constrain the firm’s possible destinies.

The firm’s decision to innovate and move toward a new dominant design sets two forces into action. One is active resistance to change within the organization in the many forms it may take. The other is the emergence of concrete technical and managerial obstacles that must be overcome. These obstacles present new opportunities for organizational learning. Their successful negotiation results in new competencies within the firm. In the process, knowledge is gained about how resistance is dealt with and how learning is accomplished within the firm.

The outcome of these activities results in a new coherence among the firm’s ensemble of knowledge practices, information, technology, people, and structure. Success in this alignment process again leads to increased competence. As the firm becomes more competent, it gains competitive advantage. It begins to improve its market share, revenue, and profit.

Then, very likely, in Schumpeterian style, its competitors respond. Competitive reactions take the form of emulating competence or advancing to a higher state. If the competitors are relatively unsuccessful (that is, if the firm’s first mover advantage is sustainable), the firm gains a dominant market share thereby changing the competitive nature of the industry.

If, however, the competitors are successful with their new technological innovations, the basis of competition in the industry also will be altered. In effect, a new playing field is created. As a consequence, the new technological solution will become part of the necessary investment a firm must make in order to survive in the industry. In the terms of industrial economics, a “barrier to entry” will have been erected (Porter 1980). In the process, the industry will be redefined.

At the Bank of America, the general outline of this plot was played out. The ensembles and complementary assets that the Bank exhibits today are radically different from what they were in 1950, 1954, 1956, 1958, 1964, or 1969 when it embarked upon various episodes of technological change. Moreover, the Bank’s overall economic structure changed materially as its dominant design became manifest.
Contributing to the Transcript

History, the American poet W. H. Auden contends, "is, strictly speaking, the study of questions." Historians seek to study questions of social continuity and change by analyzing events and contemplating data gleaned from a wide variety of empirical sources including remains, records, and recollections. This approach is not new to management in general. Studies of historical questions about management have been conducted by scholars (Chandler 1962, 1977, 1985, 1990; Porter 1980, 1985, 1990; Tedlow 1990). In parallel, economists and other management scholars have studied the historical use of technology as it affects markets (Burgelman and Rosenbloom 1989; Nelson and Winter 1982; Rosenberg 1972, 1982; Teece 1986). The driving question in these lines of research has been "What are the major factors that shape markets?" Each of these disparate efforts have reached much the same conclusion: technological innovation. Markets and basis of competition in an industry are changed—sometimes radically—by the decisions managers make when they select and invest in technology. The Bank of America study and the others in the series took their answer as a given and posed another: "What were the managerial processes that led to successful innovations (defined as a dominant design)?"

Recent developments in MIS research provide evidence that is relevant to this finding. Over the last decade or so, a rather strong link has been established between effective corporate strategy development and use of information technology (IT) as a competitive tool. Table 1 lists a few selected studies of this genre.

These studies establish the fact that information technology, when it is employed effectively, contributes to a firm's strategic performance. They do not, however, describe in detail the underlying processes, such as the

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cascade, nor the roles, such as leader, maestro, and supertech, by which it is realized. These studies provide evidence that a firm achieved strategic success as a result of employing IT and often observe that the industry was changed as well. But this evidence is not interpreted within the lens of an ideal type such as the concept of a dominant design which adds clarity and tractability to the notion of “success.” Some studies—such as the Ketlinger et al. (1994) industrial organization-based study—gain scientific rigor by employing methods of discriminant analysis and similar statistical methods in order to identify the factors that contribute to strategic performance and sustainability. That very rigor, however, precludes a fuller examination of the underlying dynamics. None fully reveal the dynamic—often dramatic—competitive, organizational, and management processes that account for these factors and give them life. The historical plot-line, described above, serves to augment this more statistical type of analysis and places it in more dynamic relief.

The effects of technological decisions unfold over long periods of time, typically measured in decades. They also are often the results of actions taken by a comparatively few key people. This is why, following Schumpeter, we believe that historical methods are appropriate for studying strategically motivated IT-based innovations in firms. Schumpeter challenged the prevailing economic belief of his time: the assumption that price competition was the primary means of achieving a long-run, perfectly competitive, economic equilibrium. Reality, he observed, is much murkier than that and “...into this state of synchronized adjustment an innovation intrudes” (Cleemans and Doody 1951, p. 9). The economic forces with the most significant consequences, thus, are innovations—breaks with the past—introduced by entrepreneurs who, in turn, are stimulated by competition, which demands a decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of existing firms but at their foundations and their very lives (Schumpeter 1942, p. 81).

The impacts are far-reaching because the entrepreneur has also triumphed for others, blazed the trail and created a model for them which they can copy. They can and will follow him, first individuals and then whole crowds (Schumpeter 1934, p. 138).

Schumpeter’s ideal type of a solitary entrepreneur fractionated into a trio in our work: leader, maestro and supertech. Nevertheless his notions have guided our research agenda for the past decade (see the Appendix). Our objective has been to draw an historical map of some important past IT innovations and the people who brought them about. In the process, we sought to understand better the nature of IT in organizations and to identify the managerial decisions, policies and roles necessary to sustain a successful IT strategy. This inquiry is driven by the following Audenian questions:

- Why have a few firms consistently led their industries in the use of IT, some in the early stages as a technological innovator, others, more recently, as the result of a planned effort to seek competitive advantage?

- Why have some early leaders slipped from their once dominant position and subsequently remained “runners up”?

- Why have some firms, which have spent millions of dollars and still are striving to improve their technological base, achieved only modest success?

- What are the necessary conditions and actions required to develop and to maintain a sustainable competitive system?

In pursuit of answers, a series of historical studies designed to describe the decisions and actions leading up to the IT innovations in a few selected, key firms and industries and the results obtained have been undertaken. So far, six firms that have used IT to change their industries and improve their competitive position---Bank of America, American Airlines, American Hospital Supply, Baxter, Trevenol, USAA, Frito-Lay and Federal Express—have been studied. Three of the firms---AA, FedEx,
and AHS/Baxter—were found to be strong sustainers of market share and profitability (Kettinger et al. 1994). All, with the possible exception of Bank of America, which won and lost its competitive advantage before it became fashionable to study it, are mentioned prominently in the IT for competitive advantage literature. Beginning as early as the 1950s, our studies trace developments in these firms from the point of their launch of a strategic system up to the present day. A summary of the results are reported in Waves of Change: Business Evolution through Information Technology (McKenney et al. 1995) and in a series of historical reports (McKenney 1992; McKenney and Weaver-Fisher 1993; Weaver-Fisher and McKenney 1993). The accompanying article, “Bank of America: The Crest and Trough of Technological Leadership,” illustrates the historical approach in application.

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James L. McKenney is Professor of Business Administration Emeritus, Harvard University, Graduate School of Business Administration. Professor McKenney received his B.S. in mechanical engineering from Purdue University in January 1952, his M.S. in industrial engineering from Purdue later that same year, and his Ph.D. in business administration from UCLA in 1960. He came to Harvard
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McKenney’s research interests focus on managing the implementation and growth of intelligent terminal communication systems, knowledge-based systems. He is presently conducting a multiyear study on the impact of information technology in the grocery industry. To date, he has finished five cases on the grocery chain of supermarkets, distributors, and producers and will continue studying the implementation of ECR in the industry. His professional interests focus on concluding two research papers on management of IT as a competitive means.

Richard O. Mason is Carr F. Collins Professor of Management Information Sciences at the Edwin L. Cox School of Business at Southern Methodist University where he teaches information systems and business ethics. Formerly a vice president and council member of The Institute of Management Sciences and a department editor for Management Science, he began his career in the computer industry with the Burroughs Corporation in 1956 after graduating from Oregon State University. While at Burroughs, he helped found an OR study group in Portland, Oregon, centered around a B-205 installation at Pacific Power and Light. Ernest Koenigsberg gave one of his early lectures on inventory theory to the group. During the mid 1960s, he studied operations research under C. West Churchman at the University of California, Berkeley. He has taught at UCLA, USC, and the University of Arizona. In 1992, he was elected as a foreign member of the Russian Academy of Natural Sciences in the Information and Cybernetics section. He is a co-author of Waves of Change (1995), Framebreak (1994), Challenging Strategic Planning Assumptions (1981), Strategic Management and Business Policy (1982), Measurement for Management Decision (1981), and Ethics of Information Management (1995).

Duncan G. Copeland is president of Copeland & Company, a Washington-based international consultancy providing information counsel to management. His research focuses on information-based competition, specifically the alignment of business strategy with information systems strategy. In addition to academic articles on the topic, he co-authored Waves of Change: Business Evolution through Information Technology (with J. L. McKenney and R. O. Mason, Harvard Business School Press, 1995). He holds a doctorate from the Harvard Business School and an HBA from the University of Western Ontario.
Appendix

The Harvard MIS History Project

During the academic year 1983–84, the Harvard University Graduate School of Business Administration celebrated its 75th anniversary. One of the events was a research colloquium entitled The Information Systems Research Challenge (McFarlan 1984b). Following the success of the colloquium, members of the Harvard Business School faculty decided to continue exploration into several key areas of research identified as important during the colloquium. One expressed concern was the need to develop an historical tradition in MIS research. It was decided that several exemplary IT-based business histories would be conducted in order to demonstrate the effects of investments in information technology and systems on companies, industries, and society and to develop methods and procedures for undertaking these studies.

In the spring of 1988, the Harvard MIS History Project was initiated to address these concerns and a team was formed comprised of individuals who had been active in technology since the 1950s. The project is coordinated by James L. McKenney, John G. McLean Professor of Business Administration at the Harvard Business School. Other members are:

- Richard G. Canning, former editor, founder, and publisher of EDP Analyzer, formerly with IBM, the Naval Air Missile Test Center, UCLA, and author of five professional books;

- Walter M. Carlson, member of the original UNIVAC installation team at DuPont, also formerly with IBM and the Department of Defense, past president of ACM;

- Duncan G. Copeland, formerly assistant professor at the University of Western Ontario and co-author of historical studies of American Airlines, now president of Copeland & Company;

- the late Philip H. Dorn, independent consultant, formerly with General Motors Research Laboratories and Union Carbide, on the editorial board of several journals, holder of a number of positions with ACM;

- George Glaser, independent consultant, formerly of McKinsey and Company and Centigram Corporation, served as president and chairman of AFIPS and chairman of the National Computer Conference Board;

- Richard O. Mason, Carr P. Collins Professor at the Edwin L. Cox School of Business, Southern Methodist University; and


Amy E. Weaver-Fisher served as the initial research associate for the project.

The Team met as a group several times a year from 1988 to 1995 to discuss results, plan for future data-gathering activities, and develop a shared concept of the processes of IT-based innovation. Between sessions, team members conducted interviews, gathered data, performed analyses, and wrote and edited reports. At the first meeting, it was decided to undertake four major studies. These
were (1) the Bank of America and impacts on banking, (2) American Airlines and impacts on the airline industry (this study extends the earlier work done by Copeland and McKinney 1988), (3) American Hospital Supply and Baxter-Travenol and impacts on the medical supply industry, and (4) the U.S. airframe industry focusing initially on North American, Northrop, Douglas, Lockheed, and other Southern California basin firms and moving through the rest of the country. The first three of these studies are complete. Subsequently, studies were completed at USAA and Frito-Lay. A study at FedEx was also recently completed.

During the research, the need to develop a methodology for doing MIS historical research was identified. The papers in this issue of MIS Quarterly are an outgrowth of the investigations and experience with MIS historiography.