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# FROM THINKING TO TINKERING: THE GRASSROOTS OF STRATEGIC INFORMATION SYSTEMS

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## ABSTRACT

When building a Strategic Information System (SIS), it may not be economically sound for a firm to be an innovator through the strategic deployment of information technology. The decreasing costs of the technology and the power of imitation may quickly curtail any competitive advantage acquired through SIS. On the other hand, the iron law of market competition prescribes that those who do not imitate superior solutions are driven out of business. This means that any successful SIS becomes a competitive necessity for every player in the industry. Tapping standard models of strategy analysis and data sources for industry analysis will lead to similar systems and enhance, rather than decrease, imitation. How then should a "true" SIS be developed? In order to avoid easy imitation, it should emerge from the grassroots of the organization, out of end-user hacking, computing and tinkering. In this way, the innovative SIS is going to be highly entrenched with the specific culture of the firm. Top management needs to appreciate local fluctuations in system practices as a repository of unique innovations and commit adequate resources to their development, even if they fly in the face of traditional approaches. Rather than looking for standard models in the business strategy literature, SISs should be looked for in the theory and practice of organizational learning and innovation, both incremental and radical.

## 1. INTRODUCTION

In order to follow the pioneering examples of American Airlines' Sabre, McKesson's Economost and American Hospital Supply's ASAP, current prescriptions for designing a Strategic Information System (SIS) include obtaining top management awareness and identifying and implementing applications that may generate competitive advantage. These systematic approaches are based on two main ingredients: a set of guidelines indicating how Information Technology (IT) can support the business vis-a-vis the competition and a planning and implementation strategy (Bakos and Treacy 1986; Wiseman 1988; Ives and Learmonth 1984; Cash and Konsynski 1984; Porter and Millar 1985).

After the 1980s generated a wealth of "how to build an SIS" recipes, the nineties have begun with a period of critical reflection (Hopper 1990). The systematic application of SIS design methodologies did not, in fact, yield a commensurate number of successful cases – at least not when measured against the pioneering technologies cited above. An intensive review of relevant empirical and theoretical literature suggests a number of reasons for these discrepancies.

- The hand, the theoretical literature emphasizes rational assessments of the firm and its environment by top management as the means to strategy formulation. It ignores alternative conceptions available in innovation literature that stress learning over thinking and value experimentation at the grass roots level of an organization as a means to finding new directions.

- Similarly, a careful examination of precedent-setting SISs provides evidence of important roles for serendipity, reinvention, and other factors that are left out of account in the conventional approach to strategy development.

There are both empirical and theoretical grounds, then, for proposing new kinds of guidelines for SIS design. After issues associated with current SIS methodologies are surfaced and the assumptions on which they rest have been reviewed, a quite different approach is proposed and justified.

Consider the following questions raised by current conceptions of SIS design

- Limitation has always been the driving force behind the diffusion of any technological innovation (Rosenberg 1982). SIS represents no exception. However, if every major player in the industry adopts the same or a similar SIS, any competitive advantage plainly evaporates. Systems that can be copied and built by a large number of firms, where no firms enjoy any distinctive or sustainable advantage in implementation, can only generate normal economic returns. In particular, small firms are at a special disadvantage in applying standard SIS planning approaches and solutions in that they will find it very difficult to manipu-

late the industry structure to their advantage through the strategic use of IT.

- Some Inter-Organizational Systems (IOS) require the connection of all the major firms in an industry, as is the case for Electronic Data Interchange. This undermines the competitive advantage such systems are supposed to offer the individual firm (Johnston and Vitale 1988).

- More generally, the competitive analysis of markets and the identification of SIS applications can be purchased as research and consulting services (Barney 1985a). They are carried out according to current frameworks, use standard data sources, and if performed professionally will reach similar results and systems.

It is not surprising, then, that business organizations should ask themselves:

- Does it really pay to be innovative?

- Are SISs offering true competitive advantage, or do they just represent a competitive necessity?

- How can a firm implement systems that are not easily copied, thus generating returns over a reasonable period of time?

In order to address such issues, researchers and consultants are finding new ways to develop SIS (Clemons 1986; Feeny and Ives 1989; Venkatraman and Short 1990). Those efforts do not typically challenge the current assumptions about business strategy formulation and industry competition. They are likely to be thwarted by the paradox of microeconomics: competition tends to force standardization of solutions and equalization of production and coordination costs among participants. To be sure, all these dynamics unfold *unless* a firm's strategy is hard to copy (Barney 1985a): the more difficult it is for other firms to imitate a successful SIS, the longer the firm can obtain a performance advantage.

We argue that the construction, or better the invention, of an SIS must be grounded on new foundations, both practically and conceptually. More specifically,

- to avoid easy imitation, the quest for an SIS must be based on unanalyzable, and even opaque, areas such as organizational culture. The investigation and enactment of unique sources of practice and know how at the firm and industry level can be the source of sustained advantage.

- developing an SIS is much closer to prototyping and to deploying end users' ingenuity than has been realized (Brown and Duguid 1989). In fact, many SIS have emerged out of plain hacking. The capability of integrating unique ideas and practical design solutions at the end user level turns out to be more important than the adoption of structured approaches to systems development or industry analysis (Schoen 1979; Ciborra and Lanzara 1990).

The paper first investigates the dilemmas of building an SIS tracing them back to current views of strategic thinking and models of competition (section 2). Such theories and models are briefly reviewed in order to show that they represent just one possible approach, and that alternative venues need to be explored for more effective SIS design ( Section 3). A closer look at how some legendary SISs were originally introduced offers clues for a different approach based on organizational learning, both incremental and radical (section 4). New principles for SIS development are then set out and justified in more detail (sections 5 and 6). Conclusions follow.

## 2. QUESTIONABLE ADVANTAGE

The rhetoric of SIS is based on a set of cases ranging from the early adopters such as McKesson (Clemons and Row 1988), American Hospital Supply [now Baxter] (Venkatraman and Short 1990), and American Airlines (Copeland and McKenney 1988) to companies that went bankrupt because they did not adopt an SIS, such as Frontier Airlines and People Express. The argument in favor of SISs is backed by frameworks that indicate how to identify SIS applications: strategic thrusts (Wiseman 1988); the value chain (Porter and Millar 1985); the customer services life cycle (Ives and Learmonth 1984); the strategic grid (McFarlan 1984); electronic integration (Henderson and Venkatraman 1989); and transaction costs (Ciborra 1987; Malone, Yates and Benjamin 1987).[1]

Much less attention has been given to the problem of how an SIS can provide a significant or *sustainable* competitive advantage, so that a pioneering company can get a valuable performance edge extract from a strategic IT application. In fact, the widely cited SIS success stories often show that such systems provide only an ephemeral advantage, before being readily copied by competitors (Vitale 1986).$_2$ This contention is confirmed by empirical evidence on the patterns of diffusion of SISs.

A recent study of 36 major IOSs in different US industries shows that although the goals set by large corporations differed considerably (e.g., decreasing costs, electronic integration), the driving force for the introduction of such systems was that other firms in the same industry had similar applications (75% of the cases); other systems were developed in collaboration with companies in the same industry (8%), while for another 8% they were individual initiatives soon to be copied by competitors. In sum, "more than 92% of the systems studied follow industry wide trends. Only three systems are really original, but they will probably be promptly imitated" (Brousseau 1990).

As a consequence, aiming at sustainable advantage requires continuously generating innovative and competitive applications and then successfully protecting that unique advantage over some time period. Feeny and Ives (1989) recommend, for example, that in order to reap a long term advantage from investments in an SIS, a firm should carefully analyze the lead time required for competitors to develop a system similar to the one being considered and it should look for asymmetries in organizational structure, culture, size, etc., that may slow down the integration of the new SIS within competitors' organizations.

Although such suggestions are very valuable, they do not entirely avoid the dilemmas faced by SIS design. For example, if it is possible for the innovator to employ a consulting service to identify specific forces that can keep followers and imitators at bay, the latter can always acquire consultants and services to help overcome those impediments. We claim, instead, that more effective tactics for SIS design will come from challenging the approaches to strategy formulation that characterized the SIS field of the 1980s.

## 3. SHIFTS IN MODELS OF STRATEGIC THINKING AND COMPETITION

It is appropriate to begin by considering the rational perspective on *strategy formulation*, applied by authors such as Porter and Millar (1985), from the business strategy to current SIS issues. According to such a perspective, management should first engage in a purely cognitive process: through the appraisal of the environment, its threats and opportunities as well as the strengths and weaknesses of the organization, key success factors and distinctive competencies are identified; next, these are translated into a range of competitive strategy alternatives. There, once the optimal strategy has been selected, and laid out in sufficient detail, the implementation phase follows.

A perspective of this type can be found in most SIS models, such as the critical success factors (Rockart 1979), the value chain (Porter and Millar 1985), strategic thrusts (Wiseman 1988), and sustainability analysis (Feeny and Ives 1989). However, in everyday practice strategy formulation differs widely from what is implied by such prescriptions and assumptions. Incrementalism, muddling through, myopic, and evolutionary decision making processes seem to prevail, even when there is a formal adherence to the principles outlined above. Structures tend to influence strategy formulation *before* they can be impacted by the new vision, and the de facto involvement of actors other than the chief executive officer is prevalent. Conflicts and double bind situations may characterize the stage where strategies are conceived and put to work. Perhaps the most notable counterevidence is provided by the theory and practice of Japanese management, at the same time so successful and so distant from the analytic - even mechanistic - principles set out above (Nonaka 1988a).

More generally, this school of thought can be questioned on three counts (Mintzberg 1990).

- **Making strategy explicit.** The rational bias for full, explicit articulation of strategy assumes, implicitly, that the environment is highly predictable and the unfolding of events is itself sequenced, to allow for an orderly process of formulation, design and implementation. However, during implementation surprises often occur that call into question carefully developed plans (Bikson, Stasz and Mankin 1985). The need for continuous, opportunistic revisions clashes with the inflexibility of the formulation and implementation sequence.

- **One-way relationship between strategy and structure.** In the conventional perspective, the strategist is regarded as an independent observer who can exercise judgement in a way that is removed from the everyday reality of the organization. For example, when evaluating strengths and weaknesses of the organization, or assessing the critical success factors, it is assumed that strategists can think and make choices outside of the influence of frames of reference, cultural biases, or ingrained, routinized ways of acting. Although a considerable body of research literature shows that such biases are at work in any decision making process (Tversky and Kahneman 1981), they are assumed away by the rationalist orientation of most approaches to strategic systems. Everyday life in organizations, on the other hand, shows that organizational structure, culture, inertia and other endemic phenomena influence the strategy formulation process, in addition to unexpected implementation outcomes (Weick 1979).

- **Thinking or learning.** Strategy formation tends to be seen as an intentional design process, rather than as the continuous acquisition of knowledge in various forms, i.e., learning. We claim, on the other hand, that strategy formulation is often likely to involve elements of surprise or sudden, radical shifts in preferences and goals, as well as vicious circles that may stifle its development and implementation (Bateson 1972; Argyris 1982; Masuch 1985). Hence, strategic decision making must be based on effective adaptation and learning (Fiol and Lyles 1985; Levitt and March 1988) – both incremental, trial-and-error learning, and radical, second-order learning (Argyris and Schoen 1978). Radical learning permits ways of seeing the environment, and commensurate views of the organization's strengths and weaknesses, to be continuously reshaped (Ciborra and Schneider 1990).

It is appropriate next to consider the *models of competition* that are implicit in today's SIS frameworks. Most rely on theories of business strategy (Porter 1980) derived from industrial organization economics (Bain 1968). According to this school of thought, returns to firms are determined

by the structure of the industry within which the firms operate. In order to achieve a competitive advantage, firms should manipulate the structural characteristics of the industry through IT – for instance, by creating barriers to entry, product differentiation, links with suppliers, and so on (Porter and Millar 1985). However, as Barney (1985a) has noted in the field of strategy and Wiseman (1988) in the field of SIS, there are alternative conceptions of competition that may be relevant to SIS development.

One contrasting alternative is the theory of *monopolistic competition* put forward by Chamberlin (1933) on this view: firms are heterogeneous. They compete on the basis of certain resource and asset differences, such as technical know-how, reputation, ability for teamwork, organizational culture and skills, and other "invisible assets" (Itami 1987). Differences of these kinds will make some firms able to implement high return strategies. Competition then means cultivating unique strengths and capabilities, and defending them against imitation by other firms.

Another perspective on competition is Schumpeter's (1950), who sees it as a process linked to *innovation* in product, market or technology. Innovation, in turn, is more the outcome of the capitalist process of creative destruction than the result of a strategic planning process. Ability at guessing, learning and sheer luck appear in such a perspective to be key competitive factors (Barney 1985b).

It is noteworthy that Chamberlin's and Schumpeter's concepts of competition are consistent with the alternative models of strategy formulation depicted by Mintzberg in his critique of rational analytic approaches. More precisely, we can identify and contrast two different "themes" in business strategy that can be applied to the SIS field. According to the first, strategy is formulated in advance, on the basis of an industry analysis; it consists of a series of moves that can be planned and subsequently implemented, to gain an advantage relative to competing firms in the same industry structure. According to the second theme, strategy formulation is difficult to plan before the fact, and competitive advantage stems from exploiting the unique characteristics of the firm and unleashing its innovating capabilities.

Looking more closely at some well known SIS applications suggests that there is a wide gap between the prevailing methodologies, close to the former theme, and business practice, definitely closer to the latter.

## 4. RECONSIDERING THE EMPIRICAL EVIDENCE

Four well known SISs, Baxter's ASAP, McKesson's Economost, American Airline's SABRE and the French Videotex, Teletel (better known by the name of the PTT terminals, Minitel) - will now be reconsidered for the light they can shed on these issues. At a closer look, such cases emphasize the discrepancy between ideal plans for an SIS and the realities of implementation.

ASAP, the system launched by AHS Corporation (subsequently acquired by Baxter), started as an operational, localized response to a customer need (Venkatraman and Short 1990). Because of difficulties in serving a hospital effectively, a manager of a local AHS office gave prepunched cards to the hospital's purchasing department; the ordering clerks could then transfer the information on the cards expeditiously through a phone terminal. From this local ad hoc solution to a particular problem, the idea gradually emerged of linking all the customer hospitals in the same way through touch-tone telephones, bar code readers, teletypes and eventually PCs. At a later stage, AHS management realized the positive impact such an electronic link with the customers could have on profits and was able to allocate adequate resources for its further development.

McKesson's Economost, another order-entry system, started in a similar way. The former IS manager admits that "behind the legend" there was simply a local initiative by one of the business units. The system was not developed according to a company-wide strategic plan; rather, it was the outcome of an evolutionary, piecemeal process that included the ingenuous tactical use of systems already available. Economost was "stumbled upon" almost accidentally, the outcome of what the French call *bricolage*, i.e., tinkering and serendipity. Interestingly, the conventional MIS unit not only was responsible for initial neglect of the new strategic applications within McKesson, but also, subsequently, for the slow pace of company-wide learning about McKesson's new information systems.

SABRE, the pioneering computerized reservation system built by American Airlines, was not originally conceived as a biased distribution channel to create entry barriers for competitors while tying in travel agents. In fact, it began as a relatively simple, inventory-management system addressing a specific need which had nothing to do with ensuring a competitive advantage. On the contrary, it was supposed to address an internal inefficiency: American's relative inability, compared to other airlines, to monitor the inventory of available seats and to attribute passenger names to booked seats (Hopper 1990).

A last telling case, at national level, is represented by Minitel. One of the rare – if not the only – successful public Videotex systems in the world, it gives France a still unmatched competitive advantage in the *informatisation de la societe* (Nora and Minc 1978). Today there are 5.6 million terminals in French households and an average of eighteen calls a month per owner.

The initial Minitel idea was not unique. Mainframes allow the creation of large centralized databases, providing

information that could be sold and accessed by a large number of customers using dumb terminals. Videotex systems promoted on this basis have failed both for early adopters (UK PTT) and latecomers (the German Bundespost) that could have benefitted from better technology, more careful planning, and the experiences of other PTTs. France Telecom (formerly Direction Generale des Telecommunications, or DGT) moved into Videotex relatively late. However, there were significant differences in the way the system was promoted to the general public. The vision of the *informatisation de la societe* convinced the government to make the Minitel a success story through the diffusion of millions of free terminals. In fact, its free distribution is seen by observers and competitors as the critical success factor for French Videotex. This is only partially true. The free terminals were at the time a necessary condition for success (recall that the launching of Minitel occurred before the diffusion of the personal computer) but not a sufficient one. Nonetheless, at the beginning the use of Minitel was sluggish, probably for the same reason other Videotex systems never took off.

To be successful, the Minitel had to be different from other media; it had to be "active." In fact, the system also provided messaging capabilities, but was never promoted as a public e-mail service by the DGT. Only because an act of hacking attracted the interest of the national press was this potential discovered and actualized by millions of users. During an experiment in Strasbourg, when a local newspaper put its classified ads section on videotex, a hacker – probably located at the dp unit of the newspaper itself – started using the Minitel to respond to the ads, establishing a direct, electronic dialogue with their authors. This was the beginning of the Minitel as an electronic mail system (*messagerie*) instead of just a system for accessing a database (Marchand 1987). At that point, the number of terminals in homes turned out to constitute a critical mass, starting a virtual circle. For instance, the network created a new marketplace where many independent service companies could sell their services. Customers immediately used the "new" medium – so much so that the national backbone packet switched network, Transpac, broke down due to overload. France Telecom was flexible and pragmatic enough to adapt the infrastructure technically and commercially to the new pattern of usage which had emerged outside the initial vision and plans; it moved "from the logic of storage to the logic of traffic" (Schneider et al. 1990).

The most frequently cited SIS successes of the 1980s, then, tell the same story. Innovative SISs are not fully designed top-down or introduced in one shot; rather, they are tried out through prototyping and tinkering. In contrast, strategy formulation and design take place in pre-existing cognitive frames and organizational contexts that usually prevent designers and sponsors from seeing and exploiting the potential for innovation.

## 5. NEW FOUNDATIONS FOR SIS DESIGN

The preceding discussion of the models of competition suggested that if an SIS application does not generate significant value, it may not be worth developing. If it is easily imitated, it can only deliver a short term, contestable advantage (Wiseman 1988). The question is, then, how to achieve uniqueness in SIS design - or at least a system difficult to emulate - if models of strategic thinking and competitive environments proposed in the 1980s are adequate?

We claim that the development of an SIS that can deliver a sustained competitive advantage must be treated as an *innovation* process (Takeuchi and Nonaka 1986; Nonaka and Yamanaouchi 1989). To innovate means to create new knowledge about resources, goals, tasks, markets, products and processes. The skills and competencies available in a corporation represent at the same time sources and constraints for innovation (Prahalad and Hamel 1990).

The creation of new knowledge can take place in two nonexclusive ways. The first is to rely on local information and routine behavior, extending them gradually when coping with a new task (examples include learning by doing, incremental decision making, and muddling through). Accessing more diverse and distant information, when an adequate level of competence is *not* present, would instead lead to errors and further divergence from optimal performance (Heiner 1983).

This approach requires allowing and even encouraging tinkering by people close to the operational level so that they can combine and apply known tools and techniques to solve new problems. No general scheme or model is available; rather, local cues from a situation are trusted and exploited in a somewhat unreflective way, aiming at ad hoc solutions by heuristics rather than high theory. Systems like ASAP or the Minitel were developed in this way. Even when big plans were present, it was *bricolage* that lead to the innovation. The value of tinkering lies in the fact that it keeps the development of an SIS close to the competencies of the organization and to on-going fluctuations in local practices.

The second route to new knowledge is to attack the competency gap directly, forging new competencies to emerge and consolidate. This is a process of radical learning that entails restructuring the cognitive and organizational backgrounds that give meaning to the practices, routines and skills at hand (Brown 1991). This approach leads to new systems and arrangements, but not by "random walks" or tinkering; at the opposite extreme, it intentionally challenges and smashes established routines in particular, it attacks day-to-day assumptions that define competence, learning by doing and learning by trial and error. From this view point, designing an innovative SIS would involve more than market analysis, systems analysis, requirements specifications and interest accommodation.

Rather, it should deal primarily with the structures and frames within which such exercises take place, i.e., with shaping and restructuring the context of both business policy and systems development. Such a context can be surfaced and changed only by intervening in situations and designing-in-action (Schoen 1979; Ciborra and Lanzara 1990).

Once a background context has been restructured-in-action, participants in the setting are free to devise new strategies and to look at both the environment and organizational capabilities in radically new ways. New strategic information and supporting systems can then be generated, based on the unique new worldview the designers and users are able to adopt. As an outcome, organizations and SIS should be very different from standard solutions and also very difficult to imitate, because they imply that competitors should abandon not only their old practices and conceptions, but also the contexts in which they routinely solve problems, run existing systems, and build new ones.

This accounts quite well for what has happened in the Minitel case. Even though its success is by now known to everybody, its imitation entails that other PTTs learn effectively and abandon – or at least discuss – their entrenched beliefs about the function of Videotex, their role as monopolists, their current practices in conceiving and developing systems, and so on. Rather than questioning such beliefs and the host of arrangements that support them, they have reacted in a defensive way. They prefer to find reasons to explain away the Minitel success. For example they cite the free terminals as the key success factor, forgetting that in most industrialized countries today there is a sufficient installed base of PCs that would make the free distribution of terminals almost superfluous. Or they suggest that a crucial role is played by pink e-mail, even though the latest statistics show that the *messagerie rose* has been only a temporary, though important, use of the system.[3] These explanations reflecting old competencies, in fact supported skilled incompetence (Argyris 1982) in a way that undermines real commitment to innovation by the various European PTTs and keeps them attached to the status quo.

## 6. SIS PLANNING BY OXYMORONS

How can we translate the theoretical reflections just presented into practical guidelines for action? What is required is a novel approach to technological and organizational innovation in a rapidly changing context (Brown 1991; Bikson and Eveland 1989; Hedberg and Jonsson 1978). A way to generate continuously innovative SIS designs is to proceed by moves that may appear to the current wisdom as oxymorons. Along this route, gaining new knowledge does not entail following a procedure or actuating a plan, but fusing opposites in practice and being exposed to the mismatches that are bound to occur (Sabel 1990). We identify seven oxymorons as alternative "planning" guidelines that can increase organizational skill in developing an SIS. The first four oxymorons are aimed at transforming *bricolage* and learning-by-doing into activities that increase the probability of "stumbling upon" SIS applications.[4] The other three set the conditions for radical learning and innovation.
To bolster incremental learning,

1. **Value bricolage strategically.** The more volatile the markets and the technologies, the more likely it is that effective solutions will be embedded in everyday experience and local knowledge. This is the petrie dish for tinkering; here creative applications that have strategic impact will be invented, engineered, and tried out.

2. **Design tinkering.** Activities, settings and systems have to be arranged so that invention and prototyping by end users can flourish, together with open experimentation (Bikson, Gutek and Mankin 1985). It requires setting up organizational arrangements that favor local innovation, such as intrapreneurship or ad hoc project teams (Nonaka 1988b). Ethnographic studies of systems and practices, and design processes that are linked to the local idiosyncrasies of actors, settings and circumstances (Suchman 1987; Zuboff 1988) are most likely to succeed.

3. **Establish systematic serendipity.** In open experimentation, designs are largely incomplete, while implementation and refinement intermingle constantly. Conception and execution tend to be concurrent or simultaneous rather than sequential. This is an ideal context for serendipity to emerge and lead to unexpected solutions.

4. **Thrive on gradual breakthroughs.** In such a fluctuating environment, ideas and solutions are bound to emerge that do not square with established organizational routines: deviations, incongruencies and mismatches will populate the design and development agenda. This is the raw material for innovation; management should appreciate and learn about such emerging practices.

Finally, to establish the pre-conditions for radical learning and innovation:

5. **Practice unskilled learning.** If incremental learning takes place within existing cognitive and organizational arrangements and does not challenge them, it is condemned to provide solutions that are not innovative. The cognitive and organizational structures that support learning can be challenged by actions, but this may lead to "incompetent" behavior, as assessed in relation to old routines. On the other hand, management should value such behavior as an attempt to unlearn old ways of thinking and doing – one that may

lead to new perspectives from which to look at resources, actions and systems (Penrose 1959).

6. **Strive for failure.** Striving for excellence usually suggests that a firm should do better what it already knows how to do. Such behavior paves the way to routinized, though efficient, systems (the competency trap). Creative reflection over failures can indicate instead the road to novel ideas, designs, and implementations as well as the recognition of discontinuities and flex points.

7. **Achieve collaborative inimicability.** In order to achieve uniqueness or emulation difficulty, do not be afraid to collaborate even with competitors in developing SIS, i.e., to expose the organization to new cultures and ideas, or improve the skills of "learning by intrusion" (Nonaka 1988b), and to find clues for new, significant changes in the most obvious routines of another organization.

These seven oxymorons can represent a new "systematic" approach for the establishment of an organizational environment where new information – and thus new systems can be generated. Precisely because they are paradoxical, they can unfreeze existing routines, cognitive frames and behaviors; they favor learning over monitoring and innovation over control.

## 7. CONCLUSIONS

Our inquiry into models and methodologies for SIS supports the hard lesson learned by a practitioner, Max D. Hopper, director of American Airlines' SABRE reservation systems. The era of conventional SIS is over. Worse, it is dangerous to believe that an information system can provide an enduring business advantage. In brief, it is high time to realize that "the old models no longer apply" (Hopper 1990).

In our perspective, the strategic application of IT can be the result of tinkering or *bricolage*; this is how new ideas from the bottom of the organization bubble up. Or it can be the outcome of an act of radical innovation, where the existing organizational reality, its environment, and IT applications are seen in a new light by the members. In the latter case, SISs are intimately associated with business renewal.

The new challenge is to harness IT to tap the core competencies of the corporation, creating new information and knowledge (Nonaka 1988b). If firms can build similar platforms and access the same data, then the competitive advantage related to IT can only come from *cognitive and organizational* capabilities for converting such data into practical knowledge for action. SIS applications are most likely to develop close to – and to serve – the grassroots of the organization, where its core competencies and skills are daily deployed and perfected.

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## 10. ENDNOTES

1. It would go beyond the scope of this paper to review in detail these rational frameworks for identifying strategic applications. To forestall objections that these approaches may have been too hastily dismissed, I should underscore that my own work on transaction cost analysis is included in this critique. A more detailed version of the paper, with a more thorough review of difficulties inherent in rational approaches to SIS planning, is available from the author on request.

2. A "strategic" system is regarded, for purposes of this paper, as one that confers a unique, sustainable, or otherwise significant performance advantage. Systems that are competitive necessities or that provide only small or short-term improvements are not viewed as "strategic" developments, however important they may be to a firm's operation.

3. A similar transitional role was played by "adult films" in the diffusion of VCRs and videocassettes and the growth of related businesses (e.g., video rental services) in the U.S.

4. Such transformations can afford significant potential for innovative SIS development for most organizations since their main prerequisite is only that mission-oriented operations be recognized and given room to move.