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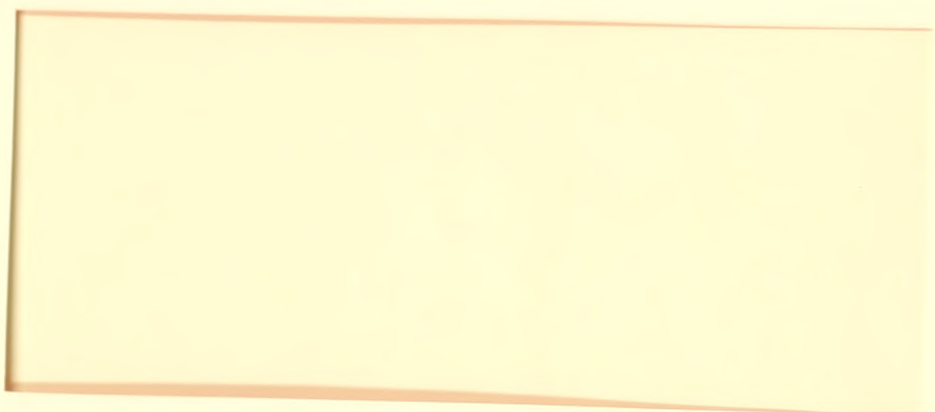

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Lawrence Loh

Sloan School of Management
Massachusetts Institute of Technology
50 Memorial Drive E52-509
Cambridge MA 02139
(617) 253-3857

N. Venkatraman

Sloan School of Management
Massachusetts Institute of Technology
50 Memorial Drive E52-537
Cambridge MA 02139
(617) 253-5044

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Diffusion of Information Technology Outsourcing: Influence Sources and the Kodak Effect

Abstract

The governance of an organizational information technology (IT) infrastructure is steadily shifting away from pure hierarchical and market mechanisms toward hybrid and partnership modes that involve external vendors. In particular, IT outsourcing has recently emerged as a significant administrative innovation in an organization's IT strategy. This paper seeks to explore the sources of influence in the adoption of this innovation. For this purpose, we generated a comprehensive sample of outsourcing contracts in the U.S. using an electronic bibliometric search process. Using diffusion modeling, our empirical analysis shows that the adoption of IT outsourcing is motivated more by internal influence (or imitative behavior) than by external influence amongst the user organizations. Subsequently, we considered the widely-publicized *Eastman Kodak*'s outsourcing decision as a critical event to assess whether this internal influence is more pronounced in the post-*Kodak* regime than in the pre-*Kodak* regime. Our results show that internal influence is dominant in the post-*Kodak* regime but not in the pre-*Kodak* regime. Implications and directions for future research are discussed.

Keywords: Diffusion models; information technology governance; information technology outsourcing; information technology strategy.

Introduction

In recent years, the governance of information technology (IT) infrastructure has shifted beyond its traditional hierarchical locus towards a hybrid mode involving external organizations. The newer approaches include joint ownership of IT networks (e.g., in an industry-wide electronic data interchange), co-development of applications software (e.g., in a multi-company consortium) as well as several other types of partnerships between users and vendors. Within such a spectrum, we focus on one governance mode that has become prominent in recent years: *outsourcing* of all or significant components of the user's IT infrastructure. In simple terms, this involves the transfer of property or decision rights in varying degrees over the IT infrastructure by a user organization to an external organization such as a technology vendor or a systems integrator.

The trend toward IT outsourcing is proffered in a prognostic commentary by Dearden (1987), who argued that the IT organization is "withering away" as end-users gain greater control of their computing environments and more importantly, as external software specialists increasingly take charge of corporate systems development. Indeed, this shift in IT governance is currently characterized by a multi-billion dollar outsourcing market. A leading IT consulting firm, *The Yankee Group* estimated that outsourcing revenues for all types of outsourcing totaled $33 billion, and are expected to reach $49 billion in 1994.[1] In a similar vein, two other consulting organizations: *G2 Research* and *Input, Inc.* separately forecasted that the annual growth rate in IT outsourcing would be about 17% for 5 years after 1990.[2]

The IT outsourcing business is rapidly evolving. On the demand (i.e., user) side, the market encompasses organizations in the for-profit and not-for-profit sectors. Many users in these different sectors are simultaneously served by the same vendor.[3] On the supply (i.e., vendor) side, the industry is dominated by the top five vendors: *Anderson Consulting, Computer Sciences Corp. (CSC), Digital Equipment Corp. (DEC), Electronic Data Systems Corp. (EDS), and International Business Machine Corp.*

(IBM). All these IT suppliers provide a full range of outsourcing services across multiple industries and sectors.[4,5]

With the increasing significance of IT outsourcing as a viable strategic option, this innovative administrative practice is being viewed with considerable attention within the professional community. Against this backdrop and the high potential profits in the marketplace,[6] there has been an aggressive push by the vendors to manage the IT infrastructure of the users. For instance, *Martin Marietta Information Systems Group* ran an advertisement with the caption: "You don't own a power plant for your electricity ... Why own a data center for your information systems?"[7] Further, *Computerworld* and *Information Week* -- two leading industry publications have devoted extensive coverage of the outsourcing phenomenon. As a *Merrill Lynch* outsourcing analyst put it, this industry is "a huge, burgeoning snowball rolling downhill. This is not a market that's burning out -- it's exploding... the current year among the leading outsourcers will be marked by fierce competition, an intensified scramble for differentiation, jockeying in the ranks and staggering deal values."[8] In this light, it has been contended that "outsourcing suddenly went from a curious anomaly to a veritable craze."[9]

The interest in IT outsourcing escalated when *IBM* announced "an unusual agreement under which it will build and operate a data center for *Eastman Kodak*."[10] According to this agreement, *IBM* "will take over the work done by four Kodak centers, and 300 Kodak workers will become IBM employees." In addition, "Kodak ... hopes to cut costs as much as 50% by turning the operation over to IBM." The impact of this large contract involving two prominent companies had been profound: IT outsourcing suddenly became a serious strategic choice for firms, and the "consideration of outsourcing" emerged as one of the top ten issues for success (or survival) in the 1990s.[11]

Within the research community, IT governance is beginning to be recognized as an important component of IT strategy in conceptual frameworks (Henderson

and Venkatraman, 1992) and analytical models (Richmond, Seidmann and Whinston, 1992; Whang, 1992). Empirical studies on IT governance adopting a cross-sectional approach are beginning to appear recently (Loh and Venkatraman, 1992a, b). This paper adds to the empirical stream by adopting a longitudinal approach to explore the sources of influence underlying the diffusion process of IT outsourcing as an administrative innovation. We apply the analytical models of diffusion as used by Mahajan, Sharma, and Bettis (1988) in the case of M-form (multidivisional) organizational structure but with a significant methodological improvement through our more powerful nonlinear estimation and specification tests. Specifically, we: (a) identify a sample of 60 outsourcing decisions in the U.S. from April 1988 to August 1990 using an electronic bibliometric search; (b) adopt nonlinear estimation methods and specification tests to examine the sources of influence -- internal, external, and mixed -- that could explain the diffusion pattern of outsourcing; and (c) treat the prominent *Kodak* outsourcing decision as a 'critical-event' in delineating two regimes -- "pre-*Kodak*" and "post-*Kodak*' · to assess the differential impacts of the influence sources within each of the regimes.

Theoretical Perspectives

IT Outsourcing as an Administrative Innovation

In general terms, outsourcing falls within a class of "make-versus-buy" decisions in an organization. It has been studied in several settings such as: the manufacturing of parts in the automobile industry (e.g., Walker and Weber, 1984); the sales function in the electronic industry (Anderson, 1985); and the distribution of equipment, components, and supplies across a broad set of industrial firms (John and Weitz, 1988).

We define IT outsourcing as the *significant* contribution by *external* vendors of the *physical* and/or *human* resources associated with the entire or specific components of the IT infrastructure in the user organization.[12] This definition is consistent with recent discussions of IT outsourcing by researchers and practitioners.

For instance, Elam (1988) suggested the possible use of three forms of cooperative arrangement (i.e., full-equity ownership, partial ownership, and no ownership) involving external vendors that can be used for the joint development of corporate information systems. Further, a leading IT periodical described outsourcing as the "turning over, or sharing, responsibility for all or part of an organization's information technology function with a third party."[13]

We argue that IT outsourcing represents a fundamental point of departure in how firms govern or manage their IT infrastructure, and hence could be viewed as an *administrative innovation* (Teece, 1980; Mahajan et. al., 1988). Venkatraman, Loh, and Koh (1992) defined an administrative innovation as "involving *significant changes* in the *routines* (or behavioral repertoires) used by the organization to deal with its tasks of *internal arrangements* and *external alignments*." This definition reflects (a) the critical notion of first-time adoption by an organization (Rogers, 1983; Zaltman, Duncan, and Holbeck, 1984); (b) the changes in the routines and procedures of organization and management involving substantial set-up costs and organizational disruptions (Nelson and Winter, 1982); and (c) a comprehensive view of administrative tasks as organization-environment coalignment (Thompson, 1967; Snow and Miles, 1983).

Table 1 summarizes our arguments supporting the treatment of IT outsourcing as an administrative innovation. First, it represents a *significant shift in the mode of governance* -- from the traditional locus of control and coordination within the hierarchy (combined with relatively standardized market transactions with vendors) towards newer modes that could be characterized as hybrids (Williamson, 1991) or partnerships (Kanter, 1989; Powell, 1990). As Markus (1984: pp. 125-127) articulated: "In the early days of computing, in-house development was the only alternative available to those organizations that wished to explore the commercial potential of computers.... most companies with sizeable internal development efforts usually run most of their applications on internally owned and

Table 1
IT Outsourcing as an Administrative Innovation

Key Component of the Definition of Administrative Innovation	*Applicability to IT Outsourcing*
Significance of the change	Critical departure from the traditional mode (hierarchical control and market exchange with vendors) towards a hybrid mode (involving alliances and partnerships with vendors).
Changes in routines dealing with internal arrangements	Major changes in the internal business processes and repertoires (e.g., liaison roles, redistribution of authority and responsibility for designing, operating and maintaining the IT infrastructure) to support the emphasis on alliances with chosen partners in the IT marketplace.
Changes in routines dealing with external alignments	Fundamental shift in the mode of dealing with firms in the IT marketplace from 'arms-length' approach towards a partnership-like arrangement anchored on mutual trust and joint decision-making

operated computers." A good example of a recent outsourcing contract involving a fundamental reorganization of the IT function is *General Dynamics Corp.* that has outsourced a major part of its IT infrastructure (with 2600 employees and a data center of over 1000 MIPS) to the *Computer Sciences Corp.*[14] In fact, such a shift in mode of governance is associated with profound transformations in the strategic and operational mechanisms that are necessary for an organization to position itself within its current mission or scope. It is consistent with Evan's (1966: p. 51) view of administrative innovation as "the implementation of an idea for a new policy pertaining to .... the allocation of resources, structuring of tasks, authority, of rewards."

Second, IT outsourcing represents *significant changes in the internal processes of the user organizations*. Kanter (1989: p. 141) argued that multi-organizational partnerships alter "internal roles, relationships, and power dynamics for the organizations entering into them." This perspective applies well to IT outsourcing in many cases. As a leading IT periodical observed, "Information systems executives left behind to mind the shop after parts of their operations have been outsourced may suddenly feel like fish out of water: They're forced to learn almost an entirely different set of job skills.... A large bulk of the responsibility IS managers take on in overseeing outsourcing contracts is monitoring the outsourcing vendor's work."[15] This clearly calls for a principal adjustment in the nature and degree of internal routines. For example, a large oil and mining company that has outsourced was left with just five managers within its IT organization.[16] These managers, however, have the responsibility for ensuring that their department develops an internal IT role that supports the firm's business strategy. Beyond this specific case, we argue that IT outsourcing -- by virtue of its radical shift in the locus of governance -- calls for changes in internal processes involving redefinitions of liaison roles, new mechanisms for joint decision-making in areas such as development, maintenance and operations of the IT infrastructure, allocation of critical resources given possible

divergence in goals, and redistribution of authority as well as criteria for performance appraisal.

Third, IT outsourcing constitutes a *significant change in the organizational routines used to deal with the external environment*. Specifically, a shift away from an arms-length approach for dealing with the IT marketplace (with multiple competing bids and price-dominated short-term contracts) towards a "quasi-firm" mode (with longer-term alliances involving a few selected partners) requires increased mutual understanding, enhanced goal compatibility and recognition of complementary skills and requirements. For instance, *National Car Rental System, Inc.* has outsourced the operational management its IT infrastructure to *EDS*.[17] As part of this alliance, *National* and *EDS* planned to jointly develop applications and systems that would be initially installed at *National* but could subsequently be marketed to other car rental companies. This implies that the routines for dealing with the external partner are different from the traditional user-vendor relationship as it involves joint-development and changes in the business scope of *National Car Rental System* (beyond merely renting cars). As Kirkpatrick (1991: p. 112) noted, "Ultimately, outsourcing may point toward a new form of corporate interdependence with implications that extend beyond the computer room."

A Diffusion-of-Innovation Perspective

The diffusion of an innovation is the process by which the innovation "is communicated through certain channels over time among the members of a social system" (Rogers, 1983: p. 5). Extant research in this area (see for instance, Mahajan and Peterson, 1985) describes this process using four critical elements: the *innovation* (any idea, object, or practice that is perceived to be new); the *social system* (the community of individuals and/or organizations that are potential adopters of the innovation), the *channels of communication* (the means by which information is transmitted to or within the social system); and *time* (the rate or speed by which members of the social system adopt the innovation). This perspective has been

adopted to understand the pattern of diffusion of a wide range of innovations technological and administrative innovations (see Mahajan, Muller, and Bass, 1990 for a recent review pertaining to the case of marketing). In the context of IT innovations, the diffusion approach has been used in studies such as: Zmud (1983) for modern software practices, Brancheau and Wetherbe (1990) for spreadsheet software, Gurbaxani (1990) for BITNET, and Nilakanta and Scamell (1990) for database design tools and techniques

This paper is concerned with IT outsourcing as an administrative *innovation* where the relevant *social system* is the set of organizations leveraging IT infrastructures to achieve their mission. Specifically, our referent community encompasses the computer-using organizations that might consider the adoption of IT outsourcing. *Channels of communication* in IT outsourcing take two forms: horizontal channel (namely: how the members of a social system interact with one another -- for example, through direct interpersonal contacts or indirect observations within the IT user community) and vertical channel (namely: how the members of a social system interact with the outside agents -- for example, through promotional efforts by the IT vendors, results of research studies or summaries of state-of-the-art practices from other countries).

Rogers and Agarwala-Rogers (1976: p. 7) related communication to organizational decision making: "an organization is an elaborate set of interconnected communication channels designed to import, sort, and analyze information from the environment and export processed messages back to the environment. Communication provides a means for making and executing decisions, obtaining feedback, and correcting organizational objectives and procedures as the situation demands" Communication can also be facilitated within the context of a professional network comprising corporate executives across different organizations (Blair, Roberts, and McKechnie, 1985; Mueller, 1986). Thus communication is an integral aspect of the diffusion model. The inter-temporal

pattern of outsourcing contract announcements represents the *time* element of the diffusion of IT outsourcing.

Influence Sources in the Diffusion of IT Outsourcing

In diffusion models, there are two basic types of influence -- internal and external -- that drive the adoption of an innovation by members of a social system. In addition, these two can be aggregated to constitute what is termed as mixed influence.

Internal influence. This perspective purports that diffusion takes place solely through channels of communication within a specific community or social system. The diffusion rate can be represented as:

$$\frac{dN(t)}{dt} = qN(t)[m-N(t)] \qquad (1)$$

where N(t) is the cumulative number of adoptions at time period t, q is the coefficient of internal influence (q>0), and m is the potential number of adopters in the social system. A plot of N(t) with t results in a standard S-shaped curve.

The internal-influence model is structurally equivalent to the imitation model (Mahajan and Peterson, 1985: p. 17). As evident in the equation, the rate of increase in the number of adoption depends on the extent in which the members of the community have already adopted the innovation. In other words, the impetus for diffusion is an emulation of prior adopters by potential adopters. In our study, imitation in the adoption of IT outsourcing may take place when organizations, that have hitherto maintained their IT function inhouse, make their sourcing choice based on other organizations that have already outsourced.

The internal-influence model has received empirical support from well-cited studies such as Griliches (1957) and Mansfield (1961). In the former study, Griliches analyzed the diffusion of hybrid seed corn amongst farmers in crop-reporting areas within the U.S. In the latter study, Mansfield examined the diffusion of several industrial innovations such as pallet loaders, diesel locomotives, and continuous

mining machines among firms. In a more recent work, Venkatraman et al. (1992) investigated the comparative diffusion pattern of two corporate governance mechanisms (specifically, joint ventures and M-form structures) -- it was verified that the internal-influence model is more appropriate in the case of joint ventures. The authors argued that this is conceptually due to the relative ease of imitability of the innovation which is brought about by the *absence* of three factors: unique historical conditions, causal ambiguity, and social complexity. Within IS research, Brancheau and Wetherbe (1990) proposed that internal (i.e., interpersonal) channels of communication are instrumental in the diffusion of spreadsheet software amongst later adopters.

External influence. This perspective specifies that diffusion is driven only by information from a communication source external to the social system. Thus, the rate of diffusion at time t is dependent only on the potential number of adopters present in the social system at time t without attributing any diffusion to interaction between prior adopters and potential adopters. Formally, this model can be written as:

$$\frac{dN(t)}{dt} = p[m-N(t)] \qquad (2)$$

where p is the coefficient of external influence (p>0). Plotting N(t) with t results in a curve that increases at a decreasing rate. In the specific context of our study, external influence on the potential adopters of IT outsourcing can emanate from efforts by vendors (e.g., *EDS* and *IBM*), consulting firms (e.g., *The Yankee Group* and *Input, Inc.*) or trade periodicals (e.g., *Computerworld* and *Information Week*).

The external-influence model has been empirically supported by Coleman, Katz, and Menzel (1966) where the diffusion of a new drug amongst physicians is being studied in four midwestern communities. The model is especially appropriate when members of a social system are isolated or when information on the innovation is not obtained through interpersonal (or interorganizational) communication but has its origins from outside the system (Mahajan and Peterson,

1985). Venkatraman et al. (1992) established that external-influence model is inherent in the diffusion of M-form structures, arguably due to the imperfect imitability of the innovation. Within the IS literature, Zmud (1983) verified that external information channels can facilitate the diffusion of modern software practices (or new system development methodologies) and this is contingent on organizational factors such as size, professionalism, task complexity, and context. Brancheau and Wetherbe (1990) argued that early adopters are more likely to rely on external channels of communication (i.e., mass media) in the adoption of spreadsheet software. Nilakanta and Scamell (1990) found limited support for the influence of external information sources and communication channels in the diffusion of database design tools and techniques (see also Swanson, Fuller, Nidumolu, Ramiller, and Ward, 1991). In a recent review, Gurbaxani, King, Kraemer, McFarlan, Raman, and Yap (1990) highlighted that several external institutions (e.g., governments, international agencies, and educational institutions) are critical in shaping the international diffusion of IT.

Mixed influence. This perspective subsumes both the internal- and external-influence models and can be represented by the following equation:

$$\frac{dN(t)}{dt} = [p+qN(t)][m-N(t)] \qquad (3)$$

The cumulative distribution of the mixed-influence model gives rise to a generalized logistic curve whose S-shape depends on the coefficients p and q. It is the most general form and widely used because the assumptions of either the external- or the internal-influence models are seldom met unequivocally. The mixed-influence model has been successfully applied in the work of Bass (1969) where the sales of several electric appliances are being forecasted. In the IT arena, Gurbaxani (1990) discovered that the diffusion of BITNET followed a S-curve, or more specifically, a logistic curve. The impetus for its diffusion was a combination of coverage by the media and the early adoption by highly visible research universities.

Based on the above discussion, we seek to assess the influence type that captures the pattern of diffusion of IT outsourcing. Our first research question is:

> ***Research Question 1:*** *What source of influence best characterizes the diffusion of IT outsourcing?*

Kodak's Outsourcing as a Critical Event

In July 1989, *Kodak* announced a unique contract under which it outsourced its data center operations to *IBM*.[18] This involved a transfer of four data centers and three hundred IT personnel within the IT function of *Kodak* to *IBM*.[19] We will argue that this specific case constitutes a critical event in the overall pattern of diffusion of outsourcing. In particular, we seek to test whether the types of underlying influence differ before and after this critical event.

The possibility that one single adoption can drive the diffusion of innovations has been documented in the management literature. Rogers and Kincaid (1981) argued cogently that adoption by an opinion leader can have a profound effect on subsequent adoptions. This is because opinion leaders have connections to multiple and diverse sources of relevant information; in addition, they usually occupy boundary-spanning and central positions within the network of potential adopters. In general, such personnel serves to reduce the incidence of uncertainty inherent in the process of adoption by providing information access, sources of reliability, and symbols of legitimacy to potential adopters. In the IT context, MIS opinion leaders can facilitate the promotion of new applications and training of users (McLeod and Fuerst, 1982) as well as foster MIS infusion (Kwon, 1990).

The most appropriate example of a critical adoption driving diffusion is the case of BITNET (Gurbaxani, 1990). BITNET was established through a link between the *City University of New York* and *Yale University*. Subscription to the network was based on the operating philosophy that a new adopter has to provide a line to the nearest network node. In the formative stages, BITNET was confined to institutions

in the U.S. east coast. As Gurbaxani (1990: p. 74) noted, "A significant event in the evolution of BITNET was the adoption by the University of California at Berkeley. This greatly lowered the access costs to other western universities who subsequently joined the network."

We build on Gurbaxani (1990) by considering a critical event and develop two regimes to see the differential types of influence on the diffusion pattern. Specifically, we consider *Kodak*'s decision as a critical event for the following reasons: One, this represented a higher level of visibility for the administrative practice than prior user-vendor relationships due to the prominence of the two companies and the magnitude of the contract ($500 million). Two, this seems to have provided a major impetus for managers in other organizations to seriously evaluate outsourcing as a governance option. As Kirkpatrick (1991: p. 103) noted, "The move startled computer managers across corporate America. No company of Kodak's size and prominence had ever turned over its computers to an outsider..." Indeed, this decision sparked a greater level of interest in this mode of IT governance: "For the majority of organizations, however, the idea became thinkable only when large and visible corporations such as Eastman Kodak Co.... began to publicize their plans to divest and openly discuss the cost benefits of outsourcing."[20] A leading outsourcing consultant attributed the current interest in outsourcing to the *Kodak* decision: "The Kodak contract was really the watershed event. The fact that Kodak is doing this sends a message that it is OK to go to outsourcing."[21] No other single decision seems to have as much impact during the time period that we considered in this paper.

We use the terms "Kodak effect" to signify the importance of the *Kodak* critical event in driving the diffusion pattern of IT outsourcing. Specifically, we examine whether the post-*Kodak* regime exhibits a different pattern of influence than the pre-*Kodak* regime. For this purpose, we consider the time period -- April 1988 to July 1989-- as the first diffusion regime, and the time period -- August 1989 to

August 1990-- as the second diffusion regime. Our second research question is:

> ***Research Question 2:*** *What source of influence best characterizes the diffusion of IT outsourcing before and after the Kodak-IBM contract?*

Methods

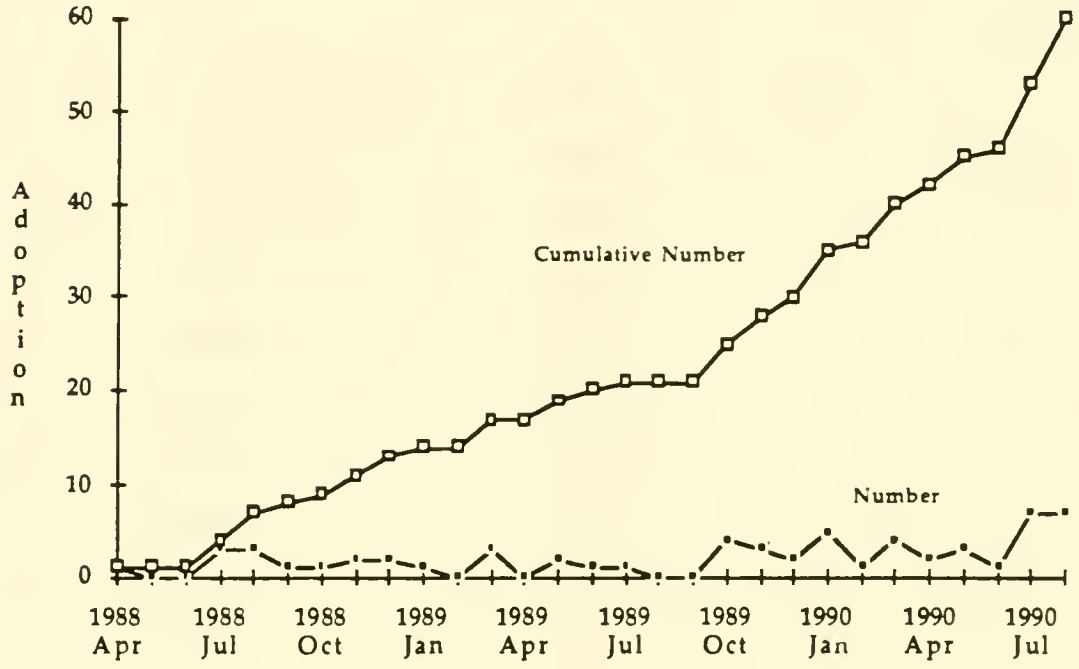
Sample

We generated a sample of outsourcing contracts by an electronic search of two CD-ROM databases -- *Newspaper Abstracts Ondisc* and *Business Dateline Ondisc* -- produced by *University Microfilms International* (*UMI*). The first contains indexes of seven major daily newspapers, while the second provides the full text of articles of nearly 180 regional magazines, daily newspapers, and wire services. We performed a comprehensive search of these information sources starting from January 1985 (as constrained by the databases) and identified a total of 60 outsourcing contracts spanning the time period April 1988 to August 1990.[22] We included both facilities management outsourcing and systems integration outsourcing, which are two major modes of IT outsourcing practiced currently and are consistent with our earlier definition. Appendix A provides a detailed breakdown of the contracts. The average size of the contracts is $191.1 million (with a standard deviation of $589.9 million), while the average duration of the contracts is 5.6 years (with a standard deviation of 5.0 years). Figure 1 shows a time-plot of the outsourcing adoption.

Analytical Framework

Mahajan et al. (1988) developed and used a linear analogue approach to test the imitation hypothesis in the case of M-form structure. This approach is, however, subject to econometric limitations such as multicollinearity and non-availability of standard errors for the crucial parameters (p, q, and m) of equations (1) to (3). Hence, we adopt nonlinear least squares (NLS) estimation of the three models. The inferential procedures are based on a special class of model specification tests developed by Davidson and MacKinnon (1981) for the case of a non-nested

Figure 1
Diffusion Pattern of IT Outsourcing



nonlinear alternative hypothesis. For testing the linear null hypothesis and a nonlinear alternative hypothesis, we apply the J-test; and for testing nonlinear null and alternative hypotheses, we apply the P-test. These specialized tests are necessary as the conventional F-test is inappropriate when the alternative hypothesis is non-nested with respect to the null hypothesis. Under such circumstances, we cannot simply constrain a portion of the hypothetical functional form to be zero. Figure 2 is a schematic representation of the analytical framework.

The null hypothesis. A stringent null hypothesis is that the diffusion pattern follows a white-noise or random walk process (Mahajan et al., 1988). This specifies that the difference between the numbers of adopters at t and (t-1) is random, implying that the rate of diffusion will be driven by the error term only. The mathematical form of the null hypothesis posits that the first differences in the noncumulative adoption time-series are random:

$$x(t) = x(t-1) + e(t) \tag{4}$$

where x(t) is the number of adopters at time t, and the residuals e(t) have a zero mean (e(t) is uncorrelated with e(t-k) for all nonzero k). Equation (4) specifies that the adoption time-series will proceed by a sequence of unconnected steps, starting each time from the value in the previous period.

The internal-influence model. Solving equation (1) to obtain the functional form for estimation, we have:

$$N(t) = \frac{m}{1+\frac{m-m_0}{m_0}\exp(-qmt)} \tag{5}$$

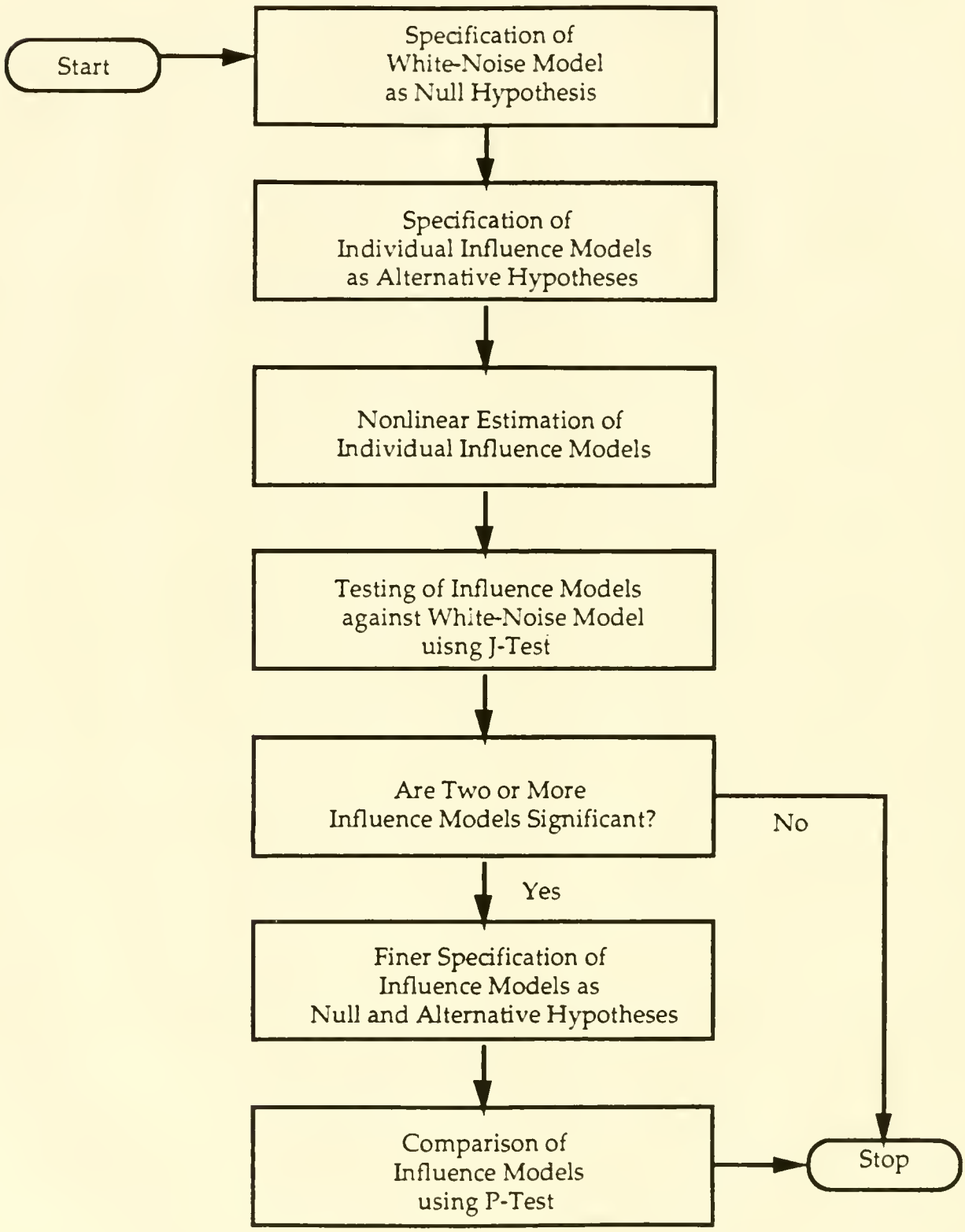
where m_0 represents the number of adopters in the initial period. Using a discrete formulation, we obtain the following functional form:

$$x(t) = m\left[\frac{1}{1+\frac{(m-m_0)}{m_0}\exp(-qmt)} - \frac{1}{1+\frac{(m-m_0)}{m_0}\exp(-qm(t-1))}\right] \tag{6}$$

The external-influence model. From equation (2) earlier, we get:

$$N(t) = m\,[1-\exp(-pt)] \tag{7}$$

Figure 2
Analytical Framework



This results in the following functional form for estimation:

$$x(t) = m\,[\exp(-p(t-1)) - \exp(-pt)] \tag{8}$$

The mixed-influence model. An NLS estimation method for the mixed-influence model has been used by Srinivasan and Mason (1986) who showed that this nonlinear estimation procedure performed better than its ordinary least squares (OLS) and maximum likelihood estimation (MLE) counterparts. Accordingly, we use the following functional form:

$$x(t) = m\left[\frac{1-\exp(-(p+q)t)}{1+\frac{q}{p}\exp(-(p+q)t)} - \frac{1-\exp(-(p+q)(t-1))}{1+\frac{q}{p}\exp(-(p+q)(t-1))}\right] \tag{9}$$

Test of alternative models against the null white-noise model. In the null hypothesis, we have specified a white-noise model for the diffusion of IT outsourcing. As reasoned earlier, the usual F-test is inapplicable. Since our null model is linear, we employ the J-test as derived by Davidson and MacKinnon (1981). Accordingly, we estimate the regression:

$$x(t) = (1-\alpha)\, f(t) + \alpha\, \hat{g}(t) + u(t) \tag{10}$$

where $f(t)=x(t-1)+e(t)$ is the null white-noise model, $\hat{g}(t)$ is the predicted value under an appropriate alternative model based on a maximum likelihood estimation, α is some constant, and $u(t)$ is a random error which is normally and independently distributed with zero mean and constant variance. The econometric properties of the estimation and inference using equation (10) enable us to test the alternative influence model by applying the conventional asymptotic one-tailed t-test for the null hypothesis that $\alpha=0$.

Testing the influence models against one another. Here, both the null and the alternative hypotheses nonlinear. The P-test is thus used (Davidson and MacKinnon, 1981). This is similar to the J-test, except that we now estimate the following function:

$$x(t) = (1-\alpha)\, f(t) + \alpha\, \hat{g}(t) + \hat{F}\,\hat{B} + u(t) \tag{11}$$

where f(t) and g(t) are the appropriate null and alternative models respectively and $\hat{F}$ is a row vector containing the derivatives of f with respect to B (the parameters of f), evaluated at $\hat{B}$.

Evaluating the two research questions. The first research question is directly tested using the analytical framework (Figure 2) for the entire diffusion regime. Nonlinear estimation of the three influence models is performed, and the J-test is used to assess the relative adequacy of an influence model vis-a-vis the white-noise model. If two or more influence models turn out significant, we perform the P-test that allow us to directly compare the individual models. The second research question is appraised using the analytical framework in the two regimes (pre-*Kodak* and post-*Kodak*). The specification tests do not permit a direct verification of the models spanning across two different regimes. Our approach is based on the standard econometric technique of testing structural change by breaking up a full time series into separate regimes using some conceptually conceived cutoff points (Johnston, 1984). The research question is then evaluated by comparing the separate J-test and/or P-test results within each of the regimes and interpreting the results in terms of the dominant type of influence in the two regimes.

Results

Research Question 1: Influence Sources in the Diffusion of IT Outsourcing

Table 2 (a) summarizes the parameter estimates and the model fit for the three models. The estimated values for m range from 149 to 206, which are in line with predicted numbers of outsourcing adoption by a leading consulting firm.[23] We note that amongst the three influence models, the internal-influence model has the best absolute fit. Table 2 (b) presents the results of comparisons of the alternative specifications with the white-noise model using the J-test, while Table 2 (c) shows the results comparing different alternative specifications using the P-tests. Based on the J-test, all three specifications are significantly superior to the white-noise model ($p < .01$). However, based on the P-test, the internal-influence model emerges as

providing the better fit to the data when tested against the external-influence model ($p < .01$). It is interesting to note that the internal-influence model is able to reject the external-influence model but not the mixed-influence model. Further, the mixed-influence model is not able to reject either the internal- or the external-influence models. We believe this is due to the parsimony of internal-influence model specification that gives it the power to reject the external-influence model; on the other hand, being more fully specified, the mixed-influence model is difficult to be rejected.

To ensure robustness of the results, we carried out the same analyses with data aggregated at a quarterly level. These findings are summarized in Appendix B where we can observe generally consistent results as those obtained using monthly data. Most interestingly, we see that the external-influence model cannot even reject the null white-noise model under the J-test, but can now be rejected by the mixed-influence model under the P-test.

The mixed-influence model is an additive combination of the two basic models of influence: internal and external. While this is included for completeness, our primary concern is with the distinction between the two basic models of influences. Given that the mixed-influence model is more fully specified, it is not surprising that the internal-influence model *per se* is unable to reject the mixed-influence model outright in our results. Nevertheless, between internal and external influences, our results strongly support the dominance of internal influence in the diffusion of IT outsourcing.

Research Question 2: Kodak's Outsourcing as a Critical Event

Tables 3 and 4 summarize the results for the pre- and post-*Kodak* regimes respectively. The patterns in the parameter estimation and model fit correspond with those obtained earlier under the full regime. In the pre-*Kodak* regime, all three models are statistically significant when tested against the white-noise model using

Table 2
Diffusion Results for IT Outsourcing in the Full Regime

2(a) Parameter Estimation and Model Fit

Description	White-Noise	Internal Influence	External Influence	Mixed Influence
Parameter				
p	NA	NA	0.0111	0.0097
q	NA	0.0501	NA	0.0427
m	NA	206.48	200.01	148.99
Model Fit				
MSE	4.929	3.099	4.386	3.671
F-value	NA	24.130***	12.879***	12.278***
Adj. R^2	0.3921	0.6315	0.4590	0.5472

*** -- p<.01

2(b) Comparison with White-Noise Model using J-Test

Influence	t-statistic	p-value
Internal	4.212***	0.0002
External	2.497***	0.0096
Mixed	3.318***	0.0014

*** -- p<.01

2(c) Comparison between Models using P-Test

Alternative Hypothesis	Null Hypothesis (entries are t-statistic with p-value in parentheses)		
	Internal	External	Mixed
Internal	NA	2.747*** (0.0056)	0.927 (0.1818)
External	1.305 (0.1025)	NA	-1.164 (0.8720)
Mixed	1.287 (0.1054)	-2.901 (0.9962)	NA

*** -- p<.01

the J-test ($p < .05$). However, using the P-test, no one model emerges as being statistically superior to another. In the post-*Kodak* regime, all three models are statistically significant under the J-test ($p < .05$). However, using the P-test, the internal-influence model rejects the external-influence model ($p < .05$). The results pertaining to the mixed-influence model are similar to those discussed earlier under the full regime.

Our critical event is a facilities management outsourcing contract between *Kodak* and *IBM*. Thus, to ensure robustness of the results, we evaluate this research question using *only* the subsample composed of facilities management agreements for the pre- and post-*Kodak* regimes. The results are summarized in Appendix C. We can see that the patterns of statistical inference under the J- and P-tests are consistent with those based on the full dataset.

Our overall conclusion is that while all the models provide adequate fit to the data in the pre-*Kodak* regime, the external-influence model is clearly an inferior model when compared to the internal-influence model in the post-*Kodak* regime. The implication is that the *Kodak* event seems to distinguish between an antecedent regime that is not dominated by any single influence and a consequent regime that is characterized by internal influence (vis-a-vis external influence). Thus, we contend that there is a *Kodak* effect underlying this unique observed pattern of IT outsourcing diffusion.

Discussion

Diffusion of IT Outsourcing: Imitation as an Explanation

Our analyses and results of this study suggest that the internal-influence model is a better explanatory mechanism of the diffusion pattern of IT outsourcing than the external-influence model. Further decomposition of the time period into pre- and post-*Kodak* regimes indicates that the critical *Kodak* event significantly differentiates the pattern of influences in the diffusion of IT outsourcing -- internal influence dominates in the post-*Kodak* regime, but not before.

Table 3
Diffusion Results for IT Outsourcing in the Pre-Kodak Regime

3(a) Parameter Estimation and Model Fit

Description	White-Noise	Internal Influence	External Influence	Mixed Influence
Parameter				
p	NA	NA	0.0103	0.0105
q	NA	0.2089	NA	0.0102
m	NA	124.24	140.21	129.81
Model Fit				
MSE	2.667	1.242	1.336	1.443
F-value	NA	11.714***	9.964***	6.166***
Adj. R^2	0.0909	0.6048	0.5445	0.5082

*** -- p<.01

3(b) Comparison with White-Noise Model using J-Test

Influence	t-statistic	p-value
Internal	2.013**	0.0336
External	3.263***	0.0031
Mixed	3.283***	0.0030

*** -- p<.01; ** -- p<.05

3(c) Comparison between Models using P-Test

Alternative Hypothesis	Null Hypothesis (entries are t-statistic with p-value in parentheses)		
	Internal	External	Mixed
Internal	NA	-0.047 (0.5183)	-0.981 (0.8251)
External	-0.237 (0.5914)	NA	-1.223 (0.8766)
Mixed	-0.240 (0.5923)	0.974 (0.1748)	NA

Table 4
Diffusion Results for IT Outsourcing in Post-Kodak Regime

4(a) Parameter Estimation and Model Fit

Description	White-Noise	Internal Influence	External Influence	Mixed Influence
Parameter				
p	NA	NA	0.0172	0.0117
q	NA	0.0904	NA	0.2099
m	NA	217.91	201.51	151.09
Model Fit				
MSE	8.083	5.311	6.171	4.973
F-value	NA	12.727***	9.828***	9.265***
Adj. R^2	0.4700	0.6807	0.5954	0.6739

*** -- p<.01

4(b) Comparison with White-Noise Model using J-Test

Influence	t-statistic	p-value
Internal	2.585**	0.0148
External	2.364**	0.0199
Mixed	3.215***	0.0047

*** -- p<.01; ** -- p<.05

4(c) Comparison between Models using P-Test

Alternative Hypothesis	Null Hypothesis (entries are t-statistic with p-value in parentheses)		
	Internal	External	Mixed
Internal	NA	2.143** (0.0323)	0.290 (0.7806)
External	1.229 (0.1294)	NA	-1.453 (0.9078)
Mixed	1.200 (0.1347)	-1.690 (0.9374)	NA

** -- p<.05

Mahajan and Peterson (1985: p.18) noted that the internal-influence perspective is "most appropriate when an innovation is .... *socially visible*, and not adopting it places social system members at a 'disadvantage' (e.g., a competitive disadvantage in business)" .... (emphasis added). Mahajan et al. (1988) tested the imitative behavior in the adoption of M-form structure within the diffusion-of-innovation perspective. Our analyses are consistent with those of Mahajan et al. (1988) but with significant methodological enhancements. Our results strongly support Mahajan and Peterson's discussion of the role of social visibility since the imitative behavior explanation is more pronounced in the post-*Kodak* regime than in the pre-*Kodak* regime.

From the theory of imitative behavior, our results are in line with the notion of institutional isomorphism presented by DiMaggio and Powell (1983). Essentially, this isomorphic phenomenon arises from a basic organization-theoretic argument: "the major factors that organizations must take into account are other organizations" (Aldrich, 1979: p. 265). The tendency for organizations to model others is often a response to uncertainty. Such organizational models can diffuse directly through explicit interaction or an external change agent. The compelling logic of imitative behavior is best examined in the context of organizational legitimization. As DiMaggio and Powell (1983: pp. 151-152) articulated: "When organizational technologies are poorly understood, [and] when goals are ambiguous, or when the environment creates symbolic uncertainty, ... organizations tend to model themselves after similar organizations in their field that they perceive to be more legitimate or successful."

Nelson and Winter (1982: p. 123) discussed imitation as an organizational routine and noted: "envious firms, then attempt to duplicate [the] *imperfectly* observed success." It is important to recognize that although the performance effects of specific administrative innovations are never perfectly known, imitation nevertheless could occur (see Burt, 1987 and Scott, 1987 for elaborations of this

argument), possibly as an insurance against being locked-out of access to new resources or new sources of competitive advantage in the marketplace.

In summary, the above set of arguments contends that organizations mimic others when the underlying administrative processes are complex, especially under conditions of environmental uncertainty. The management of IT infrastructure has been made particularly complex given the uncertainties associated with the proliferation of competing standards, fluctuations in cost-performance trends, introduction of new systemic functionalities as well as risk of technological obsolescence (e.g., Keen, 1988, 1990; Strassmann, 1991). Beyond uncertainties within the technological environment, the role of IT in the business operations has changed from an administrative support role towards providing new sources of strategic advantage in the marketplace (e.g., McFarlan, 1984; Scott Morton, 1991). Such a shift could compel organizations to mimic seemingly successful administrative practices adopted by others within the social system.

While imitative behavior as an underlying determinant for innovation adoption may appear to be non-rational, our position is that it need not be so. In a broad sense, isomorphic behavior is linked to what DiMaggio and Powell (1983) termed as "collective rationality." Further, Fulk, Schmitz, and Steinfield (1990) developed the concept of rationality in the context of a social influence model. Accordingly, rationality is subjective, retrospective, and attributable to influence through information provided by others. However, the rational argument is best advanced in the economics literature on the adoption of standards (see for instance, Farrell and Saloner, 1985).

It is then possible that a firm adopts IT outsourcing as a deliberate strategic choice that is based on a sound and rationally-conceived economic analysis. A recent event study of stock market reactions to IT outsourcing established a positive impact on the market value of the user firms adopting this governance mechanism (Loh and Venkatraman, 1992b). The implication is that corporate performance is

enhanced through such efficient choice of IT governance mechanisms which is consistent with organizational economics (Williamson, 1991).

Our paper has added to the growing literature on the diffusion of administrative innovation (such as: M-form structure and joint venture) by proposing a set of arguments for the consideration of IT outsourcing as an administrative innovation. Further, from a methodological point of view, we have contributed by developing and using more powerful analytical estimation techniques than those traditionally used. In terms of IT research, this paper constitutes an attempt to empirically assess the diffusion pattern of a significant and current administrative innovation within the IT domain and complements the study conducted by Gurbaxani (1990) in the area of diffusion of an important technical innovation.

Limitations and Extensions

Contract size. Our results are based on outsourcing contracts that are sufficiently large to merit reporting in professional trade periodicals and may be biased to the extent that smaller outsourcing decisions might be made known to the professional community of IS managers through information sources not covered in our bibliometric search. However, we believe that due to their lower visibility, smaller contracts are not critical catalysts underlying imitative behavior in the diffusion of IT outsourcing. Thus, we do not think that the exclusion of the smaller contracts may have adversely affected our results and interpretations.

Time-period. Our bibliometric search was performed from January 1985 (which is the starting date of the databases) and no coverage of IT outsourcing that met our definition was located before April 1988. Our results are limited to the extent that the trade periodicals may have changed their criteria and emphasis in the reporting of IT outsourcing contracts. Further, it has been known that several organizations had outsourced their IT operations historically from the 1960s. As Markus (1984) uncovered, such usage of external vendors was confined to time-sharing or

processing services involving service bureaus, limited use of integrated computer systems and application software involving systems houses, and some facilities management involving professional services firms (see also Phister, 1979 for additional perspectives on the history of computing and information systems). These forms of vendor participation are, however not widespread -- for instance, facilities management had been largely confined within hospitals and educational institutions. Further, these contracts were not usually reported in the media as they are normally operational agreements related to the routinal conduct of the business (e.g., custom programming and item processing).

The contemporary form of outsourcing, as evident from the extant media coverage, constitutes a more fundamental reconstitution of the overall IT infrastructure strategy in the organization. To some extent, we believe this current use of outsourcing is in line with the evolutionary importance attached to the organizational information infrastructure. Thus, we are comfortable in the time frame selected for our analysis. More importantly, even if we include the few organizations that have outsourced before our starting point, the actual diffusion curve would be more S-shaped; in other words, the direction of the bias would make the internal-influence model more pronounced than we may have found. Had we uncovered the dominance of an external-influence model in the diffusion pattern *ex post*, a more rigorous examination of this bias would be an important extension of this paper.

Specification and estimation of models. We specified and estimated a class of diffusion models that is consistent with our conceptual level of analysis pertaining to the phenomenon as well as the current state-of-the-art in estimation procedures. Within the substantive domain of information technology, our model specification represents an improvement over prior work (e.g., Gurbaxani, 1990). As the analytical progress using the diffusion perspective gains momentum within IT research, investigators should assess whether the theoretical arguments could be

framed within other forms of diffusion models such as dynamic diffusion models (e.g., Chow, 1967; Dodson and Muller, 1978) where we can relax the assumption of a constant adoption population.

Expanding the scope of the model. A useful direction for future research would be to expand the scope of the constructs considered. For instance, our models assumed a population with homogeneous mixing, where the likelihood of communication between any pair of prior and potential adopters is equal. From an analytical point of view, it is possible to relax this assumption and incorporate the effects of social structure into the diffusion modeling using an event-history method (Strang, 1991). However, this should be based on corresponding theoretical support. For instance, it may be possible to develop arguments that the diffusion of IT outsourcing within the US economy is channeled by structural characteristics of the social relations that link the adopters. Then, it may be appropriate to use the degree of interlocking directorates between the user organizations and the technology vendors/systems integrators as well as membership in common professional bodies and associations. Such an approach could build from the work of Burt (1987) who considered the effects of cohesion and structural equivalence in the well-cited diffusion of medical innovation discussed in Coleman et al. (1966).

Complementing a cross-sectional model of IT outsourcing. Our study constitutes a longitudinal approach in explaining the incidence of IT outsourcing. This complements a cross-sectional approach used by Loh and Venkatraman (1992a) where the authors empirically examined the level of IT outsourcing using firm-level determinants derived from two contexts: business cost structure, business performance, financial leverage, IT cost structure, and IT performance. Our study suggests that the institutional context at the social system level may add value in delineating a more comprehensive model that can be empirically verified.

Conclusion

It is clear that IT outsourcing is an innovative governance mechanism within the US economy today. Our paper sought to understand the sources of influence in the pattern of diffusion of this governance mode. We provide strong empirical support for the internal-influence model; this model was more pronounced after the much-publicized *Kodak-IBM* outsourcing contract than before. We conclude with an enthusiastic call for further work on IT outsourcing -- both along cross-sectional and longitudinal perspectives.

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APPENDIX A
List of IT Outsourcing Contracts

Month	Year	User Organization	Vendor Organization	Type[1]	Amount ($M)[2]	Duration (Yr)[3]
April	1988	Wisconsin's Dept of Admin	Omni Resources	FM	2	1
July	1988	Dept of Energy (US)	Computer Data Systems	FM	158	na
July	1988	Federal Aviation Administration	IBM	SI	3600	na
July	1988	General Services Administration	Computer Data Systems	FM	na	na
August	1988	St Francis Hospital	Knowle 'ge Data Systems	FM	1.6	na
August	1988	CSC Credit Services	Equifa~	FM	na	na
August	1988	US Air Force Aeronautical Systems Div	TRW	FM	6.2	1
September	1988	US Army	TRW	FM	31.1	na
October	1988	Nippon Telegraph & Telephone	Cincinnati Bell Information Systems	FM	87.5	3
November	1988	Southern Union Co	Affiliated Computer Systems	FM	na	10
November	1988	Enron Corp	EDS	FM	na	10
December	1988	Marine Corps	Computer Sciences Corp	SI	106	8
December	1988	National Weather Service	Computer Sciences Corp	FM	5.9	na
January	1989	City of Huntington Beach	Mcdonnell Douglas Computer Systems Co	FM	2.7	na
March	1989	Boeing Co	DEC	SI	na	na
March	1989	Cullen/ Frost Bankers Inc	Systematics	FM	na	na
March	1989	Massachusetts Water Resources Authority	Computer Sciences Corp	SI	16	3
May	1989	Dept of Health And Rehab Services (Florida)	EDS	SI	100	3
May	1989	Trane Co	McDonnell Douglas Information Systems Co	FM	25	5
June	1989	H.J. Heinz	Genix	FM	15	3
July	1989	Eastman Kodak Co	IBM	FM	500	10
October	1989	Beacon Oil Co	Power Computing	FM	na	3
October	1989	First Tennessee National Corp	IBM	FM	na	4
October	1989	US Postal Services	Computer Sciences Corp	FM	33	3
October	1989	American Airlines Inc	Apple Computer Inc	SI	2.5	na
November	1989	Dept of Health And Soc. Services (Delaware)	EDS	FM	16.5	8
November	1989	Citicorp	MCI	SI	80	3
November	1989	JP Foodservices Inc	Infonet	FM	na	5
December	1989	First Fed Sav & Loan Assoc of San Gabriel	EDS	FM	na	7
December	1989	Defence Supply Service	EDS	FM/SI	60	5

[1]FM: facilities management outsourcing; SI: systems integration outsourcing.
[2]The abbreviation "na" represents data not publicly disclosed.
[3]The abbreviation "na" represents data not publicly disclosed.

APPENDIX A (CONTINUED)
List of IT Outsourcing Contracts

Month	Year	User Organization	Vendor Organization	Type	Amount ($M)	Duration (Yr)
January	1990	Dept of Agriculture	EDS	FM	10	5
January	1990	Dial Corp	Andersen Consulting	FM	10	5
January	1990	Team Bank	Systematics	FM	na	10
January	1990	Texas Comptroller's Office	EDS	FM/SI	na	na
January	1990	Dept of Housing And Urban Dev (US)	Atlantic Research Corp	FM	2.8	1.5
February	1990	First USA Merchant Services	EDS	FM	na	10
March	1990	American Cellular Coms & Lin Broadacsting	Cinninati Bell Information Systems	FM	40	na
March	1990	National Aeronautics & Space Administration	Sterling Software	FM	190	5
March	1990	Federal Aviation Administration	TRW	SI	138	3
March	1990	Meritor Savings Bank	EDS	FM	na	10
April	1990	First Tenessee Bank	EDS	FM	na	5
April	1990	Westmoreland Coal Co	EDS	FM	na	10
May	1990	Pomona First Federal Savings & Loan Assoc	EDS	FM	na	7
May	1990	Treasury Department (US)	Sears Business Centers	FM/SI	400	4
May	1990	Duracell	Genix	FM	11	5
June	1990	Westar Transmission	EDS	FM	na	5
July	1990	Sun Co Inc	Andersen Consulting	FM	200	10
July	1990	Ministry of Consumer & Commerc Rel	Andersen Consulting	SI	7	na
July	1990	Mudge Rose Guthrie Alexander & Ferdon	Information Management Technologies (Imtech)	FM	2	3
July	1990	Federal Home Loan Bank of Seattle	EDS	FM	na	na
July	1990	Oppenheimer & Co	Information Management Technologies (Imtech)	FM	3	3
July	1990	Defense Information Systems Selection & Acq	EDS	FM/SI	700	8
July	1990	National Railroad Passenger Corp	AT & T Computer Systems	FM	14	na
August	1990	Abb-Combustion Engineering	Power Computing	FM	na	2
August	1990	Defense Logistics Agency	Oracle Complex Systems Corp	SI	39.4	1
August	1990	First Fidelity Bancorp	EDS	FM	450	10
August	1990	Neodata Corp	EDS	FM	na	10
August	1990	US Europe Tactical Command & Control	TRW	SI	5.9	1.67
August	1990	Permian Corp	EDS	FM	na	10
August	1990	Workers' Compensation Board	Andersen Consulting	FM	na	5

Appendix B
Diffusion Tests in the Full Regime using Quarterly Data

We further examine our Research Question 1 using the diffusion data aggregated at the quarterly level. Table B1 presents the inferential results of testing an influence model against (a) the white-noise model using the J-test; and (b) another influence model using the P-test. The J-test indicates that the internal- and mixed-influence models reject the white-noise model ($p < .05$ and $p < .01$ respectively), while the external-influence model is unable to provide a better fit to the data than the white-noise model. However, based on the P-test, the external-influence model is rejected by the internal-influence model ($p < .10$) and the mixed-influence model ($p < .05$). This set of results establishes the robustness of those obtained using monthly data as discussed earlier in the text.

Table B1: Inference Results for the Full Regime using Quarterly Data

Alternative Hypothesis	Null Hypothesis (entries are t-statistic with p-value in parentheses)			
	White-Noise	Internal	External	Mixed
Internal	2.912** (0.014)	NA	1.847* (0.062)	0.261 (0.403)
External	1.344 (0.110)	0.921 (0.205)	NA	0.949 (0.193)
Mixed	3.203*** (0.008)	0.889 (0.212)	2.824** (0.015)	NA

*** -- $p < .01$; ** -- $p < .05$; * - $p < .10$.

Appendix C
Diffusion of Facilities Management Outsourcing in the Pre- and Post-Kodak Regimes

We assess the robustness of our results pertaining to Research Question 2 by analyzing the diffusion pattern using only facilities management outsourcing contracts. This is to account for the fact that our critical event (i.e., *Kodak* contract) is a facilities management agreement, and the influences in the social system may only operate via this specific type of outsourcing. Our results (see Tables C1 and C2) supporting the dominance of the internal-influence model over the external-influence model replicate those based on the full sample discussed in the text.

Table C1: Inference Results for Facilities Management Diffusion in the Pre-Kodak Regime

Alternative Hypothesis	Null Hypothesis (entries are t-statistic with p-value in parentheses)			
	White-Noise	Internal	External	Mixed
Internal	2.088** (0.029)	NA	-2.243 (0.977)	-2.639 (0.988)
External	2.319** (0.019)	-0.233 (0.590)	NA	-2.818 (0.992)
Mixed	2.287** (0.020)	-0.230 (0.589)	-1.372 (0.902)	NA

** -- p<.05.

Table C2: Inference Results for Facilities Management Diffusion in the Post-Kodak Regime

Alternative Hypothesis	Null Hypothesis (entries are t-statistic with p-value in parentheses)			
	White-Noise	Internal	External	Mixed
Internal	2.609** (0.014)	NA	1.386* (0.100)	0.015 (0.494)
External	2.616** (0.013)	0.961 (0.184)	NA	-1.521 (0.917)
Mixed	3.931*** (0.001)	0.963 (0.184)	0.178 (0.431)	NA

*** -- p<.01; ** -- p<.05; * - p<.10.

NOTES

[1]*Network World*, February 17, 1992: pp. 1, 31-36

[2] See *Computerworld*, December 25, 1989/January 1, 1990: p. 8 and *Information Week*, October 7, 1991: p. 44.

[3]The breakdown of industry outsourcing revenue for the year 1990 amongst the various sectors is as follows: 35% commercial; 38% federal; 20% international; 7% state/local government (*Computerworld*, May 20, 1991: p. 141).

[4]*Network World*, February 17, 1992: pp. 1, 31-36.

[5]Kirkpatrick (1991: p.104) reported that the 1990 revenue and market share for the five biggest outsourcing vendors are as follows: (1) EDS ($6110m, 20.7%); (2) IBM ($3900m, 13.2%); (3) Anderson Consulting ($1880m, 6.4%); (4) DEC ($1800m, 6.1%); (5) CSC ($1500m, 5.1%).

[6] The gross margin in the business has been estimated to be as high as 25-30% (Kirkpatrick , 1991: p. 104).

[7] *Computerworld*, June 4, 1990: p. 80

[8] Computerworld, January 13, 1992: p. 8

[9] *Computerworld*, June 11, 1990: p. 1

[10]*Wall Street Journal*, July 26,.1989: p. 3

[11]*Computerworld*, December 25, 1989/January 1, 1990: pp. 14-15

[12]In our definition, we do not include the case where the IT infrastructure is transferred to a wholly-owned subsidiary as the mode of governance is still "hierarchical" as opposed to "market."

[13]*Computerworld*, April 16, 1990: p. 77

[14]*Computerworld*, September 30, 1991: p. 1

[15]*Computerworld*, September 16, 1991: p. 113

[16] *Computerworld*, November 11, 1991; p. 70

[17]Computerworld, January 14, 1991: p. 10

[18]*Wall Street Journal*, July 26, 1989: p. 3. At the same time, *Kodak* also outsourced its microcomputer systems operations to *Businessland*.

[19] See *Harvard Business School* cases, "Eastman Kodak Co.: Managing Information Systems Through Strategic Alliances," 1-192-030 and "Digital Equipment Corporation: The Kodak Outsourcing Agreement," N9-191-039 for background details.

[20]*Computerworld*, January 8, 1990: p. 67

[21]Interview with Howard Anderson, the managing director of *The Yankee Group* reported in *Computerworld*, January 8, 1990: p. 76.

[22]First, we conducted an exploratory search to discern the patterns of reporting for outsourcing contracts in the databases. Next, we generated our sample using a generalized search procedure which avoided any bias to any vendor or user. We used the following search commands to draw out all the contracts in the databases: term(contract) AND (computer OR system OR information) AND xxx, where we respectively used outsourcing, facilities management, systems integration, time-sharing, network management, systems management, information management, and data processing management for xxx. Throughout this procedure, we are confident that the sample is adequately comprehensive for the results to be generalizable.

[23]*Network World*, July 2, 1990: pp. 1, 47