Whether, When, and How to Innovate with Information Technology:
What Do Empirical Studies Tell Us?

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ABSTRACT

In this essay, we examine recent empirical research that addresses what determines whether, when, how, and with what success organizations innovate with information technology. We employ an analytic framework that joins an institutional perspective on the innovation process to a view of purposefulness and alternative rationalities in innovative action. We tie together the findings of some 82 studies across the innovation process lifecycle, from innovation comprehension to adoption, implementation, and assimilation. We consider too the alternative rationalities that are invoked by this body of research.

From our review, we find that the focus of our research community to date has been on the instrumental aspects of IT innovations. Additionally, the innovation comprehension process has come in for relatively little attention. This leads us to argue from our perspective that the more interesting and informative research contributions are and will continue to be those that take process and cognition seriously. We would encourage too studies which address the innovation phenomenon in greater scope, relative to our framework. We conclude with a focal set of questions with which to guide future research.
Whether, when, and how to innovate with information technology (IT) – this crucial question is commonplace in one form or another among today’s managers. Answering it poses particular challenges. Deciding whether and when to innovate with new IT demands a critical assessment of the innovation, including its enabling technology, its maturity, its reputed advantages, and its scope of applicability. Simultaneously, it requires managers to assess the organization itself in terms of its own needs and readiness. Such assessments may be problematic, as the innovative concept and its related technology may be difficult to grasp and appraise. Consider, for example, "knowledge management" (Zack, 1999) as an IT-based innovation. The recent trade press reports that “… although knowledge management remains one of the hottest buzz phrases in the business world, it’s also among the most nebulous. Blame an amazing array of software … that’s being touted for knowledge management.” (Garner, 1999, p. 50)

How to innovate with IT presents additional issues for decision makers. The challenge of implementation typically presents a panoply of options and obstacles, and many initiatives fail once organizational change is attempted. While the basic concept of the innovation may be appealing, essential know-how may be lacking. Not only is the adopting organization itself likely to lack the knowledge, but acquiring it from the broader community may be problematic, as experience and demonstrated success there may be thin. In the case of knowledge management, for instance, it is now admitted, “Translating theory into practice has proved a lot harder than anyone imagined.” (Garner, 1999, p. 50)

Deciding the matter of whether, when and how to innovate with an IT innovation thus necessarily links organizational decision making to developments affecting the innovation in a wider community. We observe in some cases, for example, that the lingering absence of compelling success stories can cause the basic wisdom of an innovation to be called into question in such forums as the trade press, reports of research think-tanks, the talk at executive roundtables, and consultancy advertising. Satisfaction with knowledge management, for instance, has apparently now come to rank very low. “The bloom is fading off the knowledge-management rose,” it is openly said (Garner, 1999, p. 50). And some disillusioned pioneers in knowledge management
even now disassociate themselves from the name. “I have no interest in knowledge management, but in knowledge use,” says one, now taking a different tack on the problem (Garner, 1999, p. 50). Pioneering organizations' implementation experiences – and sometimes the lack of implementation stories altogether – feed back through the communication channels of the wider community and affect firms’ decisions concerning when to move on an innovation, how deeply to commit to it, or even whether to adopt it at all.

In short, innovating with IT is never purely an organizational process, but instead joins organizational process to events and activities taking place in a wider interorganizational community. While organizations are said to "innovate" when they adopt and implement technology new to themselves (Rogers, 1995), invariably their decisions and actions link them to a larger institutional setting where the innovation itself is up-for-grabs. In that wider context, some organizations may have already adopted and applied the technology while others may have yet to consider it at all. Collective experience may be substantial or not, and hence the models available to support an organization’s deliberations about whether, when, and how to innovate may be rich and contingent and compelling – or not.

This, then, is the problematic context the innovating manager confronts. Among academics, a set of basic research questions have – for some time now – complemented the manager’s central concerns. In particular, IS scholars have asked:

[1] Why does one organization innovate with IT while another does not?
[2] If and when organizations innovate, why does one do so relatively early while another does so relatively late?
[3] Why does one organization take one implementation approach while another takes a different one?
[4] Why is one organization ultimately successful with an IT innovation while another is not?

Engaging in research on the first two questions – which focus on the organizational choice to innovate – means to entertain, more broadly, a search for what causes patterning in the diffusion of innovations across populations of organizations (Rogers, 1995). Recently, IS researchers have
extended this classical diffusionist research agenda to incorporate the innovation implementation process and innovation outcomes. These research interests are reflected in the third and fourth questions, above. Note that all four questions are posed here in the “why” form, which calls for theory providing persuasive and useful explanatory answers.¹

While the preceding research questions draw our attention to the differences among organizations, scholars have also noted that IT innovations, too, may differ in important ways (Swanson, 1994). Accordingly, researchers have most recently focused on several additional questions: Why does one IT innovation diffuse extensively while another does not? Why does one evolve considerably in form during its diffusion while another stays much the same? Why is one ultimately taken for granted as good management practice, while another comes to be discredited (Swanson and Ramiller, 1997)? This second set of questions draws our attention to the historical development and dynamic shaping of the innovation itself, as well as to processes that help to determine its ultimate impact.

When these sets of issues are brought together, it can be seen that managers attempting to determine whether, when and how to innovate with IT must accomplish this task in what is often a deeply problematic context. Managers must make sense of the options and decide while the innovation itself is in flux, and where the possibility of successful engagement depends on a welter of interpretations, choices, and resources arising in the wider community. This is truly a demanding challenge. And, in fact, when we as scholars raise the issue of why one organization is ultimately successful with an innovation while another is not, we are in effect pointing out that not all managers (nor all organizations) are equal to this challenge.

In the present essay, we examine recent empirical research to enlarge our understanding of what determines whether, when, how, and with what success, organizations innovate with information technology. We begin by developing an analytic framework that joins an institutionally-grounded process perspective to a view of purposefulness in innovative action. The focus on process will enable us to position the scope of the research examined and to relate the studies among each other

¹ The form of these questions calls for answers explaining variation in organizational behavior and performance. In posing the questions this way, we do not suggest that variance reduction models (Mohr, 1982; Markus and Robey, 1988) provide the only or even the best way to answer them.
in an integrative context. Our view of *purposefulness* will allow for alternative theories as to why organizations go about innovating with IT as they do, given different empirical findings. Here we suggest that “alternative rationalities” for innovating with IT underpin alternative theories (see, e.g., Robey and Boudreau, 1999). Employing this framework, we then review the recent literature with an eye to how its findings speak to the disposition of organizational management toward IT innovation. We conclude with a discussion of what the apparent gaps in the literature suggest about possible directions for future research.

**CONCEPTUAL FRAMEWORK**

We ground our analytic framework in an institutional view, recognizing the interaction between innovation processes at the organizational and community levels. We draw from the notion that beyond the boundaries of a particular adopting organization the IT innovation exists as what is called an *organizing vision* (Swanson and Ramiller, 1997). An organizing vision is a discursive construction (Foucault, 1972; Porter, 1992; Ramiller, 2001) – quite literally a product of the spoken and written word – that is produced dynamically by a widespread, complex, on-going conversation among such economically-motivated parties as technology vendors, consultants, industry pundits, prospective adopters, business and trade journalists, and academics. Over time, the organizing vision evolves to incorporate the experiences, insights, and beliefs of these heterogeneous interests, while defining the innovation it speaks to in broad strokes. It provides a focus for the interpretation of the innovation; it aids in legitimating it; and it helps in mobilizing associated material and commercial processes. It influences the sensemaking and decision making of prospective adopting organizations. And, eventually, it advances the material innovation toward institutionalization or, alternatively, toward discredit and abandonment.

An organizing vision is recognizable by one or a small set of “buzzwords” that serve, in effect, to label the wider community discourse. The proliferation of such buzzwords – knowledge management, e-commerce, and customer relationship management provide some recent examples – and the rapidity with which they come to prominence and then fade away, is itself a hallmark of the general milieu of IT innovation.
If an IT innovation is at one level a discursive construction produced in the wider economic milieu, *how the managers of a prospective adopter organization engage that construction* should weigh heavily in their determination of whether, when, and how they will innovate – and what measure of success they will enjoy (Ramiller, 2001). A motivating concern in this review, then, is with the effectiveness of this engagement and the manner in which, and the degree to which, the research literature speaks to it, while more directly addressing its own research questions. Our review is thus a focused one.2

We shall use a two-part conceptual framework, addressing organizational process and purpose. We first present a general descriptive model of the organizational-innovation process, anchored in our institutional perspective.

**A PROCESS MODEL**

As conceived here, an organization’s initial engagement with an IT innovation typically begins with the associated organizing vision. By this means the organization comes into contact with the basic idea of the innovation and seeks initially to comprehend it. A deeper consideration of the innovation may follow, during which the organization evaluates it for adoption. If in favor of adoption, the organization typically then initiates a project, secures needed resources, and works to implement the concept. Where the innovation is eventually brought to life in the organization and successfully used, the organization gradually comes to accept it as part of normal practice, and attention to the wider community vision for it fades.

Figure 1 expands on this summary representation. Organizational innovation with IT is viewed as a mosaic of several interrelated processes and intentionalities (Figure 1). The processes, as just suggested, include those of comprehension, adoption, implementation, and assimilation. The intentionalities, reflective of the purposefulness of the process overall, may be characterized as positional and transitional. While there is an inherently sequential order to the activation of both

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2 We observe that there are relatively broad and narrow types of literature reviews. The broader type examines the work in a given scholarly domain on its own terms. That is, such reviews critically evaluate the research in terms of the ambitions and objectives set for it by the researchers themselves. Future opportunities, then, are identified in relation to where the literature to date falls short across the full spectrum of established concerns. In the domain of IT innovation,
processes and intentionalities, once activated each is likely to remain more or less so over the course of innovation.³

<Place Figure 1 about here>

The organization is first made aware of the innovation as an organizing vision and undertakes a comprehension process. Through the efforts of its members, in interactions with others, the organization engages the idea of the innovation and ponders its meaning, its legitimacy, and the mobilization of material efforts associated with the innovation in the broader community (Swanson and Ramiller, 1997). As it learns about the innovation, the organization develops an attitude or stance toward it, and eventually positions itself as a prospective adopter or as a non-adopter.

The organization undertakes the adoption process when it considers committing itself to the innovation. Typically, it authors a rationale, or business case in this regard. It also weighs the prospect of attempting to implement the innovation. It assesses both the value and challenge presented by the move, and does so in the light of organizationally specific conditions and contingencies. The organization may turn back at this point and decline to adopt, after all. If it moves forward, the organization commits resources to implementing the innovation.

The organization embarks on implementation when it forms and staffs a project under which it acquires and allocates resources needed to make the transition. Here the organization aims to bring the innovation to life, and enable its use and assimilation, with the wider goal being to reposition itself by means of this change. Eventually it may do so; however, even here it may abort its efforts and turn away from the innovation, depending on what it learns during the course of the process.

Fichman (2000) provides an exemplary review of this type. Our own present effort, by contrast, represents the narrower type of literature review in which the intent focuses on a particular point of concern.

³ The four processes in our model combine elements of Rogers’ (1995) familiar innovation-decision process model (p. 161) and his model of the organization’s innovation process (p. 392). Overall, our model might be considered a stage model except for its process concurrencies. (See Wolfe (1994) for a review of stage models of organizational innovation.) We caution that we use several terms more narrowly than elsewhere in the innovation literature, where the terms “adoption,” “implementation,” and “assimilation” have sometimes been stretched to cover the innovation process in its entirety.
Assimilation begins on the heels of implementation. The innovation now begins to demonstrate its usefulness to organizational participants. It also reveals itself to be more or less easy for the organization to absorb. The organization moves to reposition itself according to what the innovation, in the light of these experiences, is now believed to make possible. In time, the innovation may come to be routinized, woven into the very fabric of the organization’s changed work systems; on the other hand, it may come to be associated with persistent problems that disrupt these systems and may eventually discredit it.

PURPOSEFULNESS AND RATIONALITIES

Within our process view, the construct of comprehension and the notion of intentionalities (refer again to Figure 1) combine to evoke the pervasiveness of cognition and purposefulness throughout the innovation process. They remind us that people come together, everyday, to actively produce (and reproduce) their organizations on the basis of what they know, learn, believe, and desire (Daft and Weick, 1984; Giddens, 1984). On the whole, we posit a purposeful organizational process, allowing for bounded rationality (March and Simon, 1993) in that uncertainty and learning enter into consideration. We note, for example, that the decision to innovate may be reversed at each stage based on the adopting organization's reflections on its on-going experience. But we will allow too for organizational behavior that does not conform to simple norms of rationality.

Following other IS theorists (e.g., Kling, 1980; Kumar, et al, 1998), we eschew a simplistic view of rationality for the reason that it fits poorly with the facts of real organizations, which reflect the diverse interests and actions of their participants. From our perspective, a more nuanced view of the “organizational mind” (Morgan, 1986) and its cognitive properties must be admitted. While we

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4 Furthermore, in the face of new opportunities such as those presented by technological innovations, people carry out sensemaking (Weick, 1995) on their way to transforming their organizations – and sometimes creating altogether new forms of organization (Orlikowski, 2000). Of course, organizations and their participants also vary in how effectively they undertake such sensemaking.

5 To elaborate briefly, what each individual knows, relative to the accomplishment of important tasks, is inevitably partial and must be integrated with the knowledge of others, through conversation, coordinated practice, and the use of technology (which, in effect, embeds knowledge). In this sense, mind is “distributed in society” (Mitroff, 2001). The need for coordination of such dispersed knowledge, moreover, means that organizational cognition transcends a mere summation or pooling of the cognitive properties of the organization's constituent members. Instead, organizations have distinct cognitive properties of their own (Hutchins, 1995). Organizational mind is an emergent property that certainly depends on the sensemaking activity of the organization's members but is not reducible to that activity.
invoke organizational purposefulness in our framework, we therefore also allow for “alternative rationalities” to explain why organizations innovate with IT as they do. Indeed, following others (Kling, 1980; Kumar et al., 1998; Kraut et al., 1998), we suggest interplay among rationalities in innovating with IT. As we shall argue, these rationalities and their interplay serve as underpinnings for researchers’ theories. They are largely imputed to organizational actions. We consider this next.

First, prospective adopters of innovations likely consider the sheer *instrumentality* of the innovation, that is, its potential value as a tool for *improving the operational performance* of the work systems in the organization (Alter, 2001). Here, the innovation is considered for its practical and contingent utility (Kraut et al., 1998). Comprehension, adoption, implementation, and assimilation are located in the "relatively objective value" (Kraut et al., 1998: 438) of the innovation, as realized in its "fit… with a task" (Kraut et al., 1998: 440).  

Along with other researchers, we regard the scope of purposefulness, however, as being broader than this. We admit social influence theories of innovation (Kraut et al., 1998). "Social influence" refers to the various ways in which prospective adopters are potentially compelled to consider the innovative activities of other (potential) adopters. Among the areas of social influence that interest us here are network effects, power, and legitimization.

Attending to the network effects of an IT innovation, like instrumental rationality, entails a utilitarian and calculative logic. Rather than focus on the task-related properties and benefits of the innovation, however, attention here turns to the potential for and importance of positive externalities. It responds in particular to the fact that the "number of users of a technology changes its utility" (Kraut et al., 1998: 438; Shapiro and Varian, 1999). In innovations related to communications, critical-mass effects can be the most important externality (Markus, 1987). There, the value of the innovation hinges directly on the number of adopters with whom communication is made possible. Direct cooperative efforts have something of this same "strength in numbers," network character (Kumar et al., 1998). However, positive externalities can also arise more indirectly, as increasing numbers of adopters help promote the increased availability of

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6 Instrumentality is therefore close in nature to what has elsewhere been characterized as “techno-economic rationality” (e.g., Kumar et al., 1998) and “systems rationalism” (Kling, 1980).
infrastructural support (expertise, resources, complementary technologies) while simultaneously reducing the costs to obtain it (Kraut et al., 1998).

As an organization and its members attend to the possibilities and processes for innovation, matters of divergent interests and power may also enter into consideration. Adopting an innovation may not be a freely chosen option, for instance. A prospective adopter may be coerced to proceed with an innovation. On the flipside, an organization may use power to pressure others to adopt on whose participation the benefits of the innovation may depend. Similarly, a struggle of interests may appear "looking outward" toward interorganizational relationships or "looking inward " toward the units and individuals constituting the secondary adopters inside the firm (Leonard-Barton and Deschamps, 1988).7

Of course, the matter of divergent interests and the challenge of managing them is not reducible to issues of power, overtly exercised. The working-out of interests in the context of IT innovation is a complex process that may reflect less visible aspects of power that are cultural and structurally embedded (Foucault, 1979) and that, moreover, bring in contrary elements of trust and cooperation (Kumar, et al., 1998).

Further, adopting an innovation may enhance the legitimacy of the innovating organization in the wider corporate and financial community (Scott, 2000). Visible conformance to popular trends and “best practices” in innovation, as promulgated in organizing-vision discourses, can have significant material implications. For the organization, public displays of enthusiasm for popular initiatives can win the favor of the securities markets and increase access to, and lower the cost of, capital. It can also raise the confidence of trading partners and thereby directly promote business growth. For the organization’s managers, conformance to innovation trends can win recognition and promotion.

Lastly, beyond engaging their own rationalities, organizations may sometimes intentionally model their behavior on that of innovative others. A kind of surrogate rationality may play a role,

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7 A good example of the play of power in interorganizational relationships is the move of suppliers to EDI under pressure from powerful retailers. At the level of secondary adoption, we can consider the phenomenon of mandated use. This is commonly attributed to, or simply assumed to arise from, efficiency-oriented management decisions. However, it may
invoked in effect to fill the gaps left by uncertainty (Ramiller, 2001a). After all, the classic form of a social-influence response in innovation adoption is to take with serious regard what salient and respected parties (a.k.a. opinion leaders) have to say about an innovation's benefits (Fulk et al., 1987; Kraut et al., 1998; Rogers, 1995). As a response to the problem of bounded rationality and the high uncertainty that attends IT innovations, such a borrowing can entail the realistic recognition that others may have resources, including time, money, experience and knowledge, unavailable to the innovating organization itself.

ANALYTIC FRAMEWORK

Our perspective thus combines an overall model of the innovation process with a view of purposefulness and alternative rationalities in innovative action. This provides a simple yet general framework for reviewing the recent research literature on IT innovation.

With regard to purposefulness, we identify the rationality or rationalities each article considers and imputes, as best we understand it.8 In effect, it represents our interpretation of the researcher's model of how organizational behavior and events are best to be explained. Consider, for example, a research study that examines how end-user adoption is predicted by the relative fit of the technology to the users' work tasks. Such a study likely imputes an instrumental or techno-economic rationality. While the study’s findings may be consistent with the imputed rationality, they cannot as such confirm it over alternative interpretations.9 As reviewers, therefore, we must be alert to variance in rationalities both across and within studies.

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8 The authors of these articles were of course not necessarily concerned with “alternative rationalities” as we have described them. The interpretations we make of author theories are therefore substantially our own. Our notion of “interests and power” combines Kumar et al.'s (1998) "second rationality" and "third rationality," which respectively address conflict/power and trust/cooperation, as alternative solutions to the same basic underlying problem of multiple, divergent interests.

9 Assuming the given study seeks out a mere correlation, it may beg the question of what sort of organizational mind, working behind the scenes, actually produces the observed correlation, and how. Perhaps the end-users are consciously evaluating the technology for task fit; alternatively, perhaps there is some more subtle adaptive process producing this result, the perceptions of the users themselves being largely irrelevant. Perhaps there are additional aspects of organizational mind involved that remain unexamined (which might help explain the low, albeit significant, correlation): for example, it may be that management in some cases has pressured the users to adopt the technology, while in other cases users are responding to a charismatic opinion leader who thinks the innovation is “the best thing since sliced bread.”
We conducted our primary survey of the literature as described in detail in the Appendix. Briefly, we undertook a review of selected recent empirical research on innovating with IT. We focused primarily on several key journals and one conference proceedings and their publications in the 11 years from 1990 through 2000.\textsuperscript{10} We aimed to probe the extent to which this representative body of research has spoken to the basic concern with which we began: What determines whether, when, how, and with what success, organizations innovate with IT? From the publications thus surveyed, we identified and individually reviewed some 82 research articles.\textsuperscript{11} The articles were summarized in two formats, one geared toward recording basic information (such as the research question(s), organization(s) and innovation(s) studied, key findings, and theoretical interpretation), and the second aimed at identifying each article's specific orientation and contributions relative to our framework (refer to Figures A-1 and A-2). After completing the individual reviews, we undertook a process in which we iterated between scans of the articles themselves and our own summaries of them, assessing each for the potential insights it offered. The discussion that follows records our findings and reflections.

The discussion is presented in two parts. First, we describe in a comprehensive way our primary survey of the literature relative to its coverage of the innovation process and its components: comprehension, adoption, implementation, and assimilation. Then, in further discussion, we consider more specifically how the research speaks to different rationalities for innovating with IT.

**RECENT EMPIRICAL RESEARCH**

We focus first on how our community's research activities have addressed the process aspects of innovation, as defined in Figure 1. To add depth, we elaborate upon each process in terms of its characteristic accomplishments. We then consider where the research emphasis has been placed to

\textsuperscript{10} We selected well-recognized leading publications. However, our selectivity means that we did not include most IS publications, or even all of the leading ones. Our focused article review no doubt misses more relevant articles than it includes, on the whole. As a consequence, it should be considered specific to our publication set, which, given its standards and biases, publishes research not necessarily representative of research more broadly. We comment further on this below.

\textsuperscript{11} For earlier reviews of the literature on innovating with IT see Fichman (1992) and Swanson (1994). See also Saga and Zmud (1994), who focus their review on post-implementation aspects. For a more recent comprehensive review, we note again Fichman (2000). For a review of organizational innovation more broadly, see Wolfe (1994).
date, and where heightened attention may be warranted. Table 1 provides an overview of what follows. We begin with the *comprehension* process.

<Place Table 1 about here>

**THE COMPREHENSION PROCESS**

Comprehension of an IT innovation begins with the organization and its members coming to an *awareness* of the innovation (Table 1). As suggested earlier, the innovation typically appears on an organization's horizon in the form of an organizing vision, a "high concept" (Tillquist, 2000) that emerges in an on-going inter-organizational discourse. That the organization in fact attends to this discourse is the result of members’ boundary-spanning activities. Their contacts with other persons and with media are crucial to building awareness. Interpersonal contacts can include peers in other organizations, vendors, consultants, and educators. Accessible media resources include printed publications, films and videos, CDs, and Web sites. Early in an innovation’s diffusion, where public awareness is minimal and media content is limited, interpersonal sources may be most important in achieving new awareness. Later, commercially available media resources may accelerate a broader growth in awareness.

If a deeper comprehension is to be achieved, the organization and its decision makers must move beyond mere awareness and gain substantive *familiarity* with the innovation. This begins with the acquiring of rudimentary knowledge. Here again, boundary spanning activities play the key role. Interpersonal exchanges are likely to be intensified. Professional meetings, symposia, workshops, and the like can be attended. Media resources can be explored in depth.

With sufficient familiarity, the organization and its members will develop an attitudinal *predisposition* toward the innovation, which may lead them to consider it for adoption. The organization’s comprehension thus expands to embrace a judgmental and affective component. The organizing vision is regarded as “important” or “unimportant,” as “an idea whose time has come” or as “an idea for which the technology is not here yet,” and so forth. Again, boundary spanning is likely to be important in shaping attitudes. Now, however, with increasing internal familiarity opinion leadership can come from inside as well as outside the organization.
As we suggested earlier, an organization's comprehension of an IT innovation does not attain some complete and final state simply because the organization arrives at the threshold of an adoption decision. The organization's need to update its understanding is continuous, and so comprehension not only occurs early on but also permeates adoption, implementation, and assimilation. For the purposes of the current discussion, however, we will momentarily defer our review of the literature's treatment of adopter comprehension concurrent with adoption, implementation, and assimilation. For now, we will focus on the early comprehension that occurs prior to, and leads up to, the adoption decision.

In fact, in our present review we found no research that focused specifically on the organizational comprehension of innovations by those who have yet to consider them for adoption. Nevertheless, a number of studies have addressed the issue in passing. For example, some authors have explicitly acknowledged the fundamental challenge organizations face in taking the broad, "public" idea of an IT innovation and moving with it toward a practical realization that will fit the needs and circumstances of the particular organization. In this regard, we note Tillquist's (2000) case studies involving the translation of the business process re-engineering concept into actionable plans; Nambisan et al.'s (1999) study of the role of technology users in further elaborating "context-free" ideas for local application (see also Nambisan and Wang, 1999); Tanriverdi and Iacono's (1998) identification of the importance of de novo knowledge creation in specific adoption settings for telemedicine applications; and Henderson and Lentz's (1995/1996) case study, in the insurance of industry, which documents innovation as a by-product of the explicit management of work practices as a context for learning.

Other studies touched at least indirectly on the issue of pre-adoption comprehension. Chau and Tam (1997), for example, compare adopters and non-adopters of open systems in terms of their perceptions of the innovation’s benefits and barriers to adoption, finding that benefits are perceived similarly while barriers to adoption are not. Nilakanta and Scamell (1990) consider non-adopters’ possible lack of familiarity with the subject innovation. In general, studies entertaining comparisons of adopters and non-adopters appear primarily to be interested in screening out the latter in order to
focus on the presumably more interesting subjects, namely those that can be studied relative to what they have actually done – achieve some level of innovation – rather than what they have not.

Among studies which consider boundary spanning activities and their effect on innovation familiarity, Rai and Patnayakuni (1996) find that IS departments’ adoption of CASE follows from their learning about it from external sources. They regard this learning as a “technology push” factor which shapes the subsequent adoption decision process. Grover and Goslar (1993) touch on the "initiation" phase of innovation, although this is operationalized in a limited way as the organization having conducted a formal evaluation. Kwon (1990) studies MIS “opinion leadership” and interpersonal communications with external sources and their influence on eventual IT infusion within the firm, although innovation comprehension is not specifically addressed as such. Agarwal and Prasad (1998) introduce “personal innovativeness” in explaining the propensity of certain individuals to engage in boundary spanning activities leading to familiarity with and intentions to use new IT.

These latter studies remind us that, while we do not cover it more broadly in the present review, the subject of boundary spanning has a substantial literature within the field of organization theory, which may be consulted for insights pertinent to innovation comprehension. (For recent perspectives see Manev & Stevenson, 2001; Johnson & Chang, 2000).

THE ADOPTION PROCESS

The adoption process can be said to commence when the organization and its members shift their framing of the innovation from something others are doing to something they themselves might do. Their core task then is to persuade themselves one way or the other concerning adoption. However formal and well-organized the process, a rationale for adoption is typically developed and tried on for size (Table 1). To feed the development of this rationale, a formal evaluation study may be undertaken; visits with prospective vendors are likely; and, in some cases, hands-on experimentation with the associated technology is also carried out. Where things move forward favorably, a proposal to adopt the innovation is brought to management.
The adoption process may culminate in a decision to adopt the innovation, in whole or in part, in one form or another. Alternatively, it may bring the organization to a “wait and see” or “research it further” position. A positive decision to adopt, along with the timing of such decisions, lies at the heart of research on the diffusion of innovations (Rogers, 1995). But while early adopters are thereby differentiated from later adopters and non-adopters, interestingly the decision itself is rarely studied in a rich way. Rather, the adoption decision is commonly black-boxed, with explanation moving quickly off into the abstract matching of innovation characteristics to organizational context. The implicit theory, then, is of the “organizational fit” genre (see Fichman, 2000). Meanwhile, we are left in the dark about how the adoption (or non-adoption) decision emerges and is revealed; who plays what roles in its development; the qualifications, assumptions, and contingencies that are considered; and the degree of commitment that is truly entailed.

Where the proposal to adopt the innovation moves forward, the organization also articulates a commitment to its implementation. Resources are pledged toward making the innovation successful, typically within a stated time frame. With such a commitment, the organization may be considered to have "adopted" the innovation – at least relative to typical scholarly usage of this term. Of course, as the innovation process continues to unfold, the organization may for a variety of reasons come to reconsider its adoption decision, rationale, and commitment.

Turning to recent research, we find much more work addressing adoption that we did (early) comprehension. This work covers a variety of topics, many of them relating to "classic" concerns in the broader innovation-diffusion tradition. These concerns include the antecedents of adoption versus non-adoption and early versus late adoption, the processes and prerequisites involved in adoption, and the consequences of adoption.

Consequences of Adoption
Studies that focus on the consequences of innovation adoption lie on the margins of our primary interest with innovation processes in the current review, belonging more properly to the area of inquiry that is often labeled "organizational impacts." Nevertheless, as business organizations are purposeful, inquiry into goals and even unintended consequences has an important place in our
efforts to understand what drives innovation. This intimate connection is expressed, in part, in research that looks at both the causes and effects of IT innovation.

One research question that places consequences in a classic diffusion framing asks whether adopting early in the diffusion process yields competitive advantage. Dos Santos and Peffers (1995) provide a prototypical study for the case of automated teller machines (ATMs), finding that first movers in ATM adoption gained both market share and increased income. Whether different implementation approaches were also important among adopters is not studied. Of course, we know in retrospect that ATMs were a successful innovation, now well assimilated in most economically-developed areas of the world, inviting the related question of whether and when competitive advantage yields to consumer surplus (Brynjolfsson, 1996). In a recent study, Dewan et al. (2000) explore the adoption of Internet-based technologies under conditions where such investments support product customization and discriminatory pricing, but note that erosion of competitive advantage is evident.

In another study that relates variation in innovation adoption to outcomes, Palmer and Markus (2000) investigate the relationship of performance improvements to the levels of adoption associated with quick response in the grocery industry. While innovation in quick response at a rudimentary level is found to enhance organizational performance, more elaborate forms of innovation fail to produce higher performance. Moreover, the authors find that, contrary to commonly-held expectation, a poor fit between information technology investments and corporate strategy does not lead to poorer performance.

Antecedents of Adoption
Turning now to research that focuses mainly upstream from the fact, and the act, of adoption, we can distinguish between research that is preoccupied with identifying the correlates or predictors of adoption and research that tends to take a more process-oriented view of adoption. Our current review produced a large number of representatives of this first category of research. These studies variously consider the differences between adopters and non-adopters, the differences between early adopters and later adopters, predictors of the level of adoption, and the antecedents involved in some subsidiary issues in organizational adoption.
With respect to adoption versus non-adoption, Sherif and Vinze (1999) examine organizational and individual factors that present barriers to the adoption of software-reuse practices. Rai and Patnayakuni (1996) explore factors in CASE adoption, finding significance in top management support and championship but no significance for a selection of need-pull factors. In a focused study, Tam (1996) looks at the specific effect of price elasticity over time on the diffusion of mainframe technology. Chau and Tam (1997) explore factors affecting the adoption of open systems, including competitive environment and certain organizational contingencies.

The assortment of studies just noted focuses on innovations relating to the infrastructure of systems and their development. Other studies of the antecedents of adoption turn more broadly to the business and applications side of things. Thong (1999) looks at IS adoption in small businesses and identifies a variety of predictors, including characteristics relating to the decision makers, the systems themselves, the organization, and the organization's environment. Teo et al. (1995) explore factors predicting organizational intentions relative to the adoption of financial EDI, including some classic innovation characteristics identified by Rogers (1995) – relative advantage, compatibility, complexity, observability, trialability – and some aspects of risk. Premkumar, et al. (1994), too, consider innovation characteristics as predictors of outcomes relating to aspects of the diffusion of electronic data interchange, including adaptation, internal diffusion, external diffusion, and implementation success. Grover and Goslar (1993), meanwhile, consider some equally classic organizational factors in relation to the initiation, adoption, and implementation of IT innovations, including environmental uncertainty, organizational size, centralization, formalization, and IS maturity. And Cooper and Zmud (1990) look at task-technology compatibility as a factor in the adoption of MRP.  

With respect to early versus late adoption, Neo et al. (1994) study Singaporean trading firms’ adoption of Tradenet, finding that trialability, relative advantage, and peer influence were important explanatory factors in early adoption. In this situation, eventual adoption was mandatory and
seeking competitive advantage was unlikely. Loh and Venkatraman (1992) examine the diffusion of IT outsourcing, finding that later adoption was apparently driven by purely imitative behavior among firms, following the “critical event” of Kodak’s highly publicized earlier adoption. Kauffman et al. (2000), in a study of electronic banking, find that network externalities linked to effective network size help explain early adoption, while the opportunity costs associated with prior investments in branch networks tend to discourage early adoption. And Grover et al. (1997) relate early adoption of information technology to size of the IS unit and the host organization, the availability of slack resources, the diversity in the IT portfolio, and the professional orientation of the IS unit.

Within the larger organizational decision to adopt an innovation, subsidiary decisions help to shape the adoption decision in greater particulars. Thus, VanEverdingen et al. (2000) examine a variety of product characteristics and supplier characteristics as predictors of the selection of particular ERP packages in European midsize companies. Slicing the adoption decision in a very different way, Larsen (1993) looks at factors affecting the innovativeness of middle managers. While fundamentally an individual-level analysis in the spirit of end-user studies (which we will consider under the heading of "assimilation," below), this work has clear implications for prediction of wider organizational innovation.

Finally, in a shift away from factors relating to innovation and adopter characteristics, Nilakanta and Scamell (1990) turn their attention to another area of classic concern in diffusion studies (Rogers, 1995). Specifically, they explore the effects that differences in information sources and communication channels have on initiation, adoption, and implementation of database technologies.

Relative to the primary interest motivating this review, studies of the antecedents of adoption behavior generally leave us in want. This approach largely black-boxes the sensemaking and decision-making processes involved in innovation. The reasoning and rationales employed by organizational participants may be speculated about, but they are typically not actively investigated. It is also in the nature of this approach, which focuses on the uncovering of correlations, to turn a blind eye to the patterns of action involved in the production of the outcome, adoption, that serves as the dependent variable. On the other hand, certain studies reviewed did take a more expressly
cognitive perspective on the adopting organization, or considered adoption processes more directly, or both.

**Why Organizations Adopt (or Not): More Direct Inquiries**

Some of the research we surveyed sought more specifically to explain why organizations choose to adopt an innovation. While some of these are "factors" studies, the choice of factors to examine positions them closer to the realm of direct inquiry into how organizations think about things. As such, they move us toward a more animated perspective on the organization as an active adopter, lifting the lid, to a degree at least, on the black box of sensemaking and decision making. Among the works already cited, those that consider the characteristics of innovations relative to adopter perceptions in fact take us a step toward a more explicit regard for cognition in innovation (Moore and Benbasat, 1991).

Another step in this direction is to consider prospective adopters' intentions to adopt. Harrison, et al. (1997) seek to explain the IT adoption intentions of senior IS executives at small firms. Drawing from the Theory of Planned Behavior (Ajzen, 1991), they find that executive attitudes, perceptions of norms, and perceived control most affect intentions. It is not clear how far along the respondents were in their actual decision processes. As noted earlier, Teo, et al. (1995) study Singapore companies’ intentions to adopt financial EDI. The complexity and strategic risk associated with EDI are found to affect intentions to adopt both presently and in the future. Again, it is not clear which of the organizational respondents may have actually been engaged in the adoption process themselves.

Inquiries that include uncertainty and risk tend to more directly evoke the deliberation involved in adoption. Lee and Clark (1996/1997), for example, include uncertainty and risk in their examination of barriers to adoption in four electronic markets, while also considering the importance of critical mass effects and the lack of opportunities for exercising coercive power. The risk faced by prospective participants focuses in great part on the corollary need to reengineer associated business processes. This study is interesting in that the innovation itself – an electronic market – is an enterprise, with adoption at the level of the market participant. Failure in diffusion therefore leads surely to the failure of the enterprise.
Other research has addressed the reasons for adoption more directly. Orlikowski (1993) examines the deployment of performance rationales for the adoption of CASE technology as an integral part of active programs for organizational change in the systems area. Iacovou, et al. (1995) studied seven small government suppliers in terms of their adoption of EDI, examining perceived benefits, organizational readiness, external pressures, and material facilitation. Non-adopters perceived benefits to be relatively low. External pressures relating to dependency on the government best explained adoption. Bouchard (1993), in earlier work combining a survey with case studies, found that EDI adopters were acting strategically, basing their decisions on what their business partners were doing with EDI, and on EDI’s likely impact on the business. Hart and Saunders (1997) provide a complementary perspective on EDI adoption. They examine the role of power and trust in the case of a large office supply retailer in leading its suppliers to the adoption and use of EDI. The study is interesting in that it covers not just adoption, but in effect inter-organizational assimilation of the innovation.\footnote{While our review is limited for the most part to empirical studies, we note in passing complementary analytic studies of inter-organizational systems as innovations, such as that of Barua and Lee (1997).}

Trust in relation to inter-organizational systems has indeed become a focal point of interest lately, as evidenced by other recent studies. Karahannas & Jones (1999) consider trust as an element in the development and ultimate use of inter-organizational systems. Ratnasingham and Kumar (2000) examine trust and security-based mechanisms as predictors of "participation" (adoption) in electronic commerce. Kettinger and Hackbarth (1997) consider trust and cooperation, along with perceived benefits and organizational readiness to adopt, among the factors they examine in relation to the adoption of e-commerce in small firms. Kim and Prabhakar (2000) examine factors that affect consumer trust in Internet banking; which in turn affects adoption. This last work presents a problem of classification, in that the level of analysis, on the face of things, is the individual. Nevertheless, the problematics of trust with respect to the ultimate customer have important implications for organizations' decisions to adopt.

Among research which addresses intraorganizational participation in the adoption decision, Montazemi, et al. (1996) study the roles of users and the Information Center in the evaluation and
selection of software packages within a large Canadian company, finding that users assess the usefulness of the software differently than does the IC. And we again note Larsen (1993), who describes a field study examining middle managers’ role in innovating with IT more broadly.

Processes and Prerequisites of Adoption
Elements of the literature we surveyed, in addition to taking a more active interest in illuminating the decision making involved in adoption, also regarded adoption more directly as a process, rather than merely an outcome or – in the case of studies of intention – a state of mind. Some of this work considered what we shall call the prerequisites for adoption, particularly in relation to the need for resources to reduce knowledge barriers. By prerequisite we mean something very different from antecedent. The latter is usually a correlate (e.g., organizational size, IS professionalism, slack) where the causal connection to adoption is typically theorized in some general way but, practically speaking, black-boxed. A prerequisite, by contrast, is situated integrally in the examination and articulation of adoption process.

Organizational learning is a particularly important theme in more process-oriented perspectives on adoption. Tanriverdi and Iacono (1998), for example, look at technical, economic, organizational, and behavioral knowledge barriers and their impact on the diffusion of telemedicine. Fichman and Kemerer (1997) relate adoption choice to variability in knowledge barriers and learning in a comparative study of software process innovations. Learning, when it comes to innovation, naturally does not stop just because an organization has nominally adopted an innovation. Attention to learning in research accordingly tends to invite multi-phase studies, as we witness for both of these articles. Fichman and Kemerer address the overcoming of knowledge barriers in implementation, and Tanriverdi and Iacono look to the changes in organizational arrangements and behavioral adaptations as elements that carry implications for the wider course of diffusion.

Research concern with knowledge barriers and learning also tends to compel attention to the wider context, because of the adopting organization's crucial dependence on outside resources, not simply for material technologies but also for know-how. This, too, has implications across our innovation phases (Figure 1). A seminal essay, in this regard, is Attewell's well-known work on the institutional context of innovation in business computing (Attewell, 1992). A supply-side view of
the need for, and provisioning of, knowledge for innovation, his analysis spans adoption, implementation, and assimilation. In an essay with even grander scope, King et al. (1994) consider innovation at the level of nations and articulate the role of institutional infrastructure in the differential advance of information technology. In more recent, and more focused, studies, Montealegre (1999a) examines the role of institutional actions in fostering the adoption and implementation of the Internet in four less-developed countries, finding that knowledge-building, subsidies, and innovation directives have been differentially effective across the lifecycle of the innovation. And, Walsh and Koumpis (1999) explore institutional efforts to affect the conditions for the adoption of push technology.

THE IMPLEMENTATION PROCESS
Implementation of IT-based innovations is notoriously problematic, and research on implementation dates to the origins of the IS field itself (Swanson, 1988; Lucas, et al., 1990). Until rather recently, however, this research has not been linked explicitly to the broader innovation lifecycle. For instance, implementation has commonly been studied without regard to whether the subject innovation (typically a new system) was comparatively radical, or without situating it in the context of its wider diffusion among firms. More recently, systems-implementation research has been brought more fully under the umbrella of innovation studies (see, for example, Kwon and Zmud, 1987). At the same time, innovation research has gradually subsumed implementation issues that extend beyond adoption, narrowly defined (Tornatsky and Klein, 1982; Leonard-Barton, 1988; Klein and Sorra, 1996).

From a process perspective, implementation often begins with the organization of a project, a plan, and the initial acquisition of needed resources (Table 1). The project team is thereupon staffed and begins its training. New hires having prior experience with the technology in question may be sought. Consultants and vendors are also engaged. Hardware and software procurement is initiated. Internal development of software commences, as may be appropriate. In sum, the organization seeks to acquire and assemble the requisite technology and the associated know-how.

The technology procured typically requires configuration for local application. Specifically, choices must often be made about the basic and advanced functionality to be incorporated. Features
must be selected among various options and in some cases additional components “bolted on.” Multiple complementary products from different vendors may require system integration. Implementation often further involves substantial reengineering of the business processes that will use the new IT. Work procedures likely have to be redesigned. Users must be trained in new ways of working, as well as in the use of the technology itself. Tests of basic workability, and requisite adaptations, are required. As implementation typically must be completed according to a schedule, time pressures commonly threaten to place the adequacy of all these preparations in doubt.

If all goes reasonably well, deployment takes place; that is, the innovation is “rolled out” to its intended users. Here an important decision is whether and how to phase the deployment (by module and/or by organizational location, for instance). Of course, implementation is still not considered successful until the users engage the innovation and make productive use of it. Thus, for implementation to succeed it is not enough that the innovation survive even through the deployment process, as it may ultimately be rejected by its users. We will take up this point again when we consider the assimilation phase.

Among recent research, Orlikowski (1993), noted earlier, provides a model study of implementation within the broader innovation context. Taking a process-oriented approach, she compares two firms’ adoption, implementation, and use of CASE tools, examining, among other factors, the rationales for acquisition of the tools, the implementation strategies, and changes associated with uses of the tools in terms of skills, work, and performance. Her findings underscore the importance of contextualizing implementation, more specifically, viewing it in terms of the larger organizational change process over time.

Fichman and Kemerer (1997), also noted earlier, provide an important study of progress toward assimilation of object-oriented programming languages (OOPL) among IT organizations. “Assimilation” in their terms covers stages of awareness, interest, evaluation and trial, commitment, limited deployment, and full deployment. From our own perspective, this incorporates the innovation’s comprehension, adoption, and implementation processes, if not necessarily assimilation in use. From a learning perspective, the authors find that learning-related scale, related knowledge and organizational diversity explain stage of progress. This furnishes support for
Attewell’s (1992) earlier conjecture that barriers to knowledge and the institutional availability of knowledge resources are key issues in organizational innovation with IT. In related work, Fichman and Kemerer (1999) identify “assimilation gaps” in the acquisition and deployment of software process innovations, suggesting that such gaps may follow from increasing returns to adoption together with knowledge barriers.14 The concept of assimilation gaps for IT innovations raises serious questions about the worthiness of researchers' traditional focus on merely nominal organizational adoption.

In a somewhat similar vein, Bretschneider and Wittmer (1993) consider contrasts in the extent of adoption of microcomputers between public and private enterprises. Controlling for various factors, they surmise that higher levels of adoption in the public sector relate to the information intensiveness of tasks and the provisioning of side payments in lieu of salary. From our perspective, such deployment should be distinguished from corresponding assimilation (in use) of the technology, as actual usage is not studied here as such. Harrington and Ruppel (1999) also consider the level or extent of adoption, examining in particular the unexpectedly slow growth in the organizational commitment to telecommuting, which they find related to problems in task compatibility and value compatibility.

Other research similarly situates implementation in the broader innovation cycle. As noted above, Grover and Goslar (1993) study the initiation, adoption and implementation of telecommunications technologies among U.S. firms, finding that environmental uncertainty and decentralized decision making distinguish those who have progressed the furthest with this innovation. And Grover, et al (1997) explore the evidence for Swanson’s (1994) tri-core model of IS innovation, which posits differences in diffusion among different innovation types. They compare the initiation, adoption, and implementation of ten innovations among firms, confirming differences among the types largely consistent with those suggested by Swanson.

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14 Deployment of software process innovations (relational database management systems, general purpose fourth generation languages, and CASE) in Fichman and Kemerer’s (1999) research may also be interpreted in terms of their infusion across an IS Department’s development projects. We discuss infusion as part of assimilation (in use) in the next section.
Fuller and Swanson (1992b) examine information centers as an organizational innovation, seeking to explain implementation success among adopters. Both earliness of adoption and rationale for adoption fail to predict success as expected, while organizational size and services offered show positive associations. These authors also make some observations on the evolution over time in the innovation itself.

Riggins and Mukhopadhyay (1994) examine two buyer-initiated EDI systems in terms of how they are configured for suppliers. They find in both cases that suppliers may have insufficient incentives to adopt an optional feature important to the buyer. The study is interesting in that it illustrates the problematic nature of inter-organizational innovation implementation, and how the benefits one firm may realize from interorganizational systems are a function of the implementation directions taken by trading partners. In a similar vein, Lee et al. (1999) examine how the re-engineering of interorganizational business processes may be a prerequisite to realizing benefits from EDI that supports continuous replenishment in retail chains.

In other studies with an interorganizational flavor, Sharma and Yetton (1996) study the inter-organizational development of systems for New South Wales Department of Health, finding that cooperation was the more problematic, the greater the "configurational distance" among the participants. Iacovou et al. (1995), cited earlier, consider the implications of lack of organizational readiness in the implementation of EDI in small organizations. Neo et al. (1994), also referenced above, observe that better integration of TradeNet with internal processes predicts higher resulting performance. And Chircu and Kauffman (2000), doing research in the travel industry, relate failure to realize the potential value of e-commerce related IT investments to implementation problems.

As of late, the implementation of ambitious change programs based on business process reengineering (BPR) and ERP/MRP has attracted the attention of IS scholars. In the area of reengineering, Mitchell and Zmud (1999) reveal that loose coupling between a redesign project's IT strategy and its work process strategy is favored for process inventions; however, tight coupling is favored for process imitations. Tillquist (2000), cited earlier in connection with comprehension,

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15 Parenthetically, organizational size, along with the information intensity of the industry, is also positively associated with early adoption (Fuller and Swanson, 1992a).
provides two case studies reflecting organizations' "struggles to reconcile the prescriptions and visions of the popularized… (BPR) change model with their specific needs and settings." A rationalist ideology of managed change, fostered by consultants' heavy involvement and presumed expertise, are revealed to mask conflicting interests and goals.

Turning to ERP, Brown and Vessey (1999) report research in progress toward development of a model of implementation success factors in ERP. We note here that the effort to identify "success factors" sets work in this vein clearly apart from the search for predictors that is typical of antecedents-based research. The latter often seeks correlates of an observed outcome (adoption, the extent of implementation, etc.) that may beg the question of whether superior business practice is achieved. Success factor research, in contrast, is more ambitious, notwithstanding issues in the measurement of "success." In this spirit, Irani and Love (2000/2001) provide a contrasting study of two MRP II implementations within the same UK firm. Both rational in intent, the first was unsuccessful because it was, in effect, incompletely rational through lack of attention to "human and organizational technology management factors."

Finally, in an assortment of other studies focused mainly on implementation, Montealegre (1999b) offers a case study in implementation, employing the "resource-based view," in a context shaped by some of the typical conditions of a less-developed country. Curley et al. (1995) examine the role of project scale and scope as determinants of the effectiveness of internal deployment and technology transfer. And Francik et al. (1991) explore attempts to introduce multi-media communication systems, locating limitations in such efforts in a lack of vision and misplaced emphases on individual use, cost reduction, structured processes, limited geographic and organizational scope.

THE ASSIMILATION PROCESS

Broadly speaking, assimilation of an innovation in an organization has its origins in the comprehension process. Indeed, Fichman (2000) considers assimilation to span a “process within organizations stretching from initial awareness of the innovation, to potentially, formal adoption and full scale deployment.” However, our focus here will be on the assimilation in use that commences after deployment. It is only through usage that the innovation “becomes one with the organization,” as the term “assimilate” suggests in its root origins. If the organization’s innovation journey thus
begins in a state of detachment from the innovation, where the organization’s initial attempt to comprehend it is in terms of something others are doing, it ends only with the innovation’s absorption into the organization’s own business processes – unless, of course, it is ultimately rejected. Along the way, the innovation – if it indeed does find a place in the organization – undergoes local adaptation, appropriation, and routinization (refer again to Table 1).

*Infusion* of the innovation follows closely from its deployment and constitutes an important aspect of its overall assimilation into the organization. As we shall understand the term here, infusion is marked by both breadth and depth of absorption in the innovation’s usage.\(^\text{16}\) Breadth of infusion marks the extent of the innovation’s usage across individuals and subunits. Depth of infusion marks the level of such usage, ranging from naïve to sophisticated. If deployment thus aims to make the innovation usable, infusion constitutes the actual “taking up” of the innovation, in effect validating the aimed-for usability. This taking up is likely to involve elements of “push” as well as “pull,” with implications for “perceived voluntariness” among users. Swanson (1988, Chapter 2) provides an illustrative case.

Both breadth and depth of infusion require time to achieve. Breadth may involve prior phased implementation by site, as well as optional adoption by individuals and subunits, leading to the innovation’s internal diffusion within the enterprise. Depth may require the gradual building up of skills and expertise through training and experience. Depth accordingly may be associated with phased implementation along a different dimension – the innovation’s functionality.

*Acceptance* of the innovation by its users forms a related component of its usage and assimilation. As suggested by the “Technology Acceptance Model” (TAM) (Davis, 1989), perceptions of usefulness and ease of use may be fundamental to intended and actual voluntary use. Too, experience with usage can influence and even reshape these perceptions. Skeptical beginners can have their doubts overcome; at the same time, hopeful beginners can sometimes become quickly disillusioned.

\(^{16}\) We follow here Zmud and Apple’s (1992) notion of infusion as progressively elaborated levels of use. We extend this notion of levels, or depth, to include breadth of use. We suggest further that infusion should be distinguished from the level of functionality provided for, but not necessarily taken up by users, a relatively common occurrence with IT-based
“User satisfaction” with an innovation forms a related aspect of its acceptance. Long studied in information systems research (see for example Baroudi, et al., 1986), it has often been employed as a measure of “implementation success.” While surely often associated with such success, it is also interesting in its own right as an aspect of assimilation. Lack of satisfaction is perhaps more obviously associated with lack of assimilation, than it is with the more abstract and encompassing notion of lack of success, which must rely on other assumptions.

Focusing on user acceptance and satisfaction puts our research community at some risk of portraying users as, in effect, "passive-aggressives" that merely smile or sulk, accept or resist. Other work, however, takes a more dynamic view of appropriation, in which IT users are seen as active shapers of the work systems in which new technology is deployed and even as agents in the "re-invention" (Rogers 1995) of the technology itself. More broadly, secondary adoption (Leonard-Barton and Deschamps, 1988) is regarded as a key process that helps to constitute what we label here as assimilation. Secondary adoption is often treated itself in diffusion terms, with research at the individual level taking its framing from the phases of innovation. Thus, many of the same phenomena that we consider at the organizational level – for example, innovation characteristics, knowledge barriers, and adaptation – reappear when individual organizational members and subunits are considered.

Turning to our survey of the recent literature, some studies that we have cited in previous sections include assimilation in their scope of interest. We will remark on a subset of those articles again here. But there are also quite a number of additional articles to consider. The work on assimilation includes studies of organizational-level factors and factors affecting secondary adoption, and more process-oriented studies drawing on concepts in learning, sensemaking, and structuration,

Organizational-Level Factors
Some of the studies we surveyed focus on organizational-level analyses of factors bearing on assimilation. For example, Cooper and Zmud (1990), cited earlier in connection with adoption, also

innovations, as illustrated, for example, with CASE (Kemerer, 1992). However sophisticated the tools provided, where they sit idle, there is clearly no infusion in the work system.
examine the infusion of MRP, their subject innovation, relative to its level of use among firms. They find that task-technology compatibility explains adoption, but not infusion, suggesting that explanations based on political and learning models may be better alternatives. Level of use in this case no doubt reflects the specific MRP features implemented, and it is unclear how actual level of use relates to the planned level of use. However, this notable study reminds us that assimilation in terms of infusion may depend intimately on implementation proceeding in a carefully staged fashion. From our perspective, the study is especially interesting because it spans three of the four processes of organizational innovation (omitting only comprehension).

Relative to other infusion-focused research, we revisit Kettinger and Hackbarth's (1997) study of the integration of electronic commerce into the pre-sales business processes of 17 small firms supported in their innovation by the South Carolina Business Gateway. Perceived benefits, organizational readiness, and trust and cooperation in association with the SCBG, were found to influence extent of integration. Purvis, et al. (1995) examine the internal diffusion of CASE technologies across applications projects within firms, finding that knowledge embeddedness within the CASE repository significantly explains extent of diffusion. Configuration of the innovation in implementation is thereby linked to subsequent assimilation. Premkumar, et al (1994), cited earlier, study the implementation and infusion of EDI among 201 EDI-enabled companies, finding that EDI’s relative advantage and the elapsed time of the firm’s experience with it influence both internal diffusion among other applications and external diffusion among trading partners. Again, we regard such “internal diffusion” to be a means of organizational infusion.

In earlier work at the organizational level of analysis, Kwon (1990) studied how communication activity among opinion leaders in the IS area within and between work units in the firm served to facilitate intelligence and influence in the furtherance of systems infusion. More recently, Benasou (1999) identified factors – including production costs, transaction costs, and characteristics of the co-design task – governing the selective use of CAD in relationships with suppliers. And Armstrong and Sambamurthy (1999), drawing on knowledge-based and resource-based views of the firm, examined aspects of senior leadership, IT infrastructure, and organizational size as factors in information technology assimilation and the creation of a "transformational vision for IT."
Secondary Adoption: Social-Psychological Factors

Under the category of assimilation research, our community has done much work on various aspects of secondary adoption, that is, adoption by end-users contingent on the wider organization's decision to adopt. Karahanna, et al, (1999) study the assimilation of Windows in a large financial institution, comparing pre-adoption and post-adoption beliefs. Adopters’ intentions to continue the use of Windows are explained largely by their perception of its perceived usefulness, while potential adopters’ intentions to adopt are shaped largely by normative influences. Branchau and Wetherbe (1990) earlier studied the individual adoption of spreadsheet software, finding that its internal diffusion in organizations was largely user-led and driven by interpersonal channels of communication. Many of these users were apparently bringing the technology in by themselves – making this, strictly speaking, a case of primary rather than secondary adoption. The study is interesting in particular, because it illustrates that organizational innovation at the desktop need not follow a conventional, top-down innovation model.

Among other research focused on individual acceptance, Yetton, et al. (1997) study the introduction of a human resources information system, finding that secondary adopters’ frequency of use is explained primarily by the innovation’s relevance and usefulness for the individual task; the contribution of certain "process" variables, such as management support and training, is also considered. Reinig, et al. (1995/1996) examine the acceptance of a group support system in terms of the affective rewards it offers participants, finding that insufficient rewards may lead users to employ alternative methods, productivity outcomes notwithstanding. Gill (1996) studies the acceptance and use of expert systems, finding that motivation to continue use is significantly influenced by the task change experience. Iivari and Maansaari (1997) study IS professionals' motivations to use CASE, finding that the impact of CASE on job characteristics and subsequently on personal effectiveness help to explain motivation. Moore and Benbasat (1991) study the perceptions of adopters of personal work stations, adapting and extending Rogers’ (1995) original innovation attributes. King and Lee (1991) study user satisfaction with computing applications in a university setting, based on a contingency perspective of individual impacts.

In more recent work identified in our survey, Agarwal and Prasad (1998), drawing on TAM, examine the effects of personal innovativeness on user perceptions of relative advantage, ease of

Network Effects in Secondary Adoption
Studies on secondary adoption of the type we have just considered tend to focus on the traditional attributes of innovation suggested by innovation diffusion theory (e.g., relative advantage, compatibility, complexity, trialability, and observability) (Rogers, 1995), or on end users' views of technology as shaped by the demands of task accomplishment (e.g., ease of use, usefulness). Other research takes a more broadly economic view of users' behavior. Prominent in this category of research are studies of the network externalities associated with IT innovations (Katz and Shapiro, 1986; Shapiro and Varian, 1999). Markus (1987) first noted and emphasized the presence of network externalities in email and posited that “critical mass” in secondary adoption would be pivotal in the innovation’s acceptance. Markus (1994) takes a process-oriented approach to further explore managers’ secondary adoption of email, challenging media richness theory about such adoption and use through consideration of critical mass effects, the unique functional qualities of email technology, and the effects of managerial factors, including sponsorship, socialization, and social control. In a very different but conceptually related study, Cool, et al (1997) analyze the internal diffusion of electronic switching within the Bell operating companies from 1971 to 1982, finding that supply factors dominated before critical mass was achieved, while demand factors dominated thereafter.

Process in Assimilation: Learning, Enactment, Structuration
Other research has focused less on explaining the extent of assimilation – a typical preoccupation of diffusion-oriented research – and more on understanding the complexities in the assimilation
process itself. In this category, we find research relating to learning and sensemaking, and structuration.

Jasperson, et al. (1999) investigate users' active appropriation of socially available information about IT into their decisions about adoption and use. Three modes of response are identified, including conformance to normative expectations, imitation based on observed use, and partnering toward mutual discovery of effective approaches to use. In work cited earlier, Tanriverdi and Iacono (1998) examine knowledge barriers in telemedicine’s adoption and assimilation by three medical schools. They identify a temporal learning pattern in lowering knowledge barriers of four types: technical (know-how and skills), economic (business model), organizational (integration and support), and behavioral (individual resistance and issues of power). Agarwal and Tanniru (1996) present a case study of BPR in which failure in assimilation is attributed to limitations in the organization’s receptivity to change.

In a recent article that moves learning to center stage, Seligman (2000) takes a sensemaking perspective (Weick, 1995) on IT innovation at the level of the individual. From the perspective of the current review, which focuses on organizations, this work falls into the "assimilation" category. Even so, it takes a broad, multi-phase view of secondary adoption. Moreover, the Weickian sensemaking perspective entails the recognition that sensemakers "enact," or act to create, the very situations that they endeavor to make sense of. Taken into the domain of IT assimilation, this view of the adopter as active agent provides a bridge from sensemaking to structuration, an area of inquiry that has received significant attention.

In this vein, Orlikowski, et al. (1995) explore in an R&D group the mutual adaptation of computer conferencing technology, the users' interaction with it, and the context of its use. They also introduce the idea of "meta-structuring": the possibility for structuring users’ structuring activities. In a more narrowly focused examination of user adaptation, Tyre and Orlikowski (1994) study three organizations’ use of IT innovations, finding that technology adaptation falls off abruptly after the introduction period as patterns of use congeal and user expectations adjust to their experience. Yates, et al. (1999) contrast patterns in the managed (sanctioned and rule-governed) structuring of genres of computer conferencing with more implicit structuring at the hands of the users.
Majchrzak et al. (2000) report a study on the adaptation of collaborative technology in a virtual team. They find evidence that the "constraints" identified in earlier structurational research possibly reflect differences in the malleability of structures across different work contexts. Meanwhile, Hirt and Limayem (2000) blend structuration theory, critical mass arguments, and the social information processing model (Fulk et al., 1987) in an individual-level analysis of student adoption of Internet-based technologies. This work is interesting for the scope of considerations addressed, in that it covers work-&-task related factors, network effects, institutional influences, and social influences. Finally, Nambisan et al. (1999), cited earlier in connection with comprehension, contribute in the area of assimilation through their recognition of the importance of user innovations in shaping the character of the innovation in the local context. Again, this has to do with the requisite contextualization of larger, "context-free" ideas for local application.

**FURTHER DISCUSSION**

As suggested above, we view the organization as an adaptive, self-directing, and even "intelligent" entity. In general, then, we argue that the more interesting and informative contributions in the literature are to be found in research that takes process and cognition seriously. Moreover, we believe that our community’s research efforts taken as a whole should embrace the innovation phenomenon in considerable scope. Attention to process, cognition, and scope is consistent, quite simply, with a belief that our community's efforts, as expressed in its research production, should reflect the inherent richness found in the innovation phenomenon.

Considering first the scope of the research, we refer to Figure 2. We developed this figure by going through each of our framework-based worksheets (see Figure A-2) and noting which cells we had recorded comments in. Thus, the columns in the figure represent the counts of articles addressing each particular combination of innovation process and rationality. The sum of all the counts is
considerably higher than the number of articles reviewed, as many articles addressed more than one process and/or rationality.\textsuperscript{17}

\textless Place Figure 2 about here \textgreater

The abiding impression from Figure 2 is that the primary focus of our research community's attention has been on the instrumental aspects of IT innovations.\textsuperscript{18} Moreover, the comprehension process has come in for relatively little attention, the focus of efforts having been on adoption, implementation, and assimilation. It is also worth noting that, as our preceding discussion suggests, much of the research on assimilation has in fact concentrated specifically on end-user behaviors.

We ask first why there has been so little research that actively addresses early comprehension. This likely reflects a relative lack of foundational conceptual work in this area. Our own paper on "organizing visions" (Swanson and Ramiller, 1997) to date has not had much company, although we note that more recent work relating to the contextualization of IT innovations, e.g., Tillquist (2000) and Nambisan et al. (1999), represent promising developments. The lack of attention to early comprehension may also reflect the fact that the traditional literature in organizational innovation largely does not treat comprehension of the innovation, beyond simple awareness, as problematic. On the other hand, as we suggest earlier, the literature in organizational communication, especially that related to environmental scanning and boundary spanning, certainly offers an alternative point of reference. We would also suggest that early comprehension has suffered neglect because of the very way our own research agendas, as a community, get shaped. Much of our work substantially trails developments in the business community (Barley et al., 1988). We often begin to check in with a given innovation phenomenon, in a significant way, only after the phenomenon is well underway as an organizing vision and has even enjoyed some measure of material diffusion. At this point, basic comprehension – just "getting" the idea – is already less of an issue for prospective adopters. Finally, we suspect that inattention to early comprehension may

\textsuperscript{17} We acknowledge that this aggregation primarily reflects our own reading of the literature and lacks the rigor that a coding exercise validated against an expert panel would have. Nevertheless, we do not believe the general pattern would differ much given a more rigorous analysis.

\textsuperscript{18} Here our observation as to the focus of attention may be biased by our selection of publications, which arguably reflects a strong U.S. influence. We conjecture that a review of European-based IS journal articles would produce higher
reflect in part our academic community's methodological preference for relatively trouble-free
dependent variables, which tends to lead us to research subjects that have some substantial and well-
defined outcomes to study – a clearly formulated intention, an accomplished adoption decision, or
perhaps substantial investments in the innovation.

Relative to the rationalities in Figure 2, we again remark that the focus has been on the instrumental,
that is, on the role that IT innovations (potentially) play in enhancing the material task systems of
the firm. In fact, much of our earlier survey in this paper serves to document the literature in
instrumental terms. Accordingly, here we want instead to tease out our research community's work
on the other rationalities.

We see some attention devoted to the role of externalities in the innovation process, and a
comparable level of attention to issues relating to the alignment or misalignment of interests and the
attendant exercise of power. Network effects have been a major (if not exclusive) focus of study in
their own right (e.g., Chircu and Kauffman, 2000; Kauffman et al., 2000; Hirt and Limayem, 2000;
Cool et al., 1997; Markus, 1994); network benefits are also commonly implicated in studies that
consider the institutional context of innovation (e.g., Montealegre, 1999a; Fichman and Kemerer,
1997, 1999; King, 1994; Attewell, 1992). Positive externalities vis a vis IT innovations appear to be
of two broad types: there are potential network benefits of an innovation in use, as we see in
connection with critical-mass effects in the diffusion of communication technologies (Markus,
1987); and there are network effects in implementation, specifically, as witnessed in the build-up of
supporting technologies, services, and know-how spurred by the increasing population of adopters
and prospective adopters (Attewell, 1992).

Research attention to issues of interest conflict and alignment, power, and politics, while
comparable in overall level to the attention paid to externalities (refer again to Figure 2), has been
somewhat more diffuse, tending less to be a primary subject of study but instead regarded more
peripherally. One area of some focused attention, however, has been the role of power in
interorganizational systems, in general, and EDI and e-commerce, more particularly. Thus, we have

proportions of interests-and-power and legitimacy rationalities, for instance. Sensitivity to these issues has a long
tradition outside the U.S. See, for example, Pettigrew (1973) and Mumford (1983).
learned something about direct pressure, influence tactics, and material facilitation affecting EDI in small organizations (Iacovou et al., 1995); limits to coercion relating to e-commerce in small firms (Kettinger and Hackbarth, 1997); and power as a factor in market process reengineering accomplished through e-market systems (Lee and Clark, 1997). We have seen how power may play a role in defining the directions taken by trading partners' implementation efforts (Riggins and Mukhopadhyay, 1994). And, in contrast, we have learned how powerful trading partners may eschew the use of coercion, in EDI implementation, opting instead to promote innovative change based on information sharing (Hart and Saunders, 1997). The potential for the exercise of power tends also to raise issues with trust. Trust, discussed earlier, naturally arises in connection with the risks associated both with technology and with trading partners under conditions of information asymmetry (Ratnasinghnam and Kumar, 2000; Karahannas and Jones, 1999). But trust is also an issue relative to the overt exercise of power (again, we note Hart and Saunders, 1997).

In some cases, power and political factors are less an actor on the stage of innovation than a part of the stage itself, setting the wider context for the decisions that get made and the action that takes place. We witness this in connection with the impact of governmental regulatory decisions (Cool et al., 1997; King et al., 1994), and at the organizational level (for example, the "coercive institutional environment" surrounding Tradenet (Neo et al., 1994)), and within the firm (for example, when individual technology use is mandated (Rawstorne et al., 2000)).

The coordination and management of interests enters into end-user studies. Thus, we have identified research on the shaping of technology users' behavior via senior leadership (Armstrong and Sambamurthy, 1999; Rai and Patnayakuni, 1996), persuasion (Xia and Lee, 2000), and sponsorship, socialization, and social control (Markus, 1994).

The play of contending interests does not always manifest itself in the overt exercise of power, but may work itself out in more subtle ways that are embedded in the very fabric of the social order (Foucault, 1979). We are reminded that interests do not always coordinate neatly towards successful adoption, as disincentives may be in place in the form of existing policies and resource controls that thwart innovation plans (Sherif and Vinze, 1999). Incompatibility between existing values and an innovative work arrangement based on technological capabilities may stunt the
innovation's diffusion (Harrington and Ruppel, 1999). Privileged views of "experts" in the context of managed change may lead to the marginalization of alternative interests (Tillquist, 2000). And rule-making may be a force to recognize when examining the structuring of technology in contexts of use (Yates et al., 1999; Majchrzak et al., 2000).

Turning now to the rationality termed "legitimacy", we note that our interest lies in the legitimization the adopter enjoys by virtue of engagement with an IT innovation. We set aside the legitimacy of the innovation itself – although this too represents an interesting issue for research (Swanson and Ramiller, 1997). To date we find that the literature has paid relatively scant attention to this aspect of IT innovation. This strikes us as somewhat surprising, given the considerable interest that the concepts of legitimacy and legitimization enjoy as part of institutional theory in organization studies (Powell and DiMaggio, 1991; Tolbert and Zucker, 1996; Scott, 2000), and their place also in considerations of management fads and fashions (Abrahamson, 1991; Abrahamson and Rosenkopf, 1997; Abrahamson and Fairchild, 1999), to which prominent IT innovations at times bear an unmistakable resemblance (Ramiller, 2001).

Acknowledgement of adopter legitimacy appears mainly, if somewhat implicitly, in connection with end-user computing, where the concept of subjective norms sometimes enters the picture (Rawstorne et al., 2000; Iivari and Maansaari, 1997; Jaspersen et al., 1999; Karahanna et al., 1999). Subjective norms have also been considered at the individual executive level, as this affects decisions about a firm's directions in IT adoption (Harrison et al., 1997). We concede that we are taking something of a leap in logging such work in our "legitimacy" column, but we do so based on the fact that adherence to norms of appropriate behavior tends to foster legitimacy. We make a similar inference in the case of work that pinpoints individual identity construction as a key aspect of sensemaking (Seligman, 2000). We also find threads of legitimization as a topic in work that takes an interest in how institutional influences help to shape what is deemed "proper" action with respect to IT innovations (Montealegre, 1999a; Ang and Cummings, 1997; King et al., 1994).

Turning finally to “surrogate” rationality, this notion again has to do with the possibility of a prospective adopter responding selectively, critically, and thereby "rationally" to available social influences surrounding the IT innovation. This is distinct from the phenomenon of fad-following,
where the blind sometimes lead the blind. Instead, we are talking about prospective adopters making up for the gap left by inadequate background, or insufficient resources for search and experimentation, through an appeal to qualified, expert authority. At its best, then, surrogate rationality strategically exploits opinion leadership as a valuable social resource. As we suggested in our earlier discussion, however, there are many shades of gray here, and an undue reliance on others' opinions of an IT innovation can shade readily off into an absence of rationality.

Some articles we surveyed considered social influences (beyond the normative) on end-users (Hirt and Limayem, 2000; Seligman, 2000), but work in this area generally leaves unexamined the issue of how truly selective or sound are secondary adopters' responses to the general supply of opinion. Jasperson et al. (1999), however, do address more explicitly how users "actively appropriate" social information into their decision making. Additional articles looked at social influences on larger units, including units within firms and firms themselves, focusing on such influential actors as MIS opinion leaders (Kwon, 1990), competitors (Neo at al., 1994), and internal champions (Rai and Patnayakuni, 1996).

Other, essentially contrarian, work offers what can be construed as observations on the difficulties of pursuing surrogate rationality. We thus witness: the supposedly privileged views of expert consultants being brought into question (Tillquist, 2000); the possibility raised that direct user evaluation may be superior to the evaluations of specialists acting on the users' behalf (Montazemi et al., 1996); and even how illusions of "pervasive adoption" – which throw the selectivity of surrogate rationality to the wind – can affect prospective adopters (Fichman and Kemerer, 1999).

Stepping back once again to consider the overall distribution of attention in our community's research efforts on innovating with IT (Figure 2), it is apparent that non-instrumental rationalities have not yet had their full day in the sun. In particular, while the study of interests, power, and politics in information systems matters has a venerable tradition (Kling, 1980; Markus, 1983), the stream of research in the innovation arena has nevertheless been rather thin. Informal observations that most of us have made, whether as employees or consultants or fieldworkers, certainly suggest that interests-related phenomena weigh much more heavily on the course of organizational events than our research has done justice to, so far. Hence, more work is needed here. Thinner still has
been the IS research community's attention to the role of legitimacy and surrogate rationality in organizational innovation with IT. We readily concede that our concept of "surrogate rationality" relates to a rather specific phenomenon, and its relative lack of coverage in the literature is perhaps not a surprise. The same cannot be said of legitimacy, which has long been recognized for its fundamental importance in the wider social-science literature. Clearly, here too lies an important opportunity for new work.

CONCLUSION

We have reviewed a substantial research literature, first to understand and relate its findings in terms of our own theoretical framework, and second, to obtain a critical perspective which might inform future work. Having carried out this assessment, we mention a couple of caveats. We first remind the reader that our review is not a comprehensive one, and that by design, we focused on a selected subset of publications over the time period chosen. We have thereby unavoidably neglected other worthy contributions.19

Secondly, we have not focused primarily on what the selected publications say about innovating with IT, each in its own terms. Rather, as mentioned above, we have sought to probe what this literature as a whole has to say about how organizations go about answering the basic question, “whether, when, and how should we innovate with IT?” Thus, we have found this literature insightful or not, and have chosen to comment on it, only from this particular perspective. From other perspectives, very different insights might reasonably be obtained.

Still, this said, we conclude from our own perspective by suggesting that illuminating and explaining purposeful innovation with IT, in its multiple aspects and across the full innovation lifecycle as sketched here, continues to offer a promising research agenda for the community. Looking ahead, research questions that might now be more pointedly addressed include these:

(1) What different approaches do firms take to the comprehension of new IT and how do these shape their approaches to the innovation adoption decision?
(2) How do firms actually go about making their innovation adoption decisions, and, in particular, what rationalities are engaged or not, and do these influence whether or when the innovation is adopted?

(3) How do firms’ different approaches to the innovation adoption decision shape their approaches to implementation?

(4) How do firms’ different approaches to implementation of the IT innovation affect the innovation’s subsequent assimilation?

(5) How do firms actually assimilate an IT innovation over time, and how is such assimilation related to the success achieved by the firm from the innovation?

(6) How do firm approaches to innovating with IT, as reflected in the above questions, differ according to the natures of both the firm and the innovation?

And finally:

(7) How if it all are answers to the above questions shaped by the broader history of innovating with IT among firms? That is, are we in practice, as well as in research, making something that might deservedly be called “progress”?

REFERENCES20


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19 See, for good example, the publications of the IFIP Working Group 8.6 on Diffusion, Transfer and Implementation of Information Technology, e.g. Levine (1994), McMaster, et al. (1997), Ardis and Marcolin (2001).

20 Empirical studies formally reviewed are indicated by (*). See the Appendix.


Innovation comprises four component processes: comprehension, adoption, implementation, and assimilation. Each is associated strongly (solid line) or weakly (dotted line) with underlying positional and transitional intentionalities.
Figure 2
Distribution of Attention in the Research Literature

<table>
<thead>
<tr>
<th>Innovation Process</th>
<th>Rationalities entertained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>instrumental</td>
</tr>
<tr>
<td>Comprehension</td>
<td>6</td>
</tr>
<tr>
<td>Adoption</td>
<td>35</td>
</tr>
<tr>
<td>Implementation</td>
<td>32</td>
</tr>
<tr>
<td>Assimilation</td>
<td>32</td>
</tr>
</tbody>
</table>
Table 1

Innovation Processes, Accomplishments, and Pertinent Studies

<table>
<thead>
<tr>
<th>Innovation Processes</th>
<th>Characteristic Accomplishments</th>
<th>Pertinent Studies</th>
</tr>
</thead>
</table>
APPENDIX: REVIEW METHOD

We selected six key journals and one conference proceedings for review. Among the journals, we picked three leading ones devoted entirely to information systems: Information Systems Research (ISR), Management Information Systems Quarterly (MISQ), and Journal of Management Information Systems (JMIS). We included three others that include information systems research and are based in different reference disciplines: Management Science (MS), Organization Science (OS), and Communications of the Association for Computing Machinery (CACM). We selected the conference proceedings of the world’s leading IS research conference, the International Conference on Information Systems (ICIS).

We first performed keyword searches of the selected publications for the period 1990-2000 using the terms “innovate,” “innovation,” “adopt,” and “adoption.” From the articles thus identified, we reviewed the abstracts and selected a subset for detailed review. By our criteria, those principally selected were to describe an empirical study of one or more organizations that innovate with information technology. The study’s analysis was to be either at the firm or sub-unit level. The innovation(s) was to be specific and identified by name (e.g., open systems). Along the way, we also picked up a handful of other articles that did not completely satisfy all these criteria but nevertheless showed obvious promise toward helping us identify the principal themes and directions of innovation research in our field. Our review set totaled in excess of 80 articles.

For each article selected, we reviewed and recorded the study type, the organization(s) studied, the key findings, the theoretical interpretation, and in particular whether the study addressed: (1) the adoption process/approach; (2) the adoption rationale; (3) the implementation process/approach; (4) implementation success/problems; (5) organizational learning; and (6) other organizational impacts. A prototypical review is shown in Figure A-1. Attending to points relating to processes/approaches, rationales, and learning would, we believed, provide some indication of each article's potential insights on the topic of mindfulness in innovation. We were also interested in examining how different adoption and implementation processes/approaches and different adoption rationales might be associated with implementation success/problems and other organizational impacts apart from organizational learning.
### Figure A-1
**Prototypical Review of Empirical Study**

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<tbody>
<tr>
<td>Study type</td>
<td>Field study. Key informant (executive) interviews.</td>
</tr>
<tr>
<td>Organization(s) studied</td>
<td>89 Hong Kong firms</td>
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<tr>
<td>Innovation(s) studied</td>
<td>Open systems</td>
</tr>
<tr>
<td>Key findings</td>
<td>Organizations are reactive more than proactive in adoption, and focus more on perceived barriers than on perceived benefits.</td>
</tr>
<tr>
<td>Theoretical interpretation</td>
<td>Factors explaining adoption model adapted from Tornatzky and Fleischer</td>
</tr>
<tr>
<td>Adoption process/approach (if included)</td>
<td>Adoption defined, but not otherwise studied</td>
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<tr>
<td>Adoption rationale (if included)</td>
<td>Studied indirectly through factors such as satisfaction with existing systems (negatively related to adoption)</td>
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<tr>
<td>Implementation process/approach (if included)</td>
<td>Not studied</td>
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<tr>
<td>Implementation success/problems (if included)</td>
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<tr>
<td>Organizational learning (if included)</td>
<td>Not studied</td>
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<tr>
<td>Other organizational impacts (if included)</td>
<td>Not studied</td>
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</tbody>
</table>

After summarizing the articles in this first format, we proceeded to take a second pass through the collection of articles to classify and characterize each article's contribution relative to our analytic framework. An example of the worksheet we used in analyzing each individual article is shown in Figure A-2. After completing this second set of individual reviews, we undertook a process in which we iterated between additional scans of the articles themselves and our own summaries of them, assessing each for the potential insights it offered. This iterative activity was integrated into the organization and writing of the paper itself, which represented the final step in our analytical process. (See Hammersley and Atkinson (1995) and Becker (1986) on the integral role played by the act of writing in producing – not merely "reporting" – the results of research.)
### Worksheet: Individual Article

**Author(s):** Selling in the era of the "Net": Integration of electronic commerce in small firms  
**Article:** Kettinger, W.J. and Hackbart, G.  
**Journal:** ICIS, 1997, pp. 249-262

<table>
<thead>
<tr>
<th>Rationalities</th>
<th>Instrumental</th>
<th>Externalities</th>
<th>Interests &amp; Power</th>
<th>Legitimacy</th>
<th>Surrogate</th>
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<td><strong>Innovation Process</strong></td>
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<td>&quot;integration&quot; – see below</td>
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<tr>
<td>Does offer some prop's re</td>
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<td>adoption</td>
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<td>Implementation</td>
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<td>Factors influencing the</td>
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<td>integration of pre-sales EC in a sample of small firms</td>
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<td>Assimilation</td>
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Notes: Significant factors: perceived benefits, organizational readiness to adopt, trust & cooperation.  
“Integration”: the process during which a firm becomes technologically and organizationally capable of transacting EC… but it’s not an examination of process, it’s a what-are-the predictors study.