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"Room at the Top"?

The Failed Institutionalization of Management Information Systems[*]

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ABSTRACT

In an analysis of data on the failed institutionalization of a top management position for Management Information Systems (MIS), among 430 large American public companies between 1964 and 1994, I find an effect of both rhetorical advocacy for MIS and technological change. While factors associated with functional demands for MIS can explain some of the variance in the diffusion of MIS positions among corporate offices, media promulgation of MIS, the rise and fall of strategic planning, and the steep rise of microcomputer use affect the adoption pattern over time. The likelihood for office creation varies with the extent to which management knowledge entrepreneurs promulgated MIS as a fashion. In the 1980s, public support for MIS began to fade. Data processing experts proved unsuccessful in sustaining top executives' interest for this organizational technique. MIS had aroused top management attention through an emphasis on the benefits of computers for strategic planning. When executives' interest for strategic planning waned, so did MIS. Tying the MIS concept closely to the use of mainframe computers, MIS propagators underestimated the threat posed by the diffusion of decentralized computing in corporations. The advent of PCs at the workplace had a significant negative effect on the propensity for a firm to create an MIS office. The paper adds to new institutional theory by exploring the conditions under which the institutionalization of an organizational form fails.

INTRODUCTION

What factors help explain why the institutionalization of a new organizational form fails? In 1964, none of a sample of large corporations had a vice president for management information systems (MIS). By 1985, nearly 10 percent of all companies in the sample reported a vice president for MIS. By 1994, though, this share declined to only 5 percent. Historical evidence shows that the rise of data processing managers from middle management to the top of corporations is tied to the growing utilization of mainframe computers. Hardware vendors, consulting firms and academics aligned with middle managers in corporations to champion the diffusion of MIS. The concept of "management information systems" was developed in order to centralize the corporate information flow with the use of computers. In particular, it was tailored to top management as an organizational tool for strategic planning and decision-making.

Executives at the top of corporations have been the focus of much investigation by strategy and organizational scholars alike (e.g., Finkelstein and Hambrick 1996; Hambrick and Mason 1984; Guthrie, Grimm and Smith 1991; Kesner and Sebora 1994). From a new institutional perspective, top management offices are important building stones for organizations elaborating their formal structure (Edelman 1992; Meyer and Rowan 1977). The creation of a new top management position enjoys high visibility among internal participants and external constituents because corporate managers are like 'glitter balls on the corporate Christmas tree.' Extending arguments from contingency and resource-dependence theory, scholars have speculated that organizations are likely to decouple their formal structure from their actual operation. By adopting certain organizational procedures or ceremonies, organizations signal conformity to institutionalized conventions. Thereby, they attain legitimacy within their wider environment and protect themselves from legal or

other threats. Institutional pressures toward isomorphism may result from the work of consulting firms spreading organizational prescriptions across the corporate landscape and from the education and networking of professionals (DiMaggio and Powell 1983).

The diffusion of nowadays widespread organizational forms and procedures is well studied empirically (e.g., Burns and Wholey 1993; Davis 1991; Fligstein 1985; Galaskiewicz and Burt 1991; Galaskiewicz and Wasserman 1989; Haveman 1993; Mezias 1990; Sutton et al. 1994). Much less is known about cases of failed institutionalization (Fligstein and Dauber 1989). This has been attributed to new institutionalists' bias toward organizational stability rather than change (Powell 1991; Røvik 1996) and to the limited attention devoted to the impact of power and interests on organizational continuity and change (DiMaggio 1988; Oliver 1991). In order to remedy the preoccupation with stability, theorists developed propositions concerning the deinstitutionalization of organizational forms, arguing that the persistence of institutional forms is less common than new institutional theory suggests (Oliver 1992; Zucker 1988), contending that stability and persistence of organizational forms demand an explanation (Scott 1995: 79).

In this paper, I examine the rise and fall of a particular organizational prescription—top executive positions for management information systems—over 3 decades in a sample of large-sized American corporations. I seek to specify how changing advocacy of MIS in managerial discourse and the advent of decentralized microcomputers at the workplace translate into organizational change. I do this by investigating job titles of corporate managers indicating responsibility for MIS.

I find that creation of a top management position for MIS was positively affected by the extent of promulgation of MIS through management journals. Second, I find that the likelihood for adoption of an MIS top management position is associated with the

simultaneous adoption of a strategic planning office. It appears that companies that decided to improve their strategic planning were much more likely to undergo a wider corporate restructuring and create a vice presidential post for MIS. Third, I find that the rise of decentralized use of computers at the workplace has a negative effect on the likelihood of MIS office creation. I argue that this is the case because the PC posed a severe challenge to the professional status of data processing specialists.

I begin with a brief history of the emergence of the MIS concept. Second, I illustrate the rise of data processing specialists in the corporate hierarchy. Next, I discuss how MIS was manufactured as a managerial fad. I then develop hypotheses how public advocacy for a managerial technique and technological change matter for organizational change. I introduce alternative explanations and control variables. In the data analysis, I model the adoption of a top management position for MIS among a sample of 430 large public corporations, over the period 1964-1994. I find that business press coverage and the adoption of strategic planning office show a positive effect, and PC use shows a negative effect on the adoption of an MIS executive position.

FROM EDP TO MIS: THE STRUGGLE FOR CONTROL OVER INFORMATION TECHNOLOGY

The Emergence of MIS

Below, I provide a brief historical overview of the use and management of data processing technology in business. The first applications of computers in business were to replace human labor in routine work. Growing managerial concern about the cost of computing technology prompted data processing specialists to search for alternative justifications for investments. I show that the MIS prescription suited the professional needs of these middle managers well because it sought to extend the utilization of computers to top management.

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The early use of computers in corporations in the 1950s and 1960s was largely confined to the replacement of human employees in standard, labor-intense work procedures like payroll processing, customer billing and stockholder records (Dearden 1965: 65). The adoption of computers was predominately motivated by attempts to reduce clerical costs. Middle managers for data processing could justify these investments to top management in a straightforward way (Cortada 1996: 87). In many companies responsibility for implementing and maintaining electronic data processing equipment remained under the auspices of the accounting or finance department because they were the earliest users of the new technology (Gale 1968: 46; Gallagher 1961: 28).

Beginning in the late 1960s, data processing managers increasingly faced problems to convey the usefulness of their work to top managers. Despite overly optimistic forecasts disseminated by zealots of the new technology, cost savings rarely materialized or were difficult to ascertain (Strassmann 1990). Original investments often entailed subsequent, unexpected costs for servicing and hardware upgrades. As computer budgets started growing sharply, top managers called for better justification of further expenses. Surveys by consultants, industry associations and researchers testified to the growing resistance against buying more computing power without simultaneous gains in profitability of the same magnitude; see Strassmann (1990) for further references.

Data processing specialists were tired of constantly having to justify the necessity of technical investments. Furthermore, they were dissatisfied with very limited career prospects and with their role as scapegoats for failed projects (Nolan 1973). The concept of MIS emerged as a possible way out of a professional impasse.

The first known printed reference to the term "management information system" appeared in a 1958 publication by the Rand Corporation (Stoller and Van Horn 1958; cited

in Dickson 1981: 8). The term originated as a "merchandising 'gimmick'" that same year (SMIS 1970: 7). Acknowledging the increasing importance of digital computers, the *American Management Association* had started a new electronics system conference in its finance division. After some years of initial success, the number of attendees dropped to a low in 1958. Seeking advice from a consultant, the organizers concluded that the term "electronic" had to be avoided if the goal was to attract more corporate officers of high rank. Instead, "management information systems" was used extensively in the announcement for the 1959 conference in order to "raise a flag to call attention to management that they should come to New York and attend another seminar" (SMIS 1970: 7).

In contrast to standard data processing systems used to process routine transactions, the MIS concept was marketed as a computer-based means for providing information to support the operations, management, and decision-making functions in organizations (e.g., Davis 1974: 5). The label change to MIS indicated middle managers' "changing mission of EDP [electronic data processing; D.Z.] from simply crunching numbers and data to offering analysis and help in decision making" (Cortada 1996: 2). Likewise, in his study of professions, Abbott (1988) points to the role of MIS as a vehicle for the professionalization of information specialists. In his view, the promoters of MIS "proved heirs to the old cost-accounting, systematic-management, and operations research jurisdiction of telling managers what to do with their data. This invasion of the actual management area was accompanied, of course, by the sloughing off of associations with purely routine work like personnel records maintenance" (Abbott 1988: 244). With an emphasis on the benefits MIS could yield for top managerial tasks, this innovation promised to direct top management's attention away from a single-minded preoccupation with cost controlling. Expressing an understanding widely shared among promoters of MIS, James Gallagher, a McKinsey

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consultant, stressed that the purpose of MIS was not primarily rooted in the goal of clerical cost savings. "Therefore, those selling MIS to management have to make sure that management understands the benefits to be gained going beyond cost reduction" (Gallagher 1961: 22f). An early account pictures the emergence of MIS in the following way:

> Many companies rushed to obtain the new generation computer equipment, justifying the cost with vague notions of the potential services it would provide. […] Computer hardware and software expenditures mounted, and companies suddenly discovered that they had large investments in equipment whose over-all use had never been defined. They had a horse but no wagon for it to pull. They had complex, costly, and sophisticated data processing equipment, but no idea of how to use its data output. Management then asked: How can we use this equipment? Answers to this question had to revolve around the computer, and a computer-oriented management information system developed (Gale 1968: 45).

The development of MIS was hence largely technology-driven, rather than being based on an original demand for better information on the part of top management. Playing to top executives' desire to employ cutting-edge management technology, data processing managers praised the usefulness of MIS to support top management decision-making and strategic planning processes. That way, they hoped to implement the use of their technology firmly within the core of top managerial tasks.

The Rise of Data Processing Specialists in the Corporate Hierarchy

In this section, I show that along with a change in the scope of computer applications, the rise of MIS in the 1970s also furthered the professional status of data processing specialists. Faced with very limited career opportunities within their firms, middle managers for data processing considered MIS a vehicle heralding a gain of status and legitimacy in the corporate hierarchy. By attaching their professional identities to the advancement of MIS, many data processing specialists expected to pave their way into the top management team.

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As a means to increase top management's awareness of the potential of electronic data processing beyond standard applications, MIS theorists suggested companies create a vice-president position to coordinate information technology efforts at the corporate level (Dearden and Nolan 1973; Diebold 1964). "Room at the top for the DP manager" was the title of a survey article published in the professional journal *Datamation*, representing a popular concern with career paths of data processing specialists (Greene 1976). An article in the *Harvard Business Review* contended that "[t]op management cannot afford to ignore EDP management as a valuable source for senior managers. […] Companies must offer a pathway for advancement beyond the department" (Nolan 1973: 147). A McKinsey consultant noted that

> the increased interest on the part of management in data processing and the increasing use of these systems for management information purposes will have the effect of raising the systems-data processing activity in the organization. Not only have several companies elevated this function to director level and incorporated it in a management services department on the vice-presidential level, but several other firms have even made the systems-data-processing manager a vice president. […] Judging by the active interest displayed by many top executives, there is every indication that this represents a trend which will be followed by many other firms (Gallagher 1961: 55)

MIS advocates linked this prescriptive call for an MIS top office to the idea that the management of data processing must no longer be confined to the realms of a particular subunit. Because MIS comprises an exhaustive system cutting across compartmentalized, functional structures of a firm, a low-rank functional specialist did no longer suffice to supervise it. Rather, responsibility had to be exercised on a centralized (corporate) level (Gallagher 1961: 28-29; Myers 1967a: 9). As long as the data processing manager was still

formally housed within the finance or accounting department, the management of

information systems would remain biased and ineffective (e.g., Daniel 1961; Diebold 1964).[1]

The rise of data processing managers to the level of vice presidents coincides with the

changing mission of mere data processing to management information systems (cf. Greene

1974; Grumhaus 1986; Myers 1967b for surveys). Business historian James Cortada notes

that "[e]vidence abounded on the conditions that forced an increasingly larger number of

managers to pay attention to data processing. DP managers were no longer first- and second-

line managers but rose to the rank of executives, often as directors and vice presidents, and

of MIS rather than of electronic data processing (EDP) or of DP" (Cortada 1996: 205).

These observations also receive support from the data used for the present paper. In

1964, only one percent of all companies in my sample had a vice presidential officer for the

management of data processing. None of these managers' titles referred to management

information systems. Only in 1968, the first company assigned top management attention to

MIS. By 1985, nearly one out of 11 companies had elevated the MIS prescription to the

level of top management by creating a new position in the executive team.[2] From 1980 to

1985, on average more than 5 firms added an MIS position to their top management team

each year. Yet, the chart also shows that a significant dismantling of offices took place after

1985. Thus, at the end of the observation period, the percentage of companies with an MIS

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[1] Not all consultants, though, believed that a rise in status necessarily was a decisive factor for a successful deployment of computational resources. In an assessment of past failures in the implementation of information technology, McKinsey consultants state that "[w]e found no evidence, statistical or otherwise, to suggest that high organizational status assures effective performance on the part of the corporate computer staff" (McKinsey & Company 1969: 33).

executive position is reduced by half, in spite of a general trend toward more information-technology related corporate offices.[3] That is, prevalence of top corporate offices for the management of information technology other than MIS nearly doubled between 1986 and 1994, rising from 7 to 13 percent of all firms.

Writings by business school professors and management consultants from the heyday of management information systems tend to presume the presence of managerial need for better information as a pull-factor for technological development and investment (e.g., Nolan 1982). In contrast, I am suggesting that data processing experts in firms actively sold MIS to top management as a response to their difficult professional situation. Often, those who developed and advocated MIS did not even possess a good understanding for the true informational requirements on which managerial decisions are based (Dearden 1964; Dearden 1972).

Management Fashions and Organizational Change

I start out with a brief review of new institutional theory's general take on organizational change. I argue that attention to the institutional actors promulgating managerial fashions helps to understand instances where institutionalization of organizational forms fail.

In classic accounts of organizational innovation, organizations choose to adopt organizational forms for efficiency reasons. Organizations freely and individually make

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[2] I examined whether those companies appearing to create an MIS office were just providing a new label to a top management position that had already existed in the past. This is true for only 5 companies, all of which renamed a vice presidential office for information systems into MIS. For all other companies, the introduction of the MIS label coincided with the elevation of the position into the top management team.

[3] The decline of corporate top positions for MIS is associated with both a decrease in the number of adoptions and an elimination of top management oversight of information technology among those companies who had adopted an MIS position in the past. Only in 5 cases companies just abandon the MIS label to denote this function by renaming the office into "information systems" or "data processing," respectively.

decisions regarding structural change and they are fairly certain about their own goals and the means to achieve those goals. For instance, when a firm diversifies into a number of distinct markets, it will adopt a management function to coordinate the information flow at the corporate headquarter. Scholars have challenged the view according to which only efficient structural forms diffuse among corporations, pointing to institutional forces impinging on firms to adopt a particular organizational form (DiMaggio and Powell 1983; Meyer and Rowan 1977; Baron, Dobbin and Jennings 1986; Edelman 1992).

While there have been manifold attempts to examine the process by which institutionalized forms have spread (Burns and Wholey 1993; Davis 1991; Fligstein 1985; Galaskiewicz and Burt 1991; Galaskiewicz and Wasserman 1989; Haveman 1993; Mezias 1990; Sutton et al. 1994) and, more recently, the life cycle of institutionalized standards (Scott and Meyer 1991), little is known about how concepts emerge as socially legitimized and meaningful prescriptions in the first place. In a study of the deinstitutionalization of conglomerate firms, Davis *et al.* find that besides regulatory changes encouraging firms to investigate alternative forms for growth, shifts in managerial discourse challenged the plausibility structure for the conglomerate organizational form. This cognitive shift legitimated corporate raiders to break up large conglomerates and subsequently sell off their profitable parts (Davis, Diekmann and Tinsley 1994). That is, organizational leaders draw on the prevalent discourse about management techniques "to communicate to organizational stakeholders that their organizations conform to institutional norms mandating the use of

those techniques" (Abrahamson and Fairchild 1999: 708).[4] Edelman (1992) reports that organizations employ legal terminology to name offices they create in order to signal compliance with legislative norms.

Building on new institutional theory, scholars have proposed a perspective that attempts to reconcile organizational stability with concepts of change. In this fashion, organizations draw on a multitude of organizational templates to experiment with them. The question of subsequent institutionalization is not decided before templates start spreading, but is embedded in a collective negotiation process among internal and external constituents. In this process, actors negotiate the fit between a set of actions and an organizational prescription. That is, rejection or institutionalization of an organizational form is determined while they are in use (Czarniawska and Joerges 1996).

In a manner comparable to the creation of aesthetic fashions, a coalition of powerful agents—consulting firms, professional organizations, management journals and business professors—plays an active role in selecting and whetting management's appetite for particular organizational models. By relying on these organizational templates, offered as "package solutions," managers reduce the risk of making a wrong individual choice (Kiesler 1997: 65).

The Spreading of the Fad

In this section, I begin by demonstrating that MIS was favorably embedded in a general surge of rationalist managerial rhetoric between 1955 and 1980. Next, I outline two

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[4] "Technical procedures of […] data processing become taken-for-granted means to accomplish organizational ends. Quite apart from their possible efficiency, such institutionalized techniques establish an organization as

channels by which fashion-setting agents disseminated the concept and propose two hypotheses. First, I argue that management journals constitute an important means to promulgate an organizational prescription. Second, I suggest that—due to the uncertainty involved in the use of technology—mimetic mechanisms helped spreading the fad.

Organizational stakeholders presume that the managerial arena is reigned by rational thought (March 1981). Under conditions of technological uncertainty, managers are particularly susceptible to follow organizational prescriptions championed by "knowledge entrepreneurs" (DiMaggio and Powell 1983; Abrahamson and Fairchild 1999). For their organizations to appear rationally managed, managers are inclined to use labels denoting technical means to accomplish conformity with the norms of rationality prevailing at a particular period.

With "management information systems," the data processing community offered a response that resonated with the prevalent managerial discourse and its demand for rational responses. The construction and subsequent proliferation of the term was embedded in a surge of rationalist managerial rhetoric between 1955 and 1980. Analysts of trends in management in the United States have identified several distinct rhetorical waves that swept the managerial discourse in the past (Abrahamson 1997; Barley and Kunda 1992). "Systems rationalism appropriated concepts from electrical engineering and computer science. Computer metaphors and 'systems thinking' became the lingua franca of endeavors as disparate as linear programming and organizational design" (Barley and Kunda 1992). The common theme that united the diverse camps was the metaphor of the organization as system (Abrahamson 1997: 497). Consequently, scholars emphasized the manipulation of

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appropriate, rational, and modern. Their use displays responsibility and avoids claims of negligence" (Meyer

organizational structures and decision-processes, and the systematic steering of

organizational processes. With respect to MIS, there was a substantial carryover of concepts

from cybernetics that informed its development (Dickson 1981: 6-7). In their analysis of

surges of rationalist and normative managerial discourse Barley and Kunda employ

"management information systems" among other terms to identify the period of systems

rationalism (Barley and Kunda 1992).

Business press coverage.—Embedding their prescription within this wider ideological

climate, the members of the fashion-setting arena spread their fad through various channels.

First, data processing managers formed a number of professional organizations, e.g., the

Society for Management Information Systems, founded in 1969. Its members were typically data

processing managers of medium and large-sized companies. Second, scholars began to

design academic programs and research agendas. A third, important means to engender top

management awareness to new managerial techniques was business periodicals (DiMaggio

and Powell 1983; Mintzberg 1979). As part of their activity, MIS promoters also founded a

handful of scholarly and professional journals largely devoted to MIS research. The most

important journals are *MIS Quarterly* and *Information and Management* that were both published

first in 1977 (see Dickson 1981 for a comprehensive discussion of professional activities of

the MIS field).

[Figure 2 above here]

Media attention paid to MIS in the business press shifted markedly. As figure 2

illustrates, coverage of MIS in management journals first rose quickly, and the began to

decline gradually. This is characteristic of other managerial fads and surges of discourse that

and Rowan 1977: 344).

scholars investigated in the past (Abrahamson 1997; Abrahamson and Fairchild 1999; Barley and Kunda 1992; Kiesler 1997; Shenhav 1995). The *Business Periodicals Index* (BPI) started indexing "management information systems" in 1963. In that year, 28 articles addressing this topic were recorded. The number of entries increased rapidly to a peak of roughly 160 publications in 1971. In the subsequent decade, moderate publication activity obtained. Since 1980, the number of indexed articles in the BPI has been in steady decline. At the end of the observation period, the MIS subject entry listed a mere 16 articles.[5]

The data support the idea that MIS is a managerial fad (Mintzberg 1979: 293). The renaming of the former *Society for Management Information Systems* into *Society for Information Management* in 1982 highlights the fact that by then, MIS advocates were facing diminishing foothold within the corporate world.[6] Members of the MIS community raised concerns about the fact that the MIS concept had been "oversold" to management (e.g., Schwartz 1970: 28-29).

Organizations base their decisions toward or against the adoption of a particular organizational form at least partly on the degree of popularity and legitimacy this form has in the eyes of the business press. I predict that the public attention to MIS will affect the likelihood of creation of a corporate office with MIS as part of its title.

> *Hypothesis 1: The chances for the adoption of a top management position for MIS are positively associated with business media attention paid to MIS.*

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[5] Note that all numbers are adjusted for fluctuations in the overall number of journals indexed in the BPI.
[6] The same can be said of MIS' advancement in academia; cf. Dickson (1981) for an evaluation from that period.

Adoption density.—New institutionalists contend that a mimetic mechanism obtains in situations where organizations cannot readily draw on a clear course of action.[7] Under conditions of uncertainty, managers tend to imitate organizational forms found in the environment. Organizational leaders may decide that the most adequate response is to mimic the behavior of those organizations conceived of as successful (DiMaggio and Powell 1983). Fligstein (1985) finds that the number of organizations in the same industry that adopted an organizational form in the past the likelihood of subsequent adoption by remaining firms in the industry. Haveman (1993) observes that organizations tend to follow the behavior of both large others and highly profitable other firms.

With respect to the implementation of MIS, Robert Head, then president of the newly founded *Society for Management Information Systems*, implicitly evoked the idea of mimetic behavior. "Most systems today are being supported by management, and company resources allocated to MIS development are based largely on an 'act of faith' with respect to system payout potential. The stated or unstated managerial motivation is often based on the systems accomplishments - or lack thereof - of the competition. The company that foregoes a venture into MIS may lose ground to its more ambitious business adversaries" (Head 1970: 23-24). Likewise, Cortada has observed that "executives all through the period of the computer tried to pay attention to the experiences of their predecessors, looking for patterns of effective behavior, 'rules of the road' with which to guide their exploitation of this technology. We moved from the creation of large data centers in tabulating departments to

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[7] DiMaggio and Powell note that the analytical distinction among normative and mimetic pressures toward isomorphism may not be matched empirically (DiMaggio and Powell 1983: 150). As I have pointed out in the discussion above, fashion-setting agents made skillful use of prevalent uncertainty with regard to the appropriate use of computing technology. Yet, because my variables differ substantively with regard to their operationalization, I include both of them in the analysis.

support accounting functions reporting in to vice presidents of accounting, to large division-independent MIS organizations in the 1980s and 1990s" (Cortada 1996: 189). Consulting firms were instrumental in furthering this mimetic effect (DiMaggio and Powell 1983: 151). Among the most important players who disseminated MIS in the corporate landscape were some of the major hardware vendors (IBM, Sperry Rand)[8] along with their own consulting services. Independent consulting firms such as Arthur D. Little and Arthur Andersen also advocated this organizational prescription (Abbott 1988: 244).[9] Hence, with regard to the adoption of an MIS executive position, I expect organizations to mimic the behavior of other firms.

> *Hypothesis 2: The density of MIS top management positions will have a positive effect on subsequent adoption by other organizations.*

MIS and Strategic Planning

Electronic data processing (EDP) had played a role mainly for clerical-level tasks such as data handling, report generating and to a lesser degree the monitoring of routine processes. Above, I suggested that in order to arouse top management attention for their concept, MIS advocates put the usefulness of their approach to the highest organizational ranks at the heart of their approach. MIS was praised as an essential tool for management planning and decision-making functions at the corporate level, especially strategic (or long-term) planning

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[8] Abbott finds that "[t]he place of the dominant vendors – in particular that of Hollerith's Tabulating Machine Company and its successor IBM – differs only in degree from that of the drug firms relative to the pharmaceutical profession, or that of the third-party payers to the medical profession" (Abbott 1988: 244-245).

[9] In fact, as Weber has recently pointed out, some of the large independent consulting firms owe major parts of their business to the fact that clients of the hardware-owned consulting firms were dissatisfied with the latter's aggressive selling of equipment. Because managers felt uneasy with the intermingling of hardware selling and consulting service, they happily switched to independent consulting firms promising impartial analyses (Weber 2000).

(e.g., Cortada 1996: 203). In his work, Herbert Simon had reinforced this optimistic belief in the applicability of computing technology for top management tasks: "The automatic factory will pretty much [...] run itself; the company executives will be much more concerned with tomorrow's automatic factory. Executives will have less excuse than they now have to let the emergencies of today steal the time that was allocated to planning for the future. I don't think planning is going to be a machineless function—it also will be carried out by man-machine systems [...]" (Simon 1965: 48).

Scholars have suggested several stage hypotheses to describe the expansion of computer utilization in corporations (Ference and Uretsky 1976; Nolan 1982). Ference and Uretsky suggest that the deployment of computers in firms advances from clerical and data compiling tasks to man-machine systems for strategy and long range planning (Ference and Uretsky 1976: 57). I thus expect that the existence of a strategic planning officer in the top management team makes corporate attention to the management of MIS more likely.

> *Hypothesis 3: The adoption of a top executive office for strategic planning will be positively associated with the likelihood of a simultaneous creation of a MIS position.*

The Microcomputer Revolution

In this section, I demonstrate that the advent of the microcomputer at the workplace undermined the MIS concept.

Beginning in the early 1980s, personal computers began to gain foothold in corporate offices. Data processing managers in firms conceived of this intrusion of decentralized, small computers as a threat to their professional exclusivity, because it provided laypersons with direct access to computational resources. "The microcomputer infiltrated corporations and came to give people power that was previously held by a technological priesthood" (Nat

Goldhaber, a partner at a venture capital firm, quoted in Markoff 1988)). Alerted by the advent of microcomputers, many DP managers conducted surveys of computing activities in their firms. They found that without supervision from the central data processing department, employees were spending up to the same amount as the official information technology budget for the purchase of decentralized computer systems (e.g., Fowler 1984).

In an attempt to defend their influence and status, data processing managers voiced their concerns about the looming decentralization of computer resources. While in retrospective accounts of the growing decentralization of computing at the workplace, observers acknowledged the danger that a "flood of redundant corporate data may clog the company's information arteries," they also emphasized that "so far, neither of these problems has reached quite the proportions of disaster that M.I.S., or Management Information System, officials once predicted" (Sandberg-Diment 1987). That is, MIS managers vastly exaggerated the potential complications entailed by the extension of microcomputer use. The idea of MIS had been rooted in mainframe technology. Computer specialists in firms thus came to attach their professional standing to the continued use of mainframes (Markoff 1989). Manufacturers of this type of hardware like IBM, who also started to produce microcomputers, initially labeled them as "personal computers" in order to indicate that on their part, they did not intend them to be used for commercial purposes (Sandberg-Diment 1987). By the end of the 1980s, MIS promulgators had lost the "tremendous battle, between the old-line high priests of data processing/management information systems, and the newly appointed personal computer users and managers" (Sandberg-Diment 1986). By then, personal computers had made a broad inroad into corporate offices (Cortada 1996). The diffusion of microcomputers thoroughly weakened the position of corporate information technology managers. In the eyes of top managers,

MIS was discredited. The concept lost its justification because it became demystified as a supplementary by-product (Cortada 1996: 88). I expect that the technological migration from mainframe to microcomputers had negative repercussions on the institutional trajectory of MIS. Because it undermined the MIS concept, the rise of the PC should lower the chances for MIS office creation.

Hypothesis 4: The adoption of an MIS top management position will be negatively associated with the rise of personal computing at the workplace.

ALTERNATIVE EXPLANATIONS

In this part, I briefly review a range of theories that could similarly account for the adoption of an MIS top management position. In addition, I outline control variables that are known to affect changes in organizational structure.

Organizational Size and Degree of Structural Differentiation

With increasing scale, organizations subdivide labor and managerial responsibilities (Blau 1970: 203-204). Generally, the adoption of a particular managerial office, MIS, could thus be evidence of a large firm's greater propensity toward structural differentiation. Thus, size of the focal enterprise should have a positive effect on the adoption of an MIS management post.

Besides size, structural differentiation has itself an effect: Differentiation entails a higher degree of complexity, engendering coordination and communication problems. Because the need for coordination increases under these conditions, organizations with a rationalized formal structure evolve (Meyer and Rowan 1977: 342). A larger administrative overhead is required (Blau 1970: 212-213). Along similar lines, transaction cost economists argue that a

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firm's continuous expansion of the functional structure creates "cumulative 'control loss' effects, which have internal efficiency consequences" (Williamson 1983: 133). As specialization increases with the creation of new functional divisions, actors reach their limits of control due to bounded rationality. Opportunism is more likely to occur. In order to mitigate these governance problems, organizations are expected to implement a multi-divisional structure. While MIS is never an explicit focus of their theorizing, one could surmise that the establishment of a top management position in charge of management information systems would occur as alternative response. Management information systems have been designed and advertised to resolve coordination and communication problems in large organizations. Insofar as the control loss argument is applicable to MIS, I would expect that growth in the functional structure of an organization enhances the likelihood of MIS position adoption at the corporate level.

Degree of Diversification

MIS was promulgated as a remedy problems of organizational size and structural differentiation. It was also sold to firms with a high degree of diversification. In this perspective, diversification impinges on the demand for an information system in three ways. First, an increase in the number of markets enhances the level of competition a firm is exposed to. This requires more analytical attempts to minimize costs. Second, the engagement in more segments renders operations more regionally dispersed, further demanding the integration of information at the corporate level. Finally, participation in more markets also augments uncertainty with regard to strategic questions like investment in technology, pricing strategy, etc. (Levenstein 1998: 3-4). I expect that a greater degree of

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diversification should make a company more likely to adopt an MIS top management position.

Firm Age

Stinchcombe (1965) argues that managers adopt the organizational structure prevalent at the time of an industry's founding. Consequentially, younger organizations are more likely to introduce organizational innovations. In the same vein, Selznick (1957) contends that when organizations age, they tend to be more resistant to change. Hence, older organizations should be less likely to change established practices and adopt an MIS top managerial position.

DATA AND METHODS
Sample and Data Collection

In collaboration with several other scholars, I collected data for 430 publicly traded, large industrial corporations between 1964 and 1994. From that period, we used *Fortune* lists of the 500 largest U.S. firms as the sampling frame. Apart from containing firms that exist for the whole period, this sample hence also includes both firms that ceased to exist before 1994 and firms founded some time after 1964. Unlike previous studies that sampled from the *Fortune 500* list in a single year, we drew a stratified random sample from all the lists over an extended period of thirty years in order to avoid a skewed sample for the later years of the observation period. The sample is stratified such that each of 22 different industries is

represented with roughly equal numbers.[10] Originally, my sample contained 500

corporations. After excluding companies that were sampled twice due to name changes, and

those for which no financial data were available, we obtained a final sample size of *N*=430.

We collected the data for this analysis from a number of different sources. Annual

editions of *Standard and Poor's Register of Corporations, Directors and Executives* were used in order

to obtain data on firms' top management teams. This directory lists all corporate officers in

a given year down to the vice-presidential level with their names and functional titles.

Furthermore, we recorded all 4-digit *Standard Industrial Classification* (SIC) codes that were

reported for each company in a given year by *Standard and Poor's Register*. Annual economic

and financial data come from *Standard and Poor's Compustat* database. The *Business Periodical*

Index (BPI) was used to construct a measure for annual press coverage of MIS. Data on

annual personal computer sales in the United States come from the *International Data*

Corporation. Using several editions of *Moody's Industrial Manual*, we collected information

about the founding year of the companies in the sample. In some cases, I also consulted the

International Directory of Company Histories to retrieve these data.

For the present analysis, I transformed the data into annual spells, and this resulted in a

dataset with 9281 total spells of data (company-year spells). Each annual record contains

values for the outcome and for independent variables. I retained records only for those

years in which an organization was operating and at risk of adopting an MIS top

management position. Consequently, I removed those spells in which each organization was

not at risk, that is those spells before a company was founded, and those immediately after it

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[10] Industries used for stratification are aerospace, amusement, apparel, chemicals, communications, computers, electric machinery, food, hospitals/health, machinery, metals, oil, paper, pharmaceutical, publishing, retail, stone/clay/glass, textiles, transport, transport equipment, utilities, and wholesale.

had created an MIS position. I further omit those spells for which data on any of the covariates are missing. The total number of spells included in the analysis is 8632. The total number of adoption events among the firms at risk of adoption is 55.

Measures and Model Specification

MIS adoption.—*Standard and Poor's Register of Corporations, Directors and Executives* lists the names and functional titles for all members of the top management team.[11] In my analysis, I model the adoption of a top executive position responsible for management information systems. For each of the companies in the sample, I flagged the year in which a position having "MIS" as part of its title appeared for the first time.[12] In 1964, the first year of the observation interval, none of the companies in the sample had a top corporate position in charge of management information systems. Consequently, left-censoring does not pose a problem for the model estimation.

Independent variables.—Independent variables all vary over time. With the exception of three variables (press coverage, PC sales, number of companies with MIS office) all of them were collected at the establishment level. I counted the number of articles listed in the *Business Periodical Index* to measure coverage of MIS in management journals. Because the number of indexed journals increases significantly by year, I adjusted the article count for

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[11] *Standard and Poor's Register* reliably lists all top executive positions of vice presidential rank and higher, thus comprising a company's top management team. This definition of top management teams is in line with previous research on top managers; e.g., Keck and Tushman (1993). (See Finkelstein and Hambrick 1996: 118-123 for a discussion). For that reason, all information on top management teams was drawn from this source. I also investigated potential other sources for information on executive staffing. The *Directory of Corporate Affiliations* does not report individual officers before 1973. Furthermore, it does not contain a comprehensive listing of all vice presidential positions and higher. For instance, in 1985, the latter work only contains 9 of the 30 MIS top managerial positions listed in *Standard and Poor's Register.*

this growth. I multiplied the raw annual count with the following ratio: Number of journals indexed in a given year divided by the number of journals indexed in 1978 (see Abrahamson 1997: 507 for a comparable approach).

I operationalize mimetic pressure as adoption density, that is, the percentage of companies in the sample having a top management position for MIS in the precedent year. This measure is based on the same procedure that I used to construct the outcome variable. As an alternative, I also tried a measure based on the percentage of companies in specific industry sectors. Because theories do not provide unanimous support for either measure and because the global variable performed better, I rejected the latter. Arguments regarding the industry-spanning role of management consultants also suggest that industry sectors do not matter. [13]

I measure the adoption of a top management officer for strategic planning with a binary variable. For each company-year, I flag the creation of an executive office which title contains a reference to strategic or long-range planning.

In the absence of establishment-level data on personal computer use, I use a global proxy variable to examine the effect of a rise of PCs for business applications: total sales

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[12] Typical title names for these positions were, e.g., "vice president MIS" or "senior vice president management information service." See Easton and Jarrell (1998) for a comparable approach using Standard & Poor's listing of managers' titles to determine firms that have adopted total quality management.

[13] Cortada underscores the role of consultants and migrating managers in disseminating MIS across particular industries. "Consultants in business always operated in multiple industries. In fact, for most industries the attraction to a specific consultant or his or her firm was precisely the fact that they had experience in other industries that could be applied to theirs. That process of cross-fertilization of ideas has not been studied. Yet in each decade, the use of consultants to figure out what applications to implement and then to actually install the programs was extensive. […] So studies could be of application migrations, or the movement of the vast herd of employees we call managers, with their metaphorical wagons filled with applications, management practices, industry-specific experiences, and attitudes. […] [W]hen we look at information processing personnel, these migrations did build common views about key application issues that crossed industry boundaries" (Cortada 1996: 150).

across the personal computer industry within a focal year. Values are deflated back to 1975 dollars using a *Consumer Price Index* deflator.

As a measure of company size, I use the total number of employees in a given year provided by the *Compustat* database. In order to decrease the number of missing values for this particular variable, I employed a straight-line interpolation procedure for those gaps where not more than three subsequent years were missing. I measure divisional and functional structure at the top corporate level with two indicators each, one indicating the magnitude of change, and one controlling for the overall number of managers filling each of these position types. For each company in a given year, I counted title names of corporate officers denoting a functional position. I repeated the same procedure for those titles indicating a divisional role (cf. Virany, Tushman and Romanelli 1992) who use a similar method). Based on these counts, I computed the percentage change in the number of functional and divisional managers from the preceding year.

I use the number of distinct SIC codes at the 2-digit level as measure for a firm's degree of diversification because it performed best in a number of models. (Alternatively, I also tested percentage change in the number of distinct SIC codes, both lagged and unlagged.) For each company-year observation, I computed company age by subtracting a firm's founding year from the actual year of observation. Finally, I add the year of observation as a covariate in order to control for a secular trend in the adoption rate of MIS managerial positions at the top corporate level.

Estimation

Due to the fact that data on MIS position adoption comes from annual directories, the events are measured annually, even though they might have happened at any time during a

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given year. This leads to a substantial number of "tied" events, that is, years in which several

companies create a new top management position for the oversight of MIS. For that reason,

I use an event-history method requiring only discrete measurement of events, but presuming

that the exact timing of events occurred continuously; for a detailed discussion, cf. (Allison

1995: 216-219). I employ a model where the hazard at time t for an organization with

characteristics i is equal to

$$h(t \mid C_i) = h_0(t)^{(C_i'b)}$$

Here $h_0(t)$ is a baseline hazard function describing the risk for organizations with

baseline characteristics $C=0$ and the exponent $(C_i'b)$ is a proportionate increase or reduction

in risk associated with characteristics C_i. Because of the use of company-years in the model

estimation, the hazard of adoption in each year is equivalent to P_{it}. This number yields the

probability of an event for organization i in year t, conditional on the fact that it has not

already occurred in the past. I use the complementary log-log transformation of the

cumulative survival function $(1-P_{it})$:

$$\log[-\log(1-R_{it})] = a_t + bX_{it}$$

The complementary log-log model uses a maximum likelihood method. I constrain the

effect of time by adding the year of observation as a covariate. This is equivalent to

estimating a model where the time of event occurrence follows an exponential distribution

(Allison 1995: 219). (I also specified some alternative constraints on the effect of time, e.g., I

entered observation year as a quadratic term). The estimation was carried out with the

GENMOD procedure in the statistical program SAS.[14]

FINDINGS

[Figure 3 above here]

Figure 3 shows a hazard plot for the creation of top management MIS offices over historical

(calendar) time. The hazard plot takes into account the numbers of organizations at risk of

creating an MIS office during each period.[15] The hazard plot is consistent with my argument

that the MIS title wave did not lead to the institutionalization of MIS offices. The steep

increase in the hazard of adoption is followed by a sharp decline beginning in the early

1980s. We can anticipate that in accordance with declining press coverage and increasing PC

use at the workplace, organizations were less likely to elevate responsibility for MIS to the

top executive team, a claim that is further supported by the results from event-history

models.

Table 2 reports estimates from complementary log-log models of MIS position

adoption at the corporate level.[16] Overall, the findings conform to my expectations. As

hypothesized, the coverage of MIS in business media was positively linked to the likelihood

for a company to create an MIS management position. The advent of the personal

computer at the workplace had a significant negative effect on the diffusion of MIS offices.

[14] For details concerning the estimation of a complementary log-log model with PROC GENMOD in SAS, see Allison (1995: 217). When the year of observation is a covariate, a Gompertz model is estimated. When the scaling factor *a* is set to 0, as in the present case, the Gompertz distribution gives the exponential distribution (Allison 1995: 20).

[15] The computation of the survival function was carried out with PROC PHREG in SAS. Using 430 observations (one per company) I fitted a model without covariates to the data (start and end point for each company's period of being at risk). The hazard plot was produced with the SMOOTH macro written by Allison (1995: 259-261).

The adoption of a strategic planning office in the top management team is strongly linked to the adoption hazard for an MIS position.

MIS as a Fashion

I have argued that professional groups, together with consulting firms, academics and hardware vendors, manufactured MIS as a managerial fashion and then advocated its use in the business press. Results support this hypothesis. In models 2 to 4, management journal coverage of MIS shows a consistent and robust significant effect on the hazard of MIS office creation. Increasing discussion of MIS in the media made companies more likely to appoint a top manager for MIS. Conversely, when business magazines began to decrease the amount of attention they paid to management information systems, this was associated with a subsequent decline in the hazard rate for MIS adoption. The mechanism of mimetic isomorphism does not gain support here. It appears that the spread of MIS offices is a consequence of other factors, because the measure for adoption density shows no effect. DiMaggio and Powell suggested that normative and mimetic mechanisms may not be empirically distinct (DiMaggio and Powell 1983: 150). Furthermore, when diffusion follows a (mimetic) contagion pattern, the time covariate should have a significant effect, as it does in the present series of models. The density measure might hence not be working due to problems of collinearity.[17]

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[16] Coefficients reported in table 2 can be interpreted in the following way. A $1 billion increase in PC sales produces a $100[\exp(-.0647)-1] = -6.27$ percent change in the hazard of MIS position adoption.

[17] Note that in a set of nested models not reported here, the measure of firms with an MIS executive showed a significant effect when the year of observation was not specified as a covariate.

Rising PC Utilization

Technological changes bringing about the personal computer had marked effects on the career paths of the data processing community. Microcomputers began to enter the corporate scene in the early 1980s and then rapidly spread throughout the workplace. For the likelihood of firm's creation of a top management office for MIS, I find that the rise of decentralized use of computers at work has a significant negative effect.

Structural Differentiation and Strategic Planning

Further evidence that MIS had been sold to management as a fashion wrapped into a 'package solution' comes from the effect of strategic planning offices. When a strategic planning office is created, this increases the chance of creating an MIS position substantively. It appears that in line with Blau's theory of organizations the degree of functional differentiation shows a significant positive effect in all models, lending some credence to functional arguments. In a series of models not reported here, I used a lagged binary variable to measure the effect of previous existence of strategic planning offices. Unlike the present adoption variable, it did not work. This suggests that the creation of an MIS office—net of a company's general proclivity toward functional differentiation—was also part and parcel of a more encompassing strategic reorientation.

Diversification, Age, and Size

The other theories show mixed results. Organizational size and age do not show any effect. According to its conceptual foundation, MIS war particularly suitable to firms pursuing a strategy of high diversification. Yet, I do not find a significant effect of diversification in any of the models.

CONCLUSION

The concern how to best manage MIS "led to one of the most pondered problems by executives at the end of the 1970s and start of the 1980s" (Cortada 1996: 206; see also Allen 1982). I have argued that top management's uncertainty surrounding the appropriate utilization of early computing technology encouraged hardware manufacturers, consulting firms and professional organizations to construct the MIS prescription. Data processing managers in firms embraced MIS because it promised a way out of a professional impasse with limited opportunities for professional advancement. Management information systems were designed to facilitate coordination and control of diversified corporations and to support strategic planning and decision-making at the corporate level. Embedded in a general surge of rationalist managerial rhetoric, MIS was advocated as a cutting-edge management technique in business journals. Organizations created corporate offices for the management of MIS partly because they responded to normative and mimetic pressures. My analysis illustrates that with greater coverage of the MIS concept in business periodicals, organizations began to create new top corporate offices to oversee MIS. The data also show that MIS gained top management's attention if strategic planning also became an issue on the corporate agenda. I argue that this occurred because MIS was sold to top management as part of a larger package. Because management attention to questions of technology was hard to obtain, the potential gains for strategy and decision-making tasks were placed at the core of the MIS idea to stimulate top executives' interest.

This fact notwithstanding, the data show that MIS failed to become an established organizational form in corporations. After the number of companies with a top executive for MIS among their ranks had peaked in 1985 it dropped markedly in subsequent years. I have demonstrated that this was associated with declining attention allocated to MIS in the

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managerial press. This testifies to the fact that professional organizations were unsuccessful in their attempt to establish MIS both as a brand name for data processing professionals and as an independent academic discipline. In light of the fading public attention to MIS, a handful of articles on the MIS field were published. Drawing on analyses of publication records and citation patterns, participants in the academic MIS movement observe the weak standing of their discipline within academia (e.g., Culnan 1986; Dickson 1981: 19; Shim, English and Yoon 1991; Vogel and Wetherbe 1984). Likewise, members of professional associations had early on voiced concerns that MIS might lose its attractiveness to the management community. They felt the MIS label provided a new name to something that companies had been doing anyway since years and that MIS champions were selling the "sizzle, not the steak" (SMIS 1970: 25).

I found that besides professional forces shaping managerial attention to MIS, technological change matters. The rise of decentralized computing in corporations posed a severe challenge to the MIS project. MIS managers were championing the centralization of computer resources based on mainframe technology. When PC technology enabled end users to access data processing resources at their desk, the MIS prescription was delegitimized. The data show that net of the effect of a general decline in MIS popularity, the rise of PC use in industry negatively affected chances for the creation of MIS offices at the top of corporations.

This paper has examined the effect of managerial discourse and technological innovations on the creation of a top management office. I demonstrated that declining public attention to a managerial technique and challenges posed to professional jurisdiction changed organizations' propensity to adopt an executive position for management

information systems. In future work, I plan to extend the present analysis by taking a more comprehensive look at the trajectory of data processing managers in the corporate hierarchy.

First, including data on the previous existence of lower level MIS departments, would allow us to test whether the presence of lower level units or departments for MIS helped in bringing top management attention to this organizational prescription. Evidence suggests that in some cases, MIS was first introduced to companies as a lower level unit the managers of which then climbed the career ladder. Attention to this fact might also help refine our understanding of the process in which ideas championed in management periodicals translate into organizational change. If organizations respond to the availability of new managerial techniques by first experimenting with them at lower levels, we would not expect them to surface at the top but some years later.

Second, a content analysis of articles should be conducted to determine whether media coverage changed from embracing the MIS prescription to its disapproval.

Third, in order to understand the declining prevalence of MIS offices at the strategic apex of corporations, it does not suffice to examine adoption rates. Hence, I intend to analyze the likelihood of retention for those offices. In my sample, two third of the companies that created an MIS position eliminated it before the end of the observation period. The average office was retained for less than 6 years. An analysis of the factors determining the abandonment of an organizational template could lend further support to my argument.

Fourth, the scope of analysis should be broadened by incorporating more than a single management fashion in order to further our understanding of how different fads replace one another. Scholars have observed that there is a general tendency for organizational prescriptions to alternate between centralization and decentralization (Mintzberg 1979: 294).

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In the case of information technology, there is some evidence for the idea that the concept of a Chief Information Officer, or CIO, was developed to address the problem of "data anarchy" stemming from the decentralization of computing resources by means of the PC (e.g., Burbridge and Boyle 1989). My data show that the CIO entered top management teams in the late 1980s and then rapidly spread in the next years until the end of the observation period.

With respect to new institutional theory, I suggest that scholars should attend to two factors in particular driving organizational change. First, from a large number of available managerial fashions that organizations experiment with, only few eventually become institutionalized whereas the others are discredited. Second, previously institutionalized forms become deinstitutionalized. I argue that a closer investigation of these mechanisms contributes to our understanding of the preconditions for successful institutionalization of organizational forms and procedures. Management fashions sweep the corporate landscape in waves. Apparently, it takes more than a good label to turn a fad into an institution.

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TABLE 1

VARIABLE LIST

Variable	Definition
Dependent variable: *MIS position adoption*	Binary variable indicating first year in which a company creates a top management position with "management information systems" as part of its title
Business press coverage	Number of articles indexed in the BPI, adjusted for growth in indexed journals
Adoption density	Percentage of companies with a top management office for MIS, lagged 1 year
Strategic planning	Binary variable indicating the adoption of a top management function for strategic/long-range planning in a given observation year
PC use	U.S. PC industry total sales, measured in $billions, deflated, lagged 1 year
Firm size	Number of employees in thousands
Functional managers	Number of top managers with functional responsibilities, lagged 1 year
Change in functional managers	Percentage change in number of functional top managers, lagged 1 year
Divisional managers	Number of top managers with divisional responsibilities, lagged 1 year
Change in divisional managers	Percentage change in number of divisional top managers, lagged 1 year
Diversification	Number of different markets a firm operates in, based on count of distinct 2-digit SIC codes reported
Firm age	Age in years since founding
Year of observation	Year of observation (1964 coded 1, 1965 coded 2, etc.)

TABLE 2

ESTIMATES OF ADOPTION OF AN MIS TOP MANAGEMENT POSITION

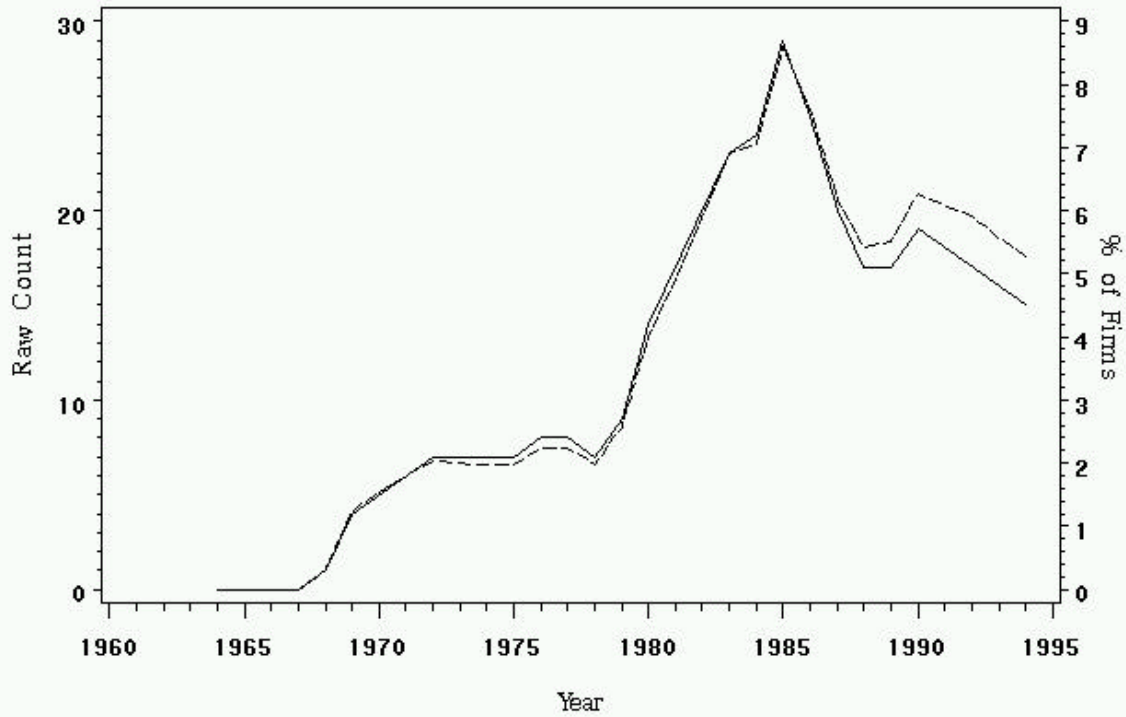| Variables	Model 1	Model 2	Model 3	Model 4
Firm size..	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Functional managers..........................	0.0439 *	0.0430 *	0.0397 *	0.0393 *
	(0.0175)	(0.0176)	(0.0176)	(0.0177)
Change functional managers	0.0031 †	0.0031 †	0.0035 †	0.0035 *
	(0.0018)	(0.0017)	(0.0018)	(0.0018)
Divisional managers...........................	0.0149	0.0158	0.0162	0.0128
	(0.0246)	(0.0248)	(0.0250)	(0.0259)
Change divisional managers	-0.00020	-0.0021	-0.0018	-0.0018
	(0.0030)	(0.0031)	(0.0.0030)	(0.0030)
Diversification....................................	-0.0096	-0.0115	-0.0196	-0.0172
	(0.0584)	(0.0584)	(0.0584)	(0.0585)
Firm age	-0.0020	-0.0021	-0.0022	-0.0019
	(0.0043)	(0.0043)	(0.0043)	(0.0043)
Year of observation............................	0.1083 **	0.0775 †	0.1514 *	0.1516 *
	(0.0365)	(0.0435)	(0.0655)	(0.0655)
Business press coverage	0.0164 *	0.0162 *	0.0155 *	0.0152 *
	(0.0070)	(0.0067)	(0.0078)	(0.0078)
Adoption density................................		0.1090	0.0915	0.0819
		(0.0925)	(0.0978)	(0.0979)
PC use..			-0.0703 *	-0.0696 *
			(0.0322)	(0.0322)
Strategic planning..............................				2.0074 **
				(0.7332)
Intercept...	-8.4096 ***	-8.2856 ***	-8.9303 ***	-8.9064 ***
	(1.1720)	(1.1307)	(1.4010)	(1.3994)
At-risk spells (*N*)	8632	8632	8632	8632
Number created..................................	55	55	55	55
χ^2	40.42 ***	41.75 ***	46.83 ***	51.29 ***

NOTE.—Numbers in parentheses are standard errors.

† p<.1, * p<.05, ** p<.01, *** p<.001.

The χ^2 given for each model represents the improvement over the baseline model with no variables and no constraint on the effect of time.
The test statistic is twice the positive difference between the log-likelihood of the two models, which under the null hypothesis of no
difference will have an asymptotic χ^2 distribution in small to moderate sized samples (Allison 1995: 86).

FIGURE 1

Management Information Systems

NOTE.—Straight line refers to the raw count, dashed line refers to percentage of firms with MIS office.

FIGURE 2

Number of Articles on MIS Indexed in BPI

FIGURE 3

HAZARD RATE FOR ADOPTION OF A TOP MANAGEMENT POSITION FOR MIS

Management Information Systems