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ORGANIZATIONAL ASSIMILATION OF INNOVATIONS: A MULTILEVEL CONTEXTUAL ANALYSIS

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This study examined the assimilation of innovations into organizations, a process unfolding in a series of decisions to evaluate, adopt, and implement new technologies. Assimilation was conceptualized as a nine-step process and measured by tracking 300 potential adoptions through organizations during a six-year period. We advance a model suggesting that organizational assimilation of technological innovations is determined by three classes of antecedents: contextual attributes, innovation attributes, and attributes arising from the interaction of contexts and innovations

Why and how do organizations evaluate, adopt, and implement innovations? Few research questions have spanned so many social science disciplines, elicited such an outpouring of empirical research, and yielded so few unequivocal findings. The literature on innovation has been described as "fragmentary" (Kelly & Kranzberg, 1978: 164), "contradictory" (Kimberly & Evanisko, 1981: 698), and "beyond interpretation" (Downs & Mohr, 1976: 700). No real theory has emerged that permits researchers to predict the extent to which a given organization will employ a given innovation (Mohr, 1982). The literature offers little guidance to those seeking to influence the rate or direction of technological change (Tornatzky et al., 1983). From both theoretical and practical perspectives, our cumulative knowledge of why and how organizations adopt and implement innovations is considerably less than the sum of its parts.

This article draws on extensive observations of organizations assimilating technological innovations conducted as part of a six-year field study (Greer, Greer, & Meyer, 1983). *Assimilation* is defined here as an organizational process that (1) is set in motion when individual organization members first hear of an innovation's development, (2) can lead to the acquisition of the innovation, and (3) sometimes comes to fruition in the innovation's full acceptance, utilization, and institutionalization.

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Our research, which concerned the assimilation of medical innovations into community hospitals, focused on discrete decisions about specific equipment. Taking decisions rather than organizations as the unit of analysis broke with a tradition of conceptualizing innovativeness as a global, systemic property of organizations. Instead, our study approached each hospital's assimilation of each innovation as the unfolding of a unique series of choices, attracting different participants, triggering different processes, and subject to shifting incentives and constraints. As a physician we interviewed put it:

> On one end you have the doctors. A lot of us want the very latest medical equipment—both for our patients' sake and for our own sake. Medicine's extremely competitive . . . there's competition for referrals and competition to be known as the guy who can handle a really tough, challenging case. This sort of competition generates incessant pleas for new equipment.
>
> On the other end you have the board members. They ask, "How are we ever going to pay for all this?" As a rule, doctors and boards never meet, so the decisions are made separately, at different levels, according to different criteria. These can range from malpractice liability to the hospital's competitive effectiveness.
>
> But sandwiched in the middle, between the doctors and the board, you have the administrators. They're the people who have to listen to the arguments and threats flowing in from both ends, and ultimately, they're the ones . . . who somehow concoct a capital budget.

CONCEPTUAL AND METHODOLOGICAL ISSUES

The doctor's description crisply summarizes this study's perspective on the organizational assimilation of technological innovations. In characterizing assimilation as a dynamic, multilevel choice process, he underscored four clusters of conceptual and methodological issues for innovation researchers.

Antecedents of Assimilation

The doctor cited factors ranging from malpractice liability to organizational strategy as influencing the acquisition of innovative medical equipment. After investigating a number of potential antecedents, researchers, too, have found fragmentary evidence linking the adoption of innovations to attributes of environments, organizations, leaders, members, and the innovations themselves. But most of the links are tenuous. Some investigations have retrospectively inferred antecedents from correlational analysis (Aiken & Hage, 1971; Daft & Becker, 1978; Moch & Morse, 1977), but such analyses mask underlying causal processes. Most comparative studies with large samples have examined short lists of predictor variables. Consequently, little is known about the relative influence of the predictors (Baldridge & Burnham, 1975; Kimberly & Evanisko, 1981), and virtually nothing is known about how they interact (Downs & Mohr, 1976).

Processes of Assimilation

Innovations, the doctor noted, are not adopted instantaneously by individual decision makers. They infiltrate organizations, moving between social units and passing through such phases as awareness, evaluation, adoption, utilization, and institutionalization (Beyer & Trice, 1978; Daft, 1982; Ettlie & Vallenga, 1979). Few studies, however, have examined the choice processes that precede adoption (Tornatsky et al., 1983) or assessed the utilization of innovations after their adoption (Kimberly, 1981).[1] Although there are some notable exceptions (cf. Beyer & Trice, 1978; Nutt, 1986; Pelz & Munson, 1982), much of the implementation literature is impressionistic. The few studies systematically measuring implementation over time (Beyer & Trice, 1978; Yin, 1977) have investigated only one or two innovations. Consequently, their findings can be challenged on the grounds they are idiosyncratic to the particular innovations studied (Bigoness & Perrault, 1981).

Effects of Assimilation

Medical innovations, the doctor pointed out, have multiple consequences for multiple participants in hospitals. The implication for researchers is that refined methods of measuring the antecedents of adoptions may produce few benefits unless matching refinements in measures of effects are also introduced. Downs and Mohr (1976) pointed out that innovation researchers have seldom measured their dependent variables with precision. After reviewing the literature, those authors reported that the most common measure merely established the date of an innovation's initial adoption and the next most common measure simply drew a nominal distinction between adoptions and nonadoptions.

Recently, a number of researchers have taken the organization as their unit of analysis and measured innovativeness as a global property (Aiken & Hage, 1971; Dewar & Dutton, 1986; Kimberly & Evanisko, 1981; Mohr, 1969). The apparent rationales for aggregating adoptions of innovations include ease of measurement (Tornatzky et al., 1983), higher reliability and generalizability of findings than single-innovation studies provide (Downs & Mohr, 1976), and the implicit assumption that because innovations benefit organizations, the more adoptions the better (Kimberly, 1981). Whatever the reason, the total number of innovations adopted has been the primary dependent variable in many recent studies. Researchers have generally assigned each organization a score reflecting the number of nominal adoptions it made, drawing on either an open- or a closed-ended list of innovations. However, in taking this aggregated approach, researchers are assuming implicitly, and probably inappropriately, that different innovations are homogeneous (Downs & Mohr, 1976; Tornatzky & Klein, 1982).

The practices cited aptly illustrate Weick's contention that "we typically do a fine grained analysis to isolate separate causes but then do a coarse

[1] In a meta-analysis of 75 studies of innovation characteristics, Tornatzky and Klein (1982) found only 5 studies that measured both adoption and implementation.

grained analysis when we examine effects" (1974: 366). When dissimilar innovation outcomes are lumped together and treated as a single effect, efforts taken to measure antecedents carefully are rendered pointless. Moreover, such lopsided efforts lead researchers to conclude erroneously that an "effect" might have arisen from any one of many possible causes. This situation, which Hannan (1971) termed overdetermination, can be remedied by carefully discriminating between subtle differences in effects.

Units of Analysis

Hospitals assimilate medical innovations, the doctor said, through multiple decisions, "made separately, at different levels, according to different criteria." Researchers trying to study temporal processes affected by multilevel factors have to grapple with two formidable and intertwined problems—selecting both levels of analysis and time frames for data collection. Specifying levels correctly is a precondition for educing operational measures of constructs, for selecting appropriate methods for aggregating data, and for concatenating variables into meaningful causal chains (Firebaugh, 1978; Freeman, 1979; Hannan, 1971; Roberts, Hulin, & Rousseau, 1978). Misspecifying them can introduce unobtrusive errors that cascade through research designs. Other difficulties ensue when data are aggregated across time in perfunctory ways. Severe inferential errors, for instance, may result when data collected at different times are pooled (Tornatzky et al., 1983), when research designs allow insufficient time for hypothesized causal processes to unfold, or when past effects are predicted from present causes (Kimberly, 1980).

Programmatic innovations are thought to be more subject to alteration during implementation than are technological innovations (Pelz & Munson, 1982). However, even innovations embodied in new equipment have few inherent attributes that can be ascertained unequivocally without reference to a specific organization at a specific time (Downs & Mohr, 1976). Identical pieces of new medical equipment might solve a long-standing problem for one hospital, create an opportunity for diversification in a second, and jeopardize well-established services in a third (Meyer, 1985). Similarly, organizations have few inherent characteristics that govern the assimilation of all innovations. The decision processes evoked in a particular hospital when ultrasonic imaging is proposed may scarcely resemble those evoked when laser surgery is proposed.

Researchers who construct innovativeness scores by adding nominally measured adoptions remove specific innovations from their social contexts, ignore pre- and post-adoption events, and raise the level of analysis in ways that are rarely acknowledged. They measure an aggregate construct— adopting lots of different innovations. But when the utilization of specific innovations is not assessed, their ultimate effects are obscured.

Conceptual and Methodological Prescriptions

If problems discussed above have contributed to the malaise afflicting innovation research, what remedies are available? This study's approach was to bring some refinements in research methods to bear upon a revised conceptualization of the adoption of innovations in organizations.

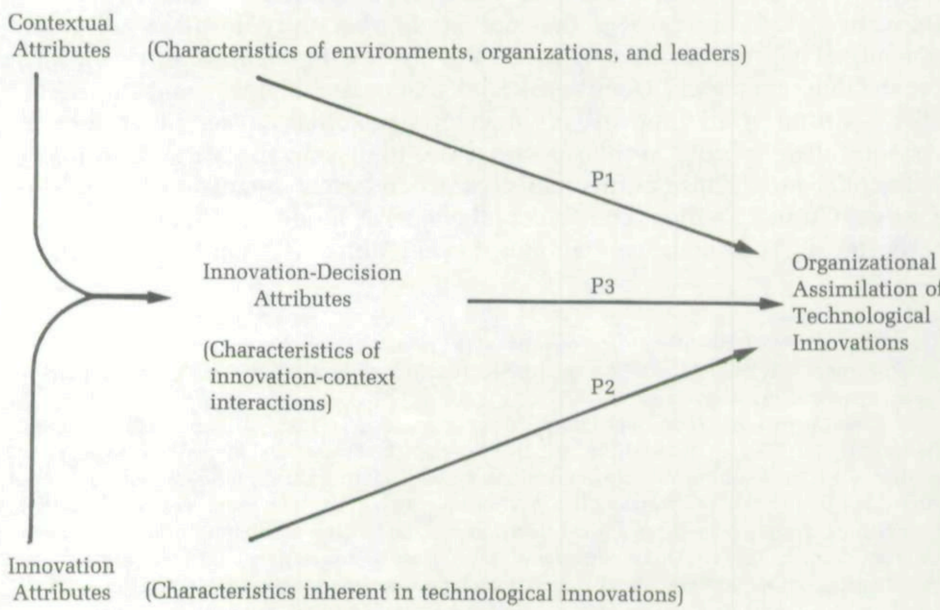
Those methodological refinements can be expressed as four prescriptions. We recommend (1) devising sensitive measures of the assimilation of innovations, (2) examining multiple antecedents of multiple innovations, (3) collecting both objective and perceptual data concerning antecedents, and (4) avoiding the aggregation of data across innovations, organizations, or time, unless theoretical justifications exist for doing so.

Figure 1 outlines our conceptual model. It suggests that three factors determine the assimilation of technological innovations into organizations: attributes of innovations, attributes of organizational contexts, and attributes arising from the interaction of innovations and contexts (termed "innovation-decision attributes" throughout this article). We evaluated the model by examining three general propositions:

> *Proposition 1: Contextual attributes influence organizational assimilation of innovations: characteristics of environments, organizations, and leaders each account for unique variance in assimilation.*

> *Proposition 2: Attributes of innovations influence organizational assimilation of innovations: technological characteristics of innovations account for unique variance in assimilation.*

FIGURE 1
A Model of Innovation Assimilation



> *Proposition 3: Innovation-decision attributes influence organizational assimilation of innovations: characteristics arising from the interaction of innovations and contexts account for unique variance in assimilation.*

Research Setting

The analysis set forth in this article drew upon a six-year field study investigating the diffusion of medical innovations into community hospitals[2] (Greer, 1984, 1986; Greer, Greer, & Meyer, 1983; Meyer, 1984, 1985). The central objective of that research was to build a grounded theory (Glaser & Strauss, 1967) by continuously comparing theory and data until adequate conceptual categories had been developed. Other articles have described the characteristic process by which hospitals were found to assimilate externally developed equipment (Greer, 1986; Meyer, 1985). Briefly, we have argued that an innovation presents an adoption opportunity to a hospital and triggers a set of formal and informal decision process that may end in awareness, evaluation, adoption, or implementation. This process unfolds within a multilevel context. Specifically, discrete medical innovations are apprehended, evaluated, adopted, and implemented within the context of formal capital budgeting systems, medical and administrative leadership, organizational structures and strategies, and constraints originating in a hospital's market environment.

Stages of Assimilation

Table 1 depicts the assimilation of medical innovations as a process consisting of three primary decision-making stages and nine substages.[3] It adapts prior frameworks (Ettlie & Vallenga, 1979; Rogers, 1983; Zaltman, Duncan, & Holbeck, 1973) to the context of community hospitals' adoption of medical equipment (Meyer, 1985). We portray innovations as triggering a predictable sequence of cognitive, social, and organizational events. Specifically, learning of an innovation's development often causes physicians to consider its feasibility in their hospital and to discuss the matter informally with colleagues. Those events may give rise to formal organizational budgetary evaluations. Medical and financial concerns tend to predominate in the early stages of hospitals' capital budget evaluations, with political and strate-

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[2] This article's first author was a member of the research team that collected these data with support from the National Center for Health Services Research, #R01 HS03238, Ann Lennarson Greer, Principal Investigator.

[3] Some theorists have questioned the validity of stage models (March & Olsen, 1976; Mintzberg, Raisinghani, & Theoret, 1976; Witte, 1972). Although the available evidence is meager, stage models seem more applicable to innovations embodied in concrete products than to those embedded in adaptable processes (Pelz & Munson, 1982). They also seem more applicable to innovations triggering preprogrammed decision routine instead of eliciting intuitive strategic choices (Norman, 1971). These considerations suggest that a stage model is appropriate for investigating equipment-embodied innovations whose adoptions hinge on satisfying medical, fiscal, political, and strategic criteria codified in hospitals' capital budgeting systems.

TABLE 1
Decision-making Stages in the Assimilation of Medical Innovations

Knowledge-Awareness Stage
1. Apprehension. Individual organization members learn of an innovation's existence.
2. Consideration. Individuals consider the innovation's suitability for their organization.
3. Discussion. Individuals engage in conversations concerning adoption.

Evaluation-Choice Stage
4. Acquisition proposal. Adoption of equipment embodying the innovation is proposed formally.
5. Medical-fiscal evaluation. The proposed investment is evaluated according to medical and financial criteria.
6. Political-strategic evaluation. The proposed investment is evaluated according to political and strategic criteria.

Adoption-Implementation Stage
7. Trial. The equipment is purchased but still under trial evaluation.
8. Acceptance. The equipment becomes well accepted and frequently used.
9. Expansion. The equipment is expanded, upgraded, or replaced with a second-generation model.

gic concerns arising subsequently. The acquisition of innovative equipment ushers in a trial period when actual results are evaluated. Auspicious results generally lead to acceptance and utilization, setting the stage for subsequent adoptions of the innovation.

However, the outcomes of adoption proposals are problematic at each stage. Informal discussions may reveal that an innovation does not merit serious consideration; formal proposals risk rejection on medical, fiscal, or political grounds; and acquisition does not ensure utilization.

METHODS

Innovation-Decision Research Design

The present analysis examined 300 processes of organizational decision making. We obtained the set of decision processes by investigating the extent to which 25 hospitals assimilated 12 medical innovations. That configuration constitutes an innovation-decision design in which the "unit of analysis is no longer the organization, but the organization with respect to a particular innovation, no longer the innovation, but the innovation with respect to a particular organization" (Downs & Mohr, 1976: 706). Data were collected using field interviews, questionnaires, organizational documents, and secondary sources.

Innovations. Medical innovations were defined as significant departures from previous techniques for diagnosis, treatment, or prevention, as determined by the collective judgments of experts in the field (Greer et al., 1983). Our objectives were to identify a representative array of new technologies, to study their adoption by organizations rather than individuals, and to observe adoption processes concurrently and prospectively. Accordingly, a panel of local and national medical experts assisted the research team in identifying a set of 12 innovations meeting three conditions. An innovation had to be (1) at an early stage in the diffusion process, (2) embodied in mechanical equipment, and (3) too costly and complex for individual physicians to adopt. The Appendix describes the innovations studied and the process of selecting them.

Organizations. The organizations studied included all 25 private, nonprofit hospitals within one federally designated Health Systems Area encompassing a large midwestern city and its rural hinterland. The hospitals had a similar goal—treating a broad range of short-term illnesses—and they encountered similar regulatory frameworks, labor markets, and standards of professional practice. However, they varied substantially along organizational dimensions such as size, structural complexity, and strategy and along environmental dimensions such as urbanization, market demographics, and wealth.

Informants. Interviews[4] were conducted between 1976 and 1980 with physicians ($N = 206$), administrators ($N = 70$), board members ($N = 46$), and nurses ($N = 33$) affiliated with the 25 hospitals. Interviewees included each hospital's chief executive and financial officers, convenience samples of board members and nurses, and physicians from 12 specialty areas[5] identified by the panel of medical school faculty members as eligible to use the studied innovations or likely to refer patients to users frequently. Interviewees were asked to describe an innovation's entire history in the hospital, noting their own initial awareness, identifying sponsors and opponents, describing progress through the capital budgeting system, and reporting final outcomes. The resulting interviews averaged about 90 minutes in length and generated over 3,000 pages of transcripts.

Measuring the Dependent Variable

Our fieldwork allowed us to chart the assimilation of each innovation into each organization over time. In most cases, members of the research team were able to observe choice processes as they unfolded. When that was

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[4] Interviews were conducted in three waves: between March and August 1976 ($N = 70$), between October 1977 and April 1979 ($N = 23$), and between May and October 1980 ($N = 285$). Overall, 71 percent of those contacted agreed to be interviewed. Faculty members and graduate students conducted the interviews. Appropriate steps were taken to enhance reliability (cf. Greer et al., 1983).

[5] Physician interviewees were drawn from the following specialties: pathology ($N = 22$), radiology ($N = 31$), cardiac surgery ($N = 11$), neonatology ($N = 4$), ophthalmology ($N = 21$), gastroenterology ($N = 14$), cardiology ($N = 17$), obstetrics and gynecology ($N = 18$), internal medicine ($N = 26$), family practice ($N = 16$), anesthesiology ($N = 6$), and general surgery ($N = 6$).

not possible, informants reconstructed the process retrospectively.[6] To help track adoption proposals, we enlisted informants' assistance in mapping the formal medical capital-budgeting system in each hospital on a flowchart (see Figure 2). The resulting charts varied in form and complexity, but each portrayed a multistage annual budgetary cycle, with adoption proposals originating in medical staff departments and going to a series of organizational destinations for various forms of evaluation. Proposals typically could be returned to certain destinations for reevaluation, and they had to bypass several routes to possible abandonment before receiving final budgetary approval.

In order to create a dependent variable for regression analyses, a 9-point Guttman-type scale was derived from the decision-stage model presented in Table 1. We then performed content analyses of the field interview transcripts, inspected the secondary data, and conducted telephone interviews to determine how far each assimilation process had progressed as of March 1981. The Appendix describes these procedures. In this fashion, each of the 300 innovation decisions was assigned an assimilation score on the following scale: (1) Members were aware of this innovation. (2) Members considered this innovation for this hospital. (3) Members discussed the equipment informally with colleagues. (4) Members formally proposed purchase of the equipment. (5) The equipment was approved on medical and financial grounds. (6) The equipment was approved on political and strategic grounds. (7) The equipment was purchased and under trial evaluation. (8) The equipment was accepted widely and used frequently. (9) The equipment was expanded, upgraded, or replaced with a second generation.

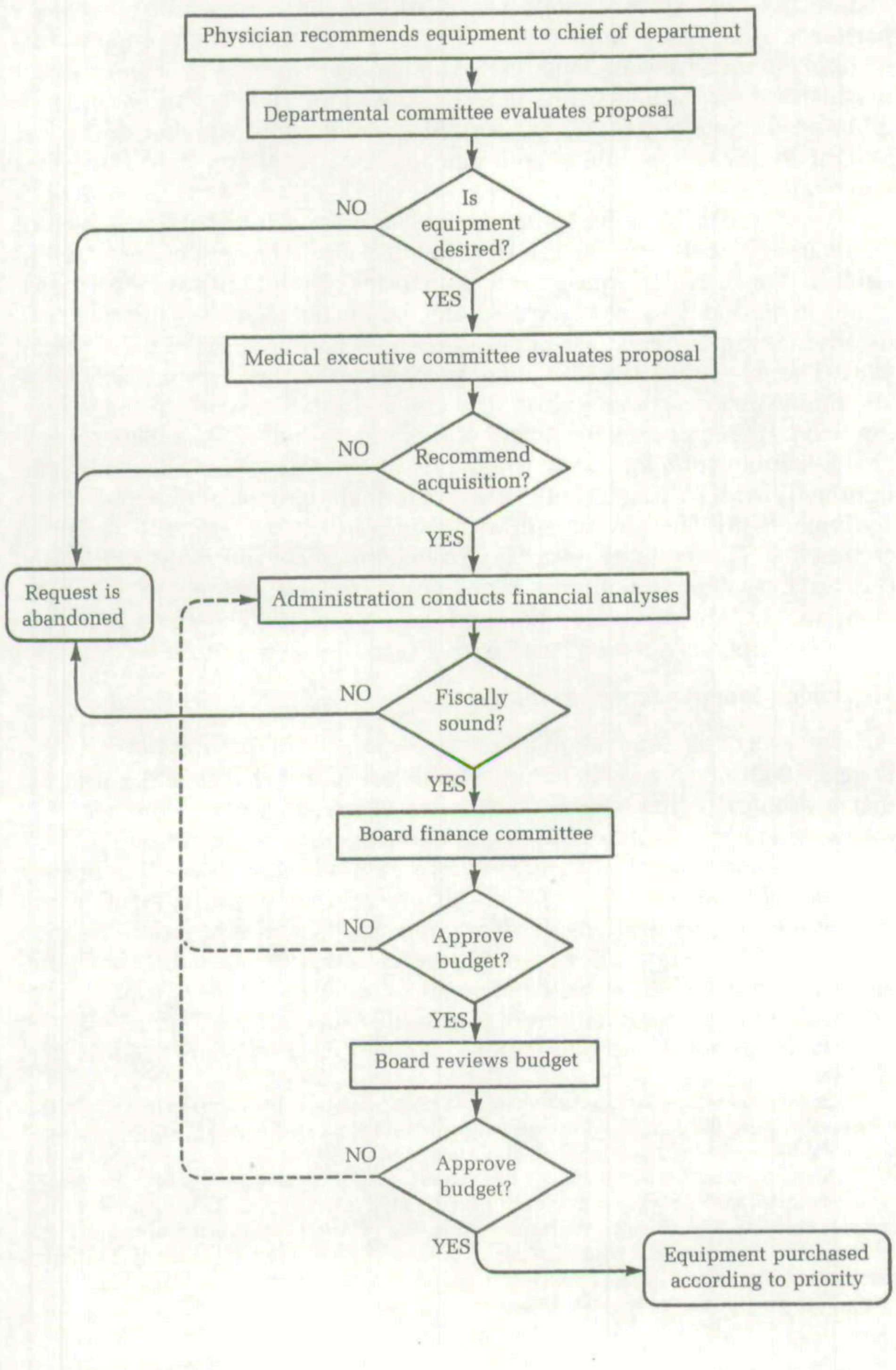
Measuring Independent Variables

Reviews of the innovation literature (Greer, 1977; Tornatzky et al., 1983; Rogers, 1983), coupled with our own fieldwork (Greer et al., 1983), suggested that attributes of innovations, attributes of organizational contexts, and interactions between innovations and contexts influence assimilation.

In an effort to verify, clarify, and extend this perspective, in the present analysis we examined five clusters of predictors measuring attributes of environments, organizations, leaders, innovations, and innovation-decision processes. To build on prior research, we included variables that have previously been found to be related to organizational adoptions of innovations. To enable causal interpretations of results, all secondary data were collected prior to the innovation assimilations they are used to predict. Some data

[6] Only retrospective data could be gathered from informants for 75 of the 300 innovation decisions because the equipment in question had been purchased before the field interviews began. For the remaining 225 innovation decisions, we obtained varying mixtures of prospective, concurrent, and retrospective reports. Although the possibility of some retrospective biasing cannot be ruled out, we sought to reduce it by framing interview questions that focused on concrete events and by using multiple informants. Even in the 75 cases where all reports were retrospective, no substantial discrepancies were observed when reports from different informants were compared. It seems unlikely that nurses, doctors, administrators, and board members would provide biased reconstructions that were equivalent.

FIGURE 2
Sample Flowchart of a Capital Budgeting System



were obtained by replicating established measures, and other measures were developed especially for this study. Table 2 lists the independent variables we examined. It cites some prior studies that have related them to innovation adoption, provides operational definitions, predicts bivariate relationships to adoption, and specifies data sources. The following sections briefly describe the five clusters of predictors, and the Appendix presents some further methodological details.

Environmental variables. Hospitals transact with their environments to acquire inputs such as patients, capital funds, and legitimacy. Many theorists have contended that organizations do not merely respond to preordained environmental conditions but actively create the environments they inhabit through processes of attention and choices of markets, products, and services (Weick, 1979). However, researchers have rarely measured enacted environments empirically.[7]

This study did so by merging two sets of secondary data. One was a patient-origin survey conducted by the state, which located by census tract each patient discharged from each hospital between June 1, 1976, and May 31, 1977. For every hospital, those data encompassed several thousand individual admission and referral choices of physicians and patients. When aggregated, they mapped the unique geographic market served by each organization. We then constructed demographic measures of these enacted environments from U.S. census data by calculating averages using the numbers of patients originating in different census tracts as weights. In this fashion, *urbanization* was measured in terms of average population density, *income growth* in terms of the average increase in median family income between 1960 and 1970, and *federal health insurance* in terms of the proportion of Medicare and Medicaid recipients. Our expectations concerning the environmental variable cluster were that *innovations would be more likely to be assimilated into organizations enacting environments that were urban and increasing in affluence and in which relatively few patients relied on federal health insurance.*

Organizational variables. A number of prior studies have reported that organizational size and structural complexity are related to the adoption of innovations (e.g., Rogers, 1983). We measured hospital *size* in terms of the number of patient beds, using a logarithmic transformation to adjust for curvilinearity (Kimberly, 1976). Following Meyer (1982), we measured *complexity* in terms of the availability of 24 distinct medical services. Since those services required either separate structural subunits or specialized staff members, the number available in a hospital reflects horizontal differentiation, the most common operational definition of complexity (Hall, 1987). Studies have also found that organizations' market strategies affect their

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[7] The enactment process is often misconstrued as limited to mental events or socially constructed realities. However, in a personal communication, Weick defined enactment as including concrete actions that confirm preconceptions. Thus, hospitals recruiting physicians or developing specialized programs in response to a perceived opportunity are enacting their environments.

TABLE 2
Independent Variables

Predictor Variables	Expected Relationships	Operational Definitions	Sources of Data
Environmental set			
Urbanization	+	Average population density within hospital service area (Baldridge & Burnham, 1975)	
Affluence	+	Average gain in median family income within hospital service area, 1960–70 (Baldridge & Burnham, 1975)	Patient origin survey (1977), U.S. Census data (1960, 1970)
Federal health insurance	–	Average proportion of Medicare/Medicaid recipients within hospital service area (Baldridge & Burnham, 1975)	
Organizational set			
Size	+	Log transformation of number of patient beds (Kimberly, 1976)	State rate review standards committee (1978)
Complexity	+	Availability of distinct medical services (Meyer, 1982; Moch & Morse, 1977)	
Market strategy	+	Aggressiveness in developing new services and penetrating new markets (Meyer, 1982)	Panel of local health care experts
Leadership set			
CEO tenure	+	Years of service (Kimberly & Evanisko, 1981)	Interview transcripts
CEO education	+	Years of education and degrees awarded (Kimberly & Evanisko, 1981)	Interview transcripts
Recency of staff's medical education	+	Median age of hospital's active medical staff (Greer, 1984)	American Medical Association
Innovation set			
Risk	–	Level of risk of injury, death, or malpractice liability (Meyer, 1985)	
Skill	–	Manual skill or specialized training requirements (Rosenthal, 1979)	Expert panel of medical-college faculty members
Observability	+	Impact of equipment on flows of patients (Meyer, 1985)	
Innovation-decision set			
Compatibility	+	Equipment's compatibility with pattern of medical staff specialization (Tornatzky & Klein, 1982)	Expert panel and rate review
CEO advocacy	+	Extent of CEO's support for adoption coupled with decision-making influence (Daft & Becker, 1978)	Content analysis of interview transcripts

proclivity to adopt innovations (Miles & Snow, 1978). Again following Meyer (1982), we measured *market strategy* by pooling the judgments of experts concerning the aggressiveness with which hospitals pursued new markets. With respect to the cluster of organizational variables, we expected that *innovations would be more likely to be assimilated into organizations that were large, complex, and eager to penetrate new markets.*

Leadership variables. Whether leaders' impacts on their organizations are primarily instrumental or symbolic is an unresolved issue (Pfeffer & Davis-Blake, 1986). However, both logic and some evidence (Hage & Dewar, 1973; Kimberly & Evanisko, 1981) suggest that those who allocate resources can influence adoptions of innovative equipment. Administrators and physicians share power in hospitals, and both are potential sponsors of innovations in medical technology (Greer, 1984). Among administrators, those with long tenures and graduate professional degrees are most likely to possess the budgetary acumen and the legitimacy needed to facilitate—or block—an adoption. Among physicians, those who received their medical training recently are most likely to have been exposed to state-of-the-art technology and to seek its adoption in their hospitals.

The tenure of the *chief executive officer* (CEO) was measured in years of service. Following Kimberly and Evanisko (1981) we measured the *CEO's educational level* using an index combining years of graduate and undergraduate education and degrees received. Among physicians, the *recency of medical education* was measured in terms of the median age of the members of each hospital's active medical staff. The expectations regarding this cluster of variables were that *innovations would be more likely to be assimilated into organizations whose chief executives had long tenures and high levels of education and whose physicians had been trained recently.*

Innovation variables. Innovations have certain inherent characteristics that influence their adoptability (Rogers & Shoemaker, 1971) and are relatively invariant across settings (Downs & Mohr, 1976; Tornatsky & Klein, 1982). For measuring characteristics like those, innovations are the appropriate units of analysis. One relatively invariant characteristic of particular pieces of medical equipment is the level of risk of injury or death to which they expose patients and the concomitant risk of malpractice litigation to which they expose physicians who use them (Meyer, 1985). A second characteristic likely to influence adoptability uniformly is the degree of manual skill or specialized medical training required to use an innovation (Rosenthal, 1979). A third characteristic is observability, the degree to which the results of using the innovation are visible to organizational members and external constituents (Rogers & Shoemaker, 1971).

Risk and *skill* were measured by pooling the judgments of a panel of medical college faculty members (see the Appendix for details). *Observability* was measured by reasoning that the visibility of medical equipment largely depends on its impact on patient flows. The basic issue then becomes who or what must be transported in order to use a piece of equipment: (1) patient specimens, (2) equipment within a hospital, (3) patients within a hospital, or (4) patients between hospitals. The expert panel used those four categories as an ordinal scale on which to classify the 12 innovations. The scale is grounded on the assumption that innovations are maximally observable if they affect patient admissions and transfers and minimally observable if they affect only flows of tissue specimens or blood samples. Our expectations regarding this cluster of variables were that *innovations would be more likely to be assimilated into organizations if, compared to other innovations, they required less skill to use, exposed patients and doctors to fewer risks, and were more observable.*

Innovation-decision variables. Certain factors affecting the assimilation of an innovation are unique to the evaluation of that particular innovation within that particular organization (Downs & Mohr, 1976). In such cases, the innovation decision becomes the appropriate unit of analysis. Two approaches are available for conducting an inquiry at this level: the direct approach is to measure variables by collecting data unique to each innovation within each organization; the indirect approach is to hypothesize a statistical interaction between two variables measured within more inclusive units of analysis than the innovation decision.

In this study, two innovation-decision variables were measured directly. An innovation's compatibility with the tasks and experiences of potential users has been the most widely investigated aspect of the fit between innovation and organization (Tornatzky & Klein, 1982). In the case of medical equipment, the primary criterion of compatibility is the presence on the medical staff of physicians practicing a specialty appropriate for using the equipment. A secondary criterion is the presence of physicians whose practices lead them to regularly treat patients who require referral to those user specialists. A tertiary criterion is the presence of physicians who refer patients only occasionally or who would enjoy other sorts of indirect benefits from the innovation. Accordingly, *compatibility* was measured for each innovation in each hospital by calculating an index reflecting the configuration of potential using physicians, referring physicians, and indirect beneficiaries (see the Appendix for details).

Another potentially important innovation-decision element is the extent to which an organization's CEO champions or opposes adoption (Beyer & Trice, 1978; Daft & Becker, 1978). In this study, we defined *CEO's advocacy* as influential support and measured it for each innovation by assessing the extent to which a CEO (1) personally supported acquisition and (2) exerted influence during decision-making processes. Our expectations regarding the directly measured innovation-decision variables were that *innovations would be more likely to be assimilated into organizations in which the innovations were compatible with patterns of medical specialization and whose CEOs were influential proponents.*

Two other innovation-decision variables were defined as statistical interactions between variables measured in more inclusive analytical units than we used for compatibility and CEO's advocacy. The first interaction term chosen for examination was *skill × recency of medical education*. We reasoned that the skill required to use an innovation would be a less important determinant of adoption in a hospital where medical training was relatively recent (Greer, 1986). The second interaction we examined was *observability* × *urbanization*. Theories about hospitals' responses to their institutional environments have maintained that organizations adopt innovations producing visible consequences for ceremonial reasons in addition to instrumental reasons (Meyer & Rowan, 1977). Research suggests that ceremonial adoptions are more prevalent in urban settings than in rural settings (Fennell, 1980), presumably because competition for patients, financial resources, and legitimacy is higher in urban settings.

Data Analysis

When a study's independent and dependent variables are conceptualized as pertaining to different units of analysis, the dependent variable determines the appropriate level of analysis (Freeman, 1978; Rousseau, 1985). This study's dependent variable was the assimilation of innovations into organizations. Because we conceptualized assimilation as the outcome of an unfolding series of organizational decisions, we conducted our analysis at the level of the innovation decision. In the model shown in Figure 1, assimilation is a multivariate function of the five sets of predictor variables discussed in the preceding sections. To measure those variables, we gathered data in different units of analysis, some of which were more inclusive than others. The result was a set of nested observations in which the research design restricts the variance of certain variables.[8] Table 3 presents the means, standard deviations, and intercorrelations of all variables included in the analyses.

The five sets of predictor variables were seen as differentiated in terms of causal priority: no variable in the organizational set appeared to be a likely cause of environmental characteristics, and no variable in the leadership set was a likely cause of either organizational or environmental characteristics. Similarly, innovation variables were not plausible causes of characteristics of leaders, organizations, or environments, and innovation-decision variables were not plausible causes of any other variable in the analyses. Simply stated, we assumed a weak causal ordering among the five sets of predictor variables.

However, our knowledge of the model's causal structure was incomplete. Although the environmental variable set, for instance, appeared to be causally prior to the organizational set, we could not specify the causal ordering of variables within either set, nor were we confident that unmeasured common causes were absent.

To capitalize on our partial understanding of the variables' causal structure, we chose hierarchical multiple regression as the method of data

[8] For example, the compatibility of an innovation with an organization is free to assume a unique value for each of the 300 innovation decisions, but reading an ultrasound image requires the same level of skill in all 25 hospitals, and the size of a hospital remains the same no matter which of the 12 innovations is under consideration.

TABLE 3
Descriptive Statistics and Correlation Matrix for All Variables

Variables	Means	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Innovation assimilation[a]	5.67	2.86														
2. Urbanization[b]	5,033.80	4,015.20	.23***													
3. Income growth[b]	81.35	20.00	−.22***	−.85***												
4. Federal health insurance[b]	2.21	1.07	.08	.67***	−.64***											
5. Size[b]	263.20	0.53	.32***	.55***	−.55***	.04										
6. Complexity[b]	20.44	7.11	.28***	.57***	−.50***	.11	.82***									
7. Market strategy[b]	2.37	0.81	.23***	.59***	−.52***	.22***	.70***	.57***								
8. CEO tenure[b]	7.88	4.80	−.07	.07	.19***	−.06	−.01	.02	−.06							
9. CEO education[b]	2.52	0.45	.14**	.39***	−.32***	.02	.45***	.53***	.23***	−.11						
10. Recency of medical education[b]	48.60	2.94	.01	−.07	.01	.20***	−.07	−.11	−.11	−.07	.10					
11. Risk[c]	2.53	1.65	−.65***													
12. Skill[c]	4.07	1.48	−.44***										.46***			
13. Observability[c]	2.67	1.11	.35***										−.25***	−.59***		
14. Compatibility[a]	65.25	44.16	.38***	.25***	−.18***	.19***	.08	.33	.23***	.04	.16**	−.06	−.47***	−.03	.05	
15. CEO advocacy[a]	4.42	1.28	.51***	.12	−.15**	−.03	.21***	.19***	.17**	−.11	.09	.03	.03	−.31***	.19***	.19***

[a] N = 300, measured at the innovation-decision level.

[b] N = 25, measured at the organization level.

[c] N = 12, measured at the innovation level. Correlations between organization-level variables and innovation-level variables are meaningless since the sampling strategy constrained their covariance to zero—the riskiness of an innovation didn't vary across the 25 organizations, and the urbanization of a hospital's environment didn't vary across the 12 innovations.

** $p < .01$

*** $p < .001$

analysis for this study. This technique provides a unique partitioning of the variance associated with different sets of independent variables (Cohen & Cohen, 1983). It allows tests of explicit hypotheses about the variance attributable to certain variables after others assumed to be temporally or causally prior have been accounted for.

If the assumption of weak causal ordering is tenable, intercorrelations between variables belonging to different sets of predictors present no problems of interpretation. Multicollinearity within each set of predictors, however, does pose problems. Consequently, we conducted item analyses to determine the feasibility of combining highly intercorrelated predictors into scales. The environmental, organizational, and innovation predictor sets each proved amenable to additive scaling (Cronbach's α's for the resulting scales were .89, .87, and .70, respectively).[9] The leadership and innovation-decision predictor sets, on the other hand, did not display either inordinately high intercorrelations or sufficient additivity for scaling (α's were .14 and .20). Consequently, we kept these predictors as separate variables in subsequent analyses.

A regression model was hypothesized and independent variables were introduced in five blocks. Since we assumed the environmental variables to be causally prior to all others, we entered the environmental scale first. The organizational scale came next, followed by the leadership variables and the innovation scale. Since innovation-decision variables were assumed to affect no other variables in the model, they were entered last. Model I F-tests of significance (Cohen & Cohen, 1983) were used to assess the changes in R^2 resulting from the addition of each new set of predictors.

RESULTS

Table 4 presents the results of the hierarchical regression of innovation assimilation outcomes on predictor variables entered in five blocks. It shows the standardized regression coefficients (β), adjusted coefficients of determination (R^2), and squared semipartial correlations (ΔR^2) after the entry of each block. R was significantly different from zero after the entry of each block. After block five was entered, with all independent variables in the equation, $R = .77$, $F_{10,289} = 42.1$, $p < .001$.

Predicting Innovation Assimilation

The central objective of our analysis was to evaluate the notion that three factors determine the assimilation of technological innovations into

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[9] These three scales also satisfy the criterion of theoretical plausibility. The items that form the environmental scale indicate that urban settings tend to afford less munificent health-care resources and to achieve lower rates of growth in personal income than other settings; the organizational scale indicates that large hospitals display more complex structures and appear more eager to penetrate new markets than others; the innovation scale reflects the tendency of highly observable diagnostic innovations (such as ultrasonic imaging) to reduce risks without requiring many new skills for their utilization.

TABLE 4
Results of Hierarchical Regression of Innovation Assimilation[a] on the Independent Variables

Variables	β	Standard Errors	R^2	ΔR^2
Environmental scale[b]	.20**	.057	.04	.04**
Organizational scale[b]	.29**	.064	.10	.06**
Leadership variables[b]			.11	.01
CEO tenure	−.08	.056		
CEO education	.01	.065		
Recency of medical education	.11	.091		
Innovation scale[c]	−.61**	.042	.48	.37**
Innovation-decision variables[a]			.59	.11**
Compatibility	.15**	.041		
CEO advocacy	.28**	.041		
Skill × recency of medical education	.12**	.041		
Observability × urbanization	−.02	.040		

Final $R = .77$
$F_{10,289} = 42.1$, $p < .001$

[a] $N = 300$.
[b] $N = 25$.
[c] $N = 12$.
** $p < .01$

organizations: contextual attributes, innovation attributes, and attributes stemming from the interaction of innovations and contexts.

Context as a predictor of assimilation. The first proposition in our conceptual model asserted that environmental, organizational, and leadership variables would account for unique variance in the assimilation of innovations. That assumption could be evaluated by determining whether and how much each set of contextual variables added to the regression model's ability to predict organizational assimilation. In block one of the hierarchical regression, the environmental scale afforded statistically significant, albeit modest, predictions ($\Delta R^2 = .04$). In block two, the addition of the organizational scale led to another significant but minimal increment ($\Delta R^2 = .10$). In block three, introducing attributes of leaders yielded no significant increment in predictive power.

Obviously, the contextual factors examined here predict innovation poorly; taken together, they account for only about 11 percent of the observed variance in assimilation. Nevertheless, the direction of the relationships indicated by the beta coefficients in Table 4 is generally consistent with our expectations—innovations were somewhat more prone to being assimilated into hospitals (1) serving urban environments and (2) exhibiting relatively large size, complex structure, and aggressive market strategies.

Innovation attributes as predictors of assimilation. The second proposition maintained that innate attributes of innovations would account for unique variance in their assimilation. This assertion could be evaluated by determining how much the scaled innovation variables added to the model's ability to predict organizational assimilation.

When the innovation scale was introduced into the regression model in block four, a marked improvement in prediction occurred ($\Delta R^2 = .37$). Apparently, medical innovations do possess innate attributes that significantly affect their adoptability—even after the effects of environmental, organizational, and leadership variables have been statistically eliminated. The zero-order correlations suggest that among the medical innovations examined here, those that were highly observable, carried low risks, and required relatively little skill to use were more readily assimilated than were other innovations.

Innovation-decision predictors of assimilation. The third proposition maintained that characteristics arising from the interaction of innovations and contexts would account for unique variance in assimilation. In block five, when the four innovation-decision variables were added to the model, another significant improvement in prediction occurred ($\Delta R^2 = .12$). This result suggests that in addition to their main effects, innovation variables and contextual variables interact to influence the assimilation of innovations.

The beta coefficients in Table 4 imply that an innovation is particularly likely to be assimilated if it is championed by a CEO who exerts substantial influence on its behalf. Compatibility with existing patterns of medical specialization also seems to facilitate assimilation—the greater the number of potential beneficiaries of a particular innovation, the more likely the hospital is to adopt and implement it. The results also suggest that skill and recency of medical education interact as anticipated; the amount of skill needed to use an innovation exerts a greater effect on its assimilation into a hospital the more years have elapsed since the typical physician completed his or her training. On the other hand, the expected interaction between observability and urbanization failed to materialize.

Overall, the results of the regression analyses offer reasonable support for the conceptual model and methodological approach proposed here. As we hoped, innovation assimilation appears to be a tractable dependent variable, and as we proposed it appears that innovation attributes, contextual attributes, and innovation-context interactions codetermine assimilation.

DISCUSSION

This study departed from a tradition of conceptualizing innovation within formal organizations as a systemic property and measuring it in terms of an aggregate innovativeness score. Instead, we conceptualized the dependent variable as the assimilation of innovations, characterized assimilation as a nine-step decision process, and measured assimilation by going to the field to track adoption proposals through organizations. We advanced a model suggesting that three classes of antecedents—contextual attributes, innovation attributes, and attributes arising from the interaction of innovations and contexts—determine the assimilation of technological innovations into organizations. We measured antecedents by gathering data from multiple sources using multiple methods and used those data to predict the outcomes of 300 innovation-assimilation processes in hospitals.

Two principal conclusions can be drawn from the results. One is that the proposed model affords reasonably good predictions of the extent to which a given hospital will assimilate a given innovation: 59 percent of the variance in evaluation, adoption, and implementation was explained. Second, the findings suggest that an organization's assimilation of a new technology is highly dependent upon attributes of the particular innovation in which it is embodied and upon attributes of the particular decision process in which it is aired. Organizational leaders, structures, and market environments appear to exert considerably less influence, at least in terms of their main effects. Our results do suggest, however, that these antecedents may influence assimilation by interacting with innovation attributes.

Before the implications of these findings are discussed, several caveats are in order. First, regarding the relative primacy of different classes of predictor variables, the results of our analyses are far from definitive. Some sets of predictors may have included more of the population of relevant variables than others, and variance was restricted for those variables not measured specifically for each innovation decision. Second, our results may lack generalizability. It is obvious that conclusions drawn from studying hospitals' adoptions of medical technology should be extrapolated cautiously to other organizations adopting other kinds of innovations. Moreover, although the innovation-decision research design used in this study appears to have facilitated prediction by capturing contextual idiosyncrasies, we may have gained accuracy at the expense of generalizability. In pursuit of internal validity, our approach has probably sacrificed external validity.

Nevertheless, this study's results may have implications for theory and research on organizational innovation. Attributes of innovations accounted for nearly 40 percent of the variance we observed in their assimilation. Previous comparative studies of innovation adoption in organizational settings have invoked innovation attributes categorically in establishing boundaries for midrange theorizing. For instance, researchers have drawn theoretical distinctions between routine and radical innovations (Dewar & Dutton, 1987), administrative and technical innovations (Kimberly & Evanisko, 1981), and product and process innovations (Pelz & Munson, 1982). However, those studies have not used innovation attributes as predictor variables. Thus, although the results presented here are not directly comparable with those of prior research, they do suggest that including innovation attributes in future studies of adoption and implementation may have considerable merit.

Organizational variables, on the other hand, accounted for considerably less variance in our study than earlier research had led us to anticipate. For instance, in an investigation of hospitals' adoption of medical innovations and computerized information systems, Kimberly and Evanisko measured many of the same predictor variables used in this study but concluded that "organization-level variables—size in particular—are *indisputably* better predictors of both types of innovation than either individual or contextual level variables" (1981: 709). (Their "individual" and "contextual level" predictors correspond to our "leadership" and "environmental" predictors.) But since Kimberly and Evanisko used organizational innovativeness as the dependent variable, the two sets of results lack comparability.

To enable a comparison, we recoded our set of 300 assimilation scores as adoptions or nonadoptions and aggregated these nominal data to the organizational level. This process yielded a single innovativeness score for each hospital. Next, we used the same predictor data to replicate, at the organization level, our analysis at the innovation-decision level. Table 5 presents the results of a hierarchical regression of the 25 hospitals' organizational innovativeness scores on the environmental, organizational, and leadership predictors. We omitted attributes of innovations and innovation decisions because the former take constant values when aggregated and the latter lose theoretical meaning. The regression model explains 74 percent of the variance in organizational innovativeness, with the largest contribution coming from the scale combining organizational size, complexity, and strategy.

The findings summarized in Table 5 closely resemble those of Kimberly and Evanisko (1981). In both analyses, organization-level variables afforded the best predictions of innovativeness, environmental variables explained about half as much variance as the organization-level variables, and leadership variables proved to have less explanatory power than the other sets. Such results are interesting and worth knowing; there are theoretical gains and practical advantages inherent in understanding which organizations are

TABLE 5
Results of Hierarchical Regression of Organizational Innovativeness[a] on the Independent Variables

Variables	β	Standard Errors	R^2	ΔR^2
Environmental scale	.44*	.187	.20	.20*
Organizational scale	.76**	.153	.62	.42**
Leadership variables			.74	.12
CEO tenure	−.24	.120		
CEO education	.14	.132		
Recency of medical education	.35	.180		

Final $R = .86$
$F_{5,19} = 10.7$, $p < .001$

[a] $N = 25$.
* $p < .05$
** $p < .01$

liable to adopt a high proportion of the technological innovations they encounter. But although organizational attributes like size and complexity may characterize generally innovative organizations, they need not lead to the adoption of discrete innovations. Research designs that take the organization as the unit of analysis are inappropriate if an investigator wishes to predict or explain the adoption of a *particular* innovation.

Consider how sharply the innovativeness results in Table 5 differ from the innovation-decision results in Table 4 even though the two analyses use the same data. This comparison underscores the consequences of unrecognized shifts in levels of analysis, and it suggests why certain variables thought to be theoretically relevant to innovation have displayed little explanatory power in earlier investigations (Downs & Mohr, 1976).

Innovation, like so many other constructs in organization theory, appears not only to assume different meanings at the individual and organizational levels of analysis but also to arise from different causal functions at different levels. It is probably a mistake to expect broad-scope examinations of organizational innovativeness to add much to our understanding of the adoption of innovations. It is probably equally mistaken to expect fine-grained studies of innovation assimilation to yield many new insights into organizational effectiveness and adaptability. Levels of analysis and domains of explanation are inextricably linked.

The results reported here may also have practical implications. Most prior studies of organizational innovativeness have found that leaders' characteristics afford poor predictions (Tornatzky et al., 1983), and they have reported few significant relationships involving variables that managers could reasonably be expected to manipulate. Consequently, many innovation researchers have joined Lieberson and O'Connor (1972) and Pfeffer (1981) in concluding that leaders have a limited impact on organizational actions.

Our findings present leaders in a more favorable light. They suggest, for instance, that although CEOs' demographic characteristics may not determine aggregate rates of adoption by their organizations, CEOs nonetheless can have substantial impact by championing the assimilation of specific innovations. Similarly, although the specialized expertise of professional organization members may exert no uniform effect on innovation adoption, in conjunction with the potential benefits or the skills required to use particular equipment, specialized expertise can become an important determinant of adoption and utilization.

In comparison to other operational definitions, measuring innovation in terms of organizational evaluation, acquisition, and utilization decisions comes closer to capturing the ebb and flow of events that people actually try to influence as members of their organizations. It may also come closer to capturing the construct that we actually want to explain as students of organizing. Moreover, aproaching innovation as an assimilation process may allow researchers to identify those occasions when innovations are adopted for ceremonial reasons. Like members of academic organizations plying sophisticated mathematical analyses to achieve publication, members of other organizations sport technological innovations to garner legitimacy in their own institutional environments (Meyer & Rowan, 1977).

For instance, state regulators' fears that health-care costs would rise owing to unnecessary purchases of computerized axial tomography (CT) scanners by the 25 hospitals we studied became a self-fulfilling prophecy. When the regulators decreed that only 6 hospitals would be authorized to purchase scanners, the edict transformed a risky investment into the quintessential symbol of a modern, technologically progressive hospital. Organizational decision makers increased revenue projections, opponents of adoption were converted into sponsors, and within four years, 14 of the 25 hospitals had purchased scanners. The potent ceremonial meanings ascribed to this equipment were evident when, in appealing a rejected request to purchase it, the city fathers of one municipality solemnly testified that a campaign to recruit industry to their community had been crippled by the absence of a scanner in the local hospital.

The city fathers won their appeal and got their CT—and a new factory moved to town. If their causal model was accurate, a ceremonial adoption (Meyer, 1984) undertaken to satisfy mythical expectations of an institutional environment (Meyer & Rowan, 1977) ultimately enacted an organization's objective environment (Weick, 1979). If the city fathers were correct, the assimilation of technological innovations into organizations may be considerably more complicated than organizational scholars have imagined.

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APPENDIX

Medical Innovations

In 1977, a five-member panel of medical college faculty members identified a list of innovations from which the following 12 were chosen for study: *automated batch analyzer*, computer-assisted automatic chemical analysis of blood serum; *computerized axial tomography*, diagnostic radiographic and computer techniques generating cross-sectional images of the body; *coronary artery bypass facilities*, equipment supporting saphenous vein autografts to bypass obstructed coronary arteries; *coronary precutaneous transluminal angioplasty*, treatment for coronary artery disease via dilation of a balloon within the artery to reduce circulatory obstructions; *electronic fetal monitoring*, continuous monitoring of levels of fetal stress; *fiberoptic endoscopy*, flexible scope for visualizing stomach, esophagus, colon, etc.; *laser surgery*, microsurgical equipment using laser beams in optical and gastrointestinal applications; *neonatal intensive care*, specialized monitoring and respiratory equipment housed in a nursery for premature infants; *phacoemulsification*, cataract removal procedure using ultrasonic vibrations to fragment the diseased lens; *radioimmunoassay*, diagnostic equipment for measuring antigen-antibody interaction in body fluids; *radionuclide scanning*, diagnostic imaging of gamma-ray emissions of radioactive labeled tumor-seeking agents; and *ultrasonic imaging*, pulsed sound waves used to map cross-sectional body topography on the basis of variance in acoustical impedance.

Assimilation of Innovations

The extent of each organization's assimilation of each innovation was determined as follows: (1) interview transcripts were divided into logical segments, attached to McBee sorter cards, and coded for retrieval; (2) all references made by all interviewees to a given innovation in a given hospital were retrieved using a needle-sort procedure and arranged chronologically according to the date of the interview; (2) two raters independently assessed the highest score achieved on the adoption scale; (3) discrepancies were eliminated by reanalyzing interview data and when necessary, recontacting interviewees; (4) scores between 7 and 9 on the scale were verified by consulting the state's annual survey of services available in hospitals, Certificate of Need applications, and other secondary data sources.

Organizational Attributes

Eight industry experts rated the hospitals' market strategy on a 4-point scale anchored as follows: This organization (1) seeks to dominate secure niches in stable health-care markets; (2) prefers to serve traditional markets, but may add services to remain viable; (3) attempts to incorporate innovative programs while preserving a firm base of traditional services; (4) seeks to pioneer in developing innovative services and programs. The experts rated market behavior displayed during 1978. Their ratings had an interclass correlation of .89.

Innovation Attributes

Seven medical college faculty members used 7-point scales to rate the innovations in terms of risk, defined as the degree to which the medical profession accepted the equipment as safe and efficacious in 1978, and skill, the extent of specialized expertise or training needed for a typical specialist to begin using the equipment in 1978. Interclass correlations for risk and skill were .76 and .95, respectively.

Innovation-Decision Attributes

Compatibility scores (C) were calculated for each innovation in each hospital as follows: $C = 3U + 2R + B$, where U = the number of physicians serving on a hospital's active medical staff in 1976 practicing in a medical specialty that utilized that equipment directly, R = the number whose practices regularly generated referrals of patients to utilizing specialties, and B = the number making infrequent referrals or otherwise benefiting indirectly from acquisition of the equipment.

CEO advocacy was measured by constructing an index combining a CEO's personal position concerning an innovation (support, opposition, or neutrality) and the amount of power that he or she exercised during decision making (high, medium, or low).

The CEO's support was determined as follows: (1) using the McBee sorter cards, all relevant interview segments were retrieved using a needle-sort procedure; (2) two raters independently classified these segments as displaying opposition, neutrality, or support by the CEO; (3) 14 disagreements between raters were resolved through discussion, and 7 were resolved by recontacting informants.

The CEO's power was assessed in terms of the rate at which participants alluded spontaneously to the CEO while reporting a decision process. We reasoned that such allusions indexed the CEO's influence on the process and constituted a measure of attributed power that is likely to have more validity than self-reports concerning power (Pfeffer, 1981). Power was measured as follows: (1) interview segments describing relevant decision processes were retrieved; (2) a rater counted the number of references made by all informants to the CEO, either by name or by position; (3) to control for variations in informants' verbosity, the number of references was divided by a description's total length in words; (4) the resulting values were trichotomized into high, medium, and low.

Finally, measures of the CEO's position on adoption and power during decision making were combined to yield an advocacy score on the following 7-point scale:

Position	Opposes			Neutral	Supports		
Power	H	M	L	H, M, or L	L	M	H
Advocacy score	1	2	3	4	5	6	7

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