Information Systems Innovation and Diffusion: Issues and Directions

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IDEA GROUP PUBLISHING
Hershey, USA • London, UK
1998

CHAPTER
17

Information Systems Innovation: A Framework for Research and Practice

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The present (and quite likely the future) business environment requires more innovation occurring in a more distributed and organic pattern with less time available to make decisions. Information systems (IS) innovation plays an increasingly important role in facilitating and supporting business innovation. This chapter argues that a holistic understanding of IS innovation is needed and proposes a process based on the systems thinking "human activity system" view. This holistic view is developed through paying attention to key innovation issues and key issue structure, these being the basis for the development of an IS innovation framework. The IS innovation framework is used to develop models for single as well as multiple IS innovation processes. These are exciting research questions that need our attention.

The number of issues that may be studied within the field of management information systems (MIS) is vast and the interaction among elements virtually infinite. A frequent tactic employed to manage the complexity of the field has been to concentrate on specific domains, for example, strategic use of information systems (IS), the role of change champions, the diffusion of IS, systems development, end-user computing, and, less often, maintenance.

By focusing on one domain, researchers risk leaving out elements that are essential to organizational success. That is, too much focus

on detailed studies increases the danger of reductionism (Lakatos, 1970). Commonly used methods may direct developers attention to particular, perhaps more often than not technological, IS development aspects. Since IS development requires the integrated solution of a wide range of phenomena, the danger is that the end IS result does not satisfy business needs and human requirements. Support for the argument that organizations quite frequently do not master their IS innovation processes can be found in surveys of user opinions, indicating that as much as 80 percent of IS development efforts are judged as either direct or partial failures (Mowshowitz, 1976; Vowler, 1991). Although the IS failure rate may not be this high, these reports tell us that we need to increase our understanding of how IS innovations unfold. After all, from the viewpoint of the organization, the total benefit of IS deployment is the combined utility of all its various uses.

Elements of IS innovations include technical issues, human concerns, managerial actions and knowledge, interactions among line employees and information technology (IT) experts, strategic, tactical and operational requirements, organizational elements, and vision. A holistic approach to IS development and use is needed to counteract the dangers of reductionism, that is, paying too much attention to a subset of these elements while glossing over others. This chapter offers innovation theory as the basis for the development of an integrated understanding of IS development and use.

In the next section, the background of the IS innovation view adopted here is presented, followed by the development of an IS innovation framework. The framework is used to suggest future trends within organizational IS innovation research and practice.

Background

The first challenge in developing a holistic IS innovation view is the identification of the basic positioning that will determine the subsequent content. The chosen positioning must be followed by the identification of key issues embedded within IS innovation. Actors will interpret key issues in specific ways. The basic positioning, the key issues, and key issue interpretation serve as the basis for the development of an IS innovation framework.

The Basic Positioning

The basic question here is whether IT itself is the prime mover of innovation or whether IS innovation must be understood in a human actor context. This is the question of technology push versus pull (Zmud, 1984).

Obviously, firms in the IT industry sector have a market potential in mind in their IS/IT product development efforts. Because of the

immense vendor and software houses IS/IT product innovations, the possible areas of IS/IT use today is radically larger than what was the case in, for example, the early 1970s. The development of efficient mass data storage devices, multi-media processing, PCs, powerful microcomputers, enhanced telecommunication services, and flexible software applications have vastly increased the range of the areas where IS/IT can be utilized, or existing IS solutions adapted to address new problems. In this regard the innovation process is technology driven.

Diffusion of IT innovation models may help us understand how IS/IT products are disseminated from vendors and software houses into user organizations. When they have the resources, user organizations may choose to combine IS/IT products and internally developed applications to derive a benefit. The unique application of IS/IT to the development of organization-specific applications is the organizational IS innovation.

It seems appropriate to observe that the quality of the IS/IT product is a necessary but not sufficient prerequisite for IS innovation success. The *people* within the organizations determine the outcome. Consider three points relevant to the coupling between technology issues and the human element.

First, of importance to researchers, and managers of organizational IS innovation are the relative contributions of IS experts versus employees (users and managers) within the line organizations. IS experts are frequently, albeit often indirectly, blamed for IS innovation failures because the innovation process is driven by IT rather than business considerations (Morton, 1991). Second, the critical factor in ensuring appropriate utilization of IS is the line-managers' knowledge of IS business potentials and IT platforms. Line managers who take responsibility for coupling business needs and IS solutions and support avoid the negative impacts that can come from focus on technical, rather than business considerations (Keen, 1991). Third, middle managers engaged in business innovation and active in discussing IS-related issues are responsible for implemented IS innovations. Usage may not play a decisive role (Larsen, 1993a).

The critical role of the human element in the innovation process is clearly articulated in the following definition of innovation:

> "An innovation is the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context." (Van de Ven, Andrew, "Central Problems in the Management of Innovation," *Management Science*, Vol. 32 (5), May 1986, p.604.)

The view that people are key to understanding an innovation process is also parallelled in systems thinking with the notion that only

people, through a ***human activity system***, can create artifacts (Checkland, 1981; Checkland and Scholes, 1990). The term "human activity system" denotes *how* people, with a purpose in mind, execute their efforts. An artifact is an outcome that is other than a natural made phenomenon, that is, a human-made physical or abstract product.

These observations lead to the conclusion that a holistic understanding of IS innovation must take as its foundation the people within an institutional setting. An IS innovation is an artifact and can only be explained as a result of human activity. The position taken here does not mean that studies of IS/IT diffusion are irrelevant or of less value. Diffusion studies incorporate people issues. However, people issues are attached to the IS/IT phenomenon defined as the anchor element studied. The human actor as the basis unit for investigation has simply not gotten the level of attention it needs.

The IS Innovation Framework

The IS innovation framework is developed in two steps. First, key issues that a framework might contain are discussed. Next, key issue interpretations are presented. These are the basis for the IS innovation framework.

Key Issues

Leavitt (1965) was among the first to present a coherent framework for issues that may regulate organizational processes: task, structure, technology and people. His model has been further developed to include factors, such as organizational culture (Davis and Olson, 1985) or strategy, management processes and roles (Morton, 1991). Leavitt's model has been extensively used and cited, but Larsen (1993b) has argued that the model allows direct interaction among items, for example, between task and technology, without human interference, a highly unlikely occurrence.

The recent approach to IS innovation—business process reengineering—advocates a conceptual process framework consisting of five phases (Davenport, 1993). The phases are: identifying process for innovation, identifying change levers, developing process vision, understanding existing processes, and designing and prototyping the new process. It has strong similarities with phase models commonly found within the IS strategy literature (for example, Wetherbe, 1993) and systems development literature (for example, Olle, Hagelstein, Macdonald, Rolland, Sol, Van Assche, and Verrijn-Stuart, 1988). While the concept of phases may help us develop methods and understand the uses of IS, the innovation process may not be linear. It is more likely that human beliefs, attitudes, interests and behaviors

determine how the process unfolds and influence process content (Van de Ven, 1986, 1992; Van de Ven and Poole, 1995). Human intervention may result in continuous execution of processes other than those initially planned and planned processes may not be carried out.

This author suggest from the discussion conducted so far, we can draw upon five key issues to explore IS innovation. First, human activity unfolds within an *organizational* setting. Second, as Keen has pointed out, *knowledge* plays a vital part. Third, drawing upon systems thinking principles, the objective of an IS innovation process is the creation of an *artifact*, that is, an information system that satisfies certain needs. Fourth, since IS innovations occur on strategic, tactical, and operational levels, the *time horizon* for the innovation process is an element. Fifth, the creation of an IS artifact needs an *innovation process*.

Key Issue Interpretation

Each of the five key issues consist of components and these components may be put into a specific order. The combination of components and order are labelled "structure" and compromises a chosen way to understand and interpret a key issue. The chosen structure may not represent the subject matter true components and component order but it is what an actor uses to understand it. A model for key issues and structure is presented in Figure 1 (see p. 419).

Time Horizon Structure

The most common view is to differentiate among strategic, tactical and operational issues. Although an IS innovation may not be clearly identified with one of these, it is generally true that: (1) some innovations have a long-term horizon and strategic nature, (2) some systems have an intermediate-term horizon (for example, tactical planning, and control,) and (3) some systems have a short-term focus (for example, transaction systems or systems that support workers and office personnel on a daily basis).

Note, however, that a transaction system (for example, an order processing system in an international business setting) may also be a strategic solution. Additionally, transaction systems may also provide valuable information to top and middle managers and therefore be of tactical importance. Clearly, one IS may be placed within each of the three levels of strategic, tactical and operational.

Knowledge Structure

Among others, Keen (1991) and Swanson (1994) have convincingly shown that IS knowledge among line managers and business knowledge among IS professionals play a vital role in IS success. In the present model knowledge is divided into three levels; (1) in-depth expertise - the knowledge actors should posses within their own job

domain, (2) principal understanding - the knowledge actors should have of critical issues outside their own job domain, and (3) rudimentary insight - the shallow knowledge actors may have of issues outside their own job domain.

Organizational Structure

Organizational structure creates both opportunity and limitation for innovation. Some organizations are more innovative than others, a theme that has been studied in its own right (Henderson, 1979; Peters and Waterman, 1982; Kanter, 1983; Lawrence and Dyer, 1983). The minimum differentiation of structure needed to account for IS innovation are the levels of the organization, group and individual. The organization level includes traditional arrangements of units (divisions, departments and offices) and designed networks binding these units together. Because many organizations purposefully choose to cooperate through legally binding contracts over considerable time, networks may include units in more than one organization.

The group level should be divided into two types: formal and informal. Formal groups exist at all levels of the organization, making decisions on issues in regularly scheduled meetings. Among the formal groups of the organization, there is ample evidence that the power elite (top managers within the line-organization and IT department) is a critical body (Thompson, 1967; Hage and Dewar, 1973). The power elite, because they have decision mandate and resources available, initiate more change than managers lower in the organizational hierarchy. To a large extent, the power elite use innovation to promote their own organizational views and interests (Kling, 1980). They may suffer from self-induced protective behavior to further their own interests and protect themselves against competing views (Janis, 1971). It can take considerable pressure to induce them to initiate radical change (Pettigrew, 1985).

Informal groups emerge through individual action to introduce change. They may work as much through informal contacts as through established managerial command chains in the organizational hierarchy (Schein, 1980; Kanter, 1983, Albrecht and Ropp, 1984). Informal groups may be quite stable over time.

Individual employees, and specifically middle managers in the core organization, also take action to initiate change (Kanter, 1983; Beath, 1991; Larsen, 1993a). Often, individuals employ newly introduced IS before the organization has developed active strategies for its use (Brancheau and Wetherbe, 1990).

Artifact Structure

Usually, the introduction of an IS/IT component/tool is regarded as the IS innovation. Most diffusion of innovation studies use a clearly defined IS/IT component as their study object, for example, spreadsheets (Brancheau and Wetherbe, 1990) or a work-station (Moore and

Benbasat, 1991.) It can be inferred that Swanson's (1994) IS innovation topology had concrete IS and IT components/tools as his anchor (electronic data interchange systems as an example of type III innovations and executive information systems as an example of type II innovations).

The basic assumption the present definition of the artifact structure rests on is that the implemented IS or IT component/tool is a concrete and visible component of a wider phenomenon. The artifact is a mix of people's views of information needs, what an IS is and its purpose, and the IS/IT as it physically exists. The German philosopher Emanuel Kant defined the differentiation made here as "how people interpret a phenomenon" (Das Ding an Mich) and "what the phenomenon is in the real world" (Das Ding an Sich).

Consequently, the definition of the artifact must span from people's views to the concrete and installed IS/IT solutions. It is suggested it consists of five levels: the core business level, the information needs and requirements level, the IS/IT expert level, the IS level and the database level.

The starting point adopted here is that actors in the line organization have ideas - some nebulous, others concrete - about the core business processes in their organization (this is the core business level). These ideas provide the basis for what the actors think are their information needs and requirements (this is the information needs and requirement level). In most cases IS/IT experts assist actors in the line organization in formalizing their business views and information needs and translate the formalized descriptions into concrete solutions (this is the IS/IT expert level).

The core business level, the information needs and requirements level and the IS/IT expert level are the basis for the physical part of the artifact structure. The physical part contains two elements. First, at the IS level organizations create principal IS/IT solutions that subsequently guide the development and use of IS. It includes: 1) the IT architecture, a foundation for an organization's IS portfolio (which includes methods and tools for the development and maintenance of the IS portfolio), necessary rules and guidelines, 2) IS applications, including in-house-developed IS and packaged systems, and 3) IT components, including hardware, telecommunication equipment and operating systems. The database level includes all the data the organization and its actors store: personal files, transaction databases, document archives and data warehouse.

Innovation Process Structure

It is quite common to advocate that an innovation develops over time in phases, but a development process may contain many elements not included in a phase model (Van de Ven, 1992). The process may reiterate phases more often than thought and each reiteration may contain different elements and include actors not previously involved in the process.

Many IS innovations are large, complex undertakings that require formal project organization to develop. However, a project organization is not the first step in the innovation process. A project is established because actors in the organization decided there was a need for it at an earlier point in time. Nor is a project organization an end. It is a vehicle for creating an IS solution. The demise of a project organization occurs when its product has been transferred to the users.

In the actor oriented model, then, we see that most IS innovations develop through three distinct phases. In the idea phase, actors within the organization give birth to an idea and process it until a decision is reached to create a project organization. In the creation phase the project organization tests the soundness of the initial idea and conducts the necessary activities needed to create the new IS solution. In the usage phase the new IS solution has been handed over to the core organization and taken into daily use.

The idea phase, the creation phase and the usage phase are the absolute minimum number of phases needed to understand most IS innovation processes, from birth to death. The division of the total process into only three phases makes the model robust. The names for phases describe the principal process within each. For example, the traditional label for the creation phase is systems development. However, systems development has strong technological overtone and because of IS failures, many actors within the core organization react negatively to the term.

The three phases put forward here are fewer than those Cooper and Zmud (1990) suggest in their technological diffusion model. Their stages are initiation, adoption, adaption, acceptance, routinization and infusion. Since an external IS/IT innovation is their anchor, these phases mirror technology penetration into user organizations. The basic premise made is that the IS/IT solution to a well defined problem already exists. This is a good illustration of the subtle difference between the present framework and diffusion of innovations. The principal element in the IS innovation framework is the human actors within the organization. The anchor of the innovation process is the development of peoples' ideas over time and how these ideas attach IS/IT as part of the solution.

The nature of the three phases requires elaboration.

The Idea Phase. Idea generation is the source of organizational renewal. Organizations must encourage individual creativity as well as provide a structure to guide and encourage the development of novel business approaches.

Ideas may come from many sources: strategic processes, individuals within the line organization, or IS/IT experts. Regardless of source, an idea needs to gain organizational support for its development (Kanter, 1983; Van de Ven, 1986; Beath and Ives, 1989; Beath, 1991). Both informal groups and the power elite of the organization

must be convinced of its benefits and allocate resources for its development. The idea phase may consist of two sub-phases; idea percolation and idea molding. Innovation is fostered or hindered in both.

The Idea Percolation Sub-Phase. The freedom to generate ideas—idea percolation—may vary substantially among organizations. Some researchers argue that nearness to demanding customers is the most effective way to secure innovative behavior (Kohli and Jaworski, 1990; Narver and Slater, 1990). Others point to an organizational climate favorable to change. In a positive climate ideas are welcomed and are not interpreted as a danger to the existing order. Ideas are tested objectively and rewards for idea generation and implementation are appropriate. People are not incorrectly punished for failures (Feldman, 1986; Frost, Moore, Louis, Lundberg, and Martin, 1991; Linstead and Grafton-Small, 1992). According to Kanter, mechanisms the organization may use to foster innovation are inter departmental job rotation and reward in the form of recognition rather than monetary premium or promotion.

Strategic planning may lead to the identification of areas for IS innovation (Clemons and Harris, 1991; Morton, 1991; Clemons and Row, 1992). Since the power elite (e.g. top managers) are more active in initiating business change (Hage and Dewar, 1973; Ettlie, 1983), one might think that the power elite also initiate IS innovation as well. However, this is not necessarily so. Larsen (1993a) found no relationship between implemented IS innovation and the managerial hierarchy. Some evidence suggests that in cases where top management initiate IS innovation, organizations experience more problems than if IS management starts the process (Lederer and Sethi, 1988).

Individuals within the line organization are important sources of ideas (Beath, 1991) and middle managers may play a particularly critical role (Kanter, 1983; Larsen, 1993a). Younger and better educated employees are more likely to try newly developed information technology (Brancheau and Wetherbe, 1990). IS/IT experts also forward ideas (Allen and Morton, 1994). All these categories of people display a high degree of innovativeness.

The Idea Molding Sub-Phase. Kanter (1983) found that innovative organizations strengthen coalition building through the dispersal of resources — monetary and human. These resources should be spread throughout the organization to ensure that innovators have to negotiate with people outside their own department to secure funding and support. In the process, innovative managers use the informal network to engage the support of their peers and the formal network to get resources allocated from their superiors.

Rogers (1993) argued that the probability of innovation acceptance may depend on the innovation's fundamental characteristics. Relative advantage, result demonstrability and visibility were found to

be the best predictors for adoption versus non-adoption (Moore and Benbasat, 1991). (These constructs were tested on the adoption of personal work stations. They may not apply in the situation where only conceptual ideas about IS/IT exists.)

At the organizational level very little is said in the literature about how the idea molding process should be carried out. Within the IS strategy literature, the focus is on phases and their contents. The human actor is not treated as the major focus (Clemons and Harris, 1991; Morton, 1991; Clemons & Row, 1992). Material related to customers, vendors, competitors, the threat of new entrants, and the probability of substitute products is also commonly found (Porter, 1985; Porter and Millar, 1985).

The Creation Phase

At some time during the molding sub-phase an idea will have gained enough support for a decision to be made about its development into an IS. This is the creation phase. The MIS literature presents a variety of approaches for this phase: systems development, the water-fall model, the socio-technical approach, heuristic development, prototyping or object oriented analysis and design. Each has differences and similarities.

In principle, the creation phase consists of two sub-phases. First, a formal testing of the soundness of the underlying idea must be carried out (this is the change process definition sub-phase). Second, if the solution is found to be both systemically desirable and culturally feasible (Checkland and Scholes, 1990), the new IS is created and implemented (this is the change creation sub-phase).

The Change Process Definition Sub-Phase. The traditional phrase for this phase is feasibility study but I propose we substitute the term "change process definition" for two reasons. The high failure rate of IS innovation justifies shifting the testing of an idea from the systems development process and formalizing it as a preconditional activity. Second, the term "change process definition" more clearly signals that this sub-phase is the bridge that takes the innovation process from the molding sub-phase to the creation sub-phase.

The scope of change process definition is wider than that of traditional feasibility studies. It incorporates three issues. First, an idea, its promoters and opponents already exist. These elements must be consciously incorporated as the basis for the work carried out in the change process definition sub-phase. Kanter (1983) found that innovative middle managers active in idea generation do not take on the role of project managers, or take part in carrying out the detailed work of the project but rather act as brokers between the project team and the rest of the organization. Their contributions are their ability to anticipate problems and to take an active role in solving emerging problems and political issues. They maintain project momentum and

keep the effort going. Kanter called this "boundary walking."

Second, the idea, alternative technical solutions, and effects of these solutions on the innovation process participants (organization, power elite, IT, IS experts, informal networks and individuals) must be documented. Research indicate that projects have a higher probability of success when a line manager, rather than an IS/IT expert takes on the role of project manager (Johnston and Carrico, 1988).

Third, as advocates of total quality management argue, the requirements guiding the detailed IS development that will take place in the following sub-phase and later, during maintenance, must be determined (Gillies, 1992). This would include selection of quality standards, methods, information technology support (CASE), budgeting, scheduling, and milestones (Swanson, McComb, Smith, and McCubbrey, 1991).

The Change Creation Sub-Phase. The change creation sub-phase includes traditional systems development activities: detailed information requirements development, detailed IS evaluation documentation, IT procurement installation, program development and testing, and implementation (see, for example, De Marco, 1978; Mumford, 1983; Olle et. al., 1988; Swanson, 1988; Westerman and Donoghue, 1989; Snow and Couger, 1991). This illustrates the complexity of the area.

The quality of the change creation execution is crucial to the IS innovation success. Many of these research issues are examined in Cotterman and Senn (1992). Systems development may be said to be one of the most researched areas within MIS. Despite these efforts many issues seem unresolved, for example: securing positive and limiting negative IS effects, the role of user participation, the line management versus IS management role or implementation strategies. The purpose here is not to argue the pros and cons of various approaches to change creation but to define where this sub-phase fits into the IS innovation context.

The Usage Phase

The usage phase in a product market life-cycle includes at minimum: initiation, maturation and decline (Kotler, 1991). With an IS innovation, parallel phases include change anchoring, change refinement and change termination.

The Change Anchoring Sub-Phase. A new information system is a complex and novel experience for users and IS/IT experts. Some users may be pessimistic, others overly optimistic. They need time to adapt to the new IS. The time required for this phase may vary but cannot be shorter than the time it takes people to adapt to a new situation cognitively and emotionally. If the IS contains elements that are used seasonally, a year may be an appropriate time frame.

People's reactions to an IS innovation may depend upon whether that person initiated the change effort or whether the innovation is the result of organizational activity, and the characteristics of the particular hardware and software being introduced. Preparing the ground for successful use of an IS innovation starts in the idea phase and should be systematically implemented in the creation phase (Swanson, 1988). The preparation includes idea generation participation and responsibility. As the innovation process progresses, informing others about the idea and IS effects, securing user participation and establishing educational programs.

The Change Refinement Sub-Phase. Following completion of change anchoring, the information system enters its longest period. From an innovation standpoint, the critical aspect of this phase is the continuous changes made to the information system. The term maintenance has been used to describe this process, however, maintenance implies fixing something that is wrong. A more appropriate view, this author suggests, would be to consider the difference between the concepts of product versus process innovation (Abernathy and Utterback, 1982). The product innovation is the radical IS renewal undertaken in the creation phase. However, the new IS includes principal design features that limit the degree of change that can be made in the usage phase. Consequently, the change potential in the usage phase is incremental relative to the change potential in the creation phase. Therefore, the change potential in the usage phase can be characterized as process innovations. They are *refinements* within the established IS innovation design features.

Although the change refinement sub-phase lasts longer than any other and, quite probably, is the most important period in an IS's life-cycle, relatively little research has been reported. I see it as symptomatic that comprehensive IS textbooks do not use the word "maintenance," or its equivalent, in the table of contents or in the index, include it under subheadings, or give it less than one page of space (for example: Cash, McFarlan, and McKenney, 1988; Wysocki and Young, 1990, Laudon and Laudon, 1996). Journal articles often have a technical flavor, focusing on professional problems or purely technology considerations (Edwards, 1984; Kim and Westin, 1988). The exception to the rule is the work of Swanson and Beath (1989). Their book gives a comprehensive view of the many issues of maintenance and how it could be better managed.

The focus of literature on the change refinement phase has mainly been on how the IS operation should be organized and run (Dearden, 1987; La Belle and Nyce, 1987; Wysocki and Young, 1990). The most important line management concern seems to be calculating the right sum of money that should be paid for IS services (Hufnagel and Birnberg, 1989).

Regarding end-user computing systems, change refinement is

viewed as problematic - seemingly because people in the line organization do not have the discipline needed to analyze their own information requirements, or to test and document their programs properly (Davis, 1989). Managerial challenges have been more thoroughly investigated in the area of end-user computing (Nelson, 1989).

Frameworks for the evolution of the management of end-user computing over time have also been presented (Henderson and Treacy, 1986). Recent publications have initiated a discussion of the overall responsibilities of line managers (Keen, 1991; Boynton, Jacobs, and Zmud, 1992). In conclusion, so far change refinement has been investigated sparsely and fragmentally. Generally, it has not been addressed as a critical IS innovation opportunity.

The Change Termination Sub-Phase. Because of the inherent limitations in any IS, and because of IS/IT developments, the gap between business needs and deliverables from an IS will increase over years of use. Therefore, every IS will enter a period where the question of its demise and substitution with a new system surfaces. This is the "change termination phase".

To the knowledge of this author there is no published work that specifically addresses this phase. Rather, this dimension of a system's life is subsumed under other fields in a structural and technical manner. For instance, when strategic planning or an application project effort define an opportunity or a problem, it is automatically assumed that a new system will render an old one obsolete. During implementation the emphasis is on how an old system's data will be converted into the new IS and how functional transition from the old system to the new may be achieved.

Probably, change termination and idea percolation are two sides of the coin. If an IS can be said to have progressed into the change termination sub-phase, the organization must have come to the conclusion that this IS can no longer be acceptably enhanced through change refinements. This state of affairs must fertilize thoughts about IS potentials and opportunities, the heart of idea percolation.

The problem is that many organizations do not have a conscious understanding of how far in the usage "life-cycle" their ISs have progressed. Because they do not practice a systematic and strategic evaluation of their IS portfolio, they do not evaluate IS quality in an appropriate manner. This scenario leads to a very jumpy and abrupt transition from the change termination phase to a new idea percolation phase.

The IS Innovation Framework Defined

The framework presented in Figure 1 shows the key issues and key issues structure.

IS innovation processes may vary substantially in regard to the

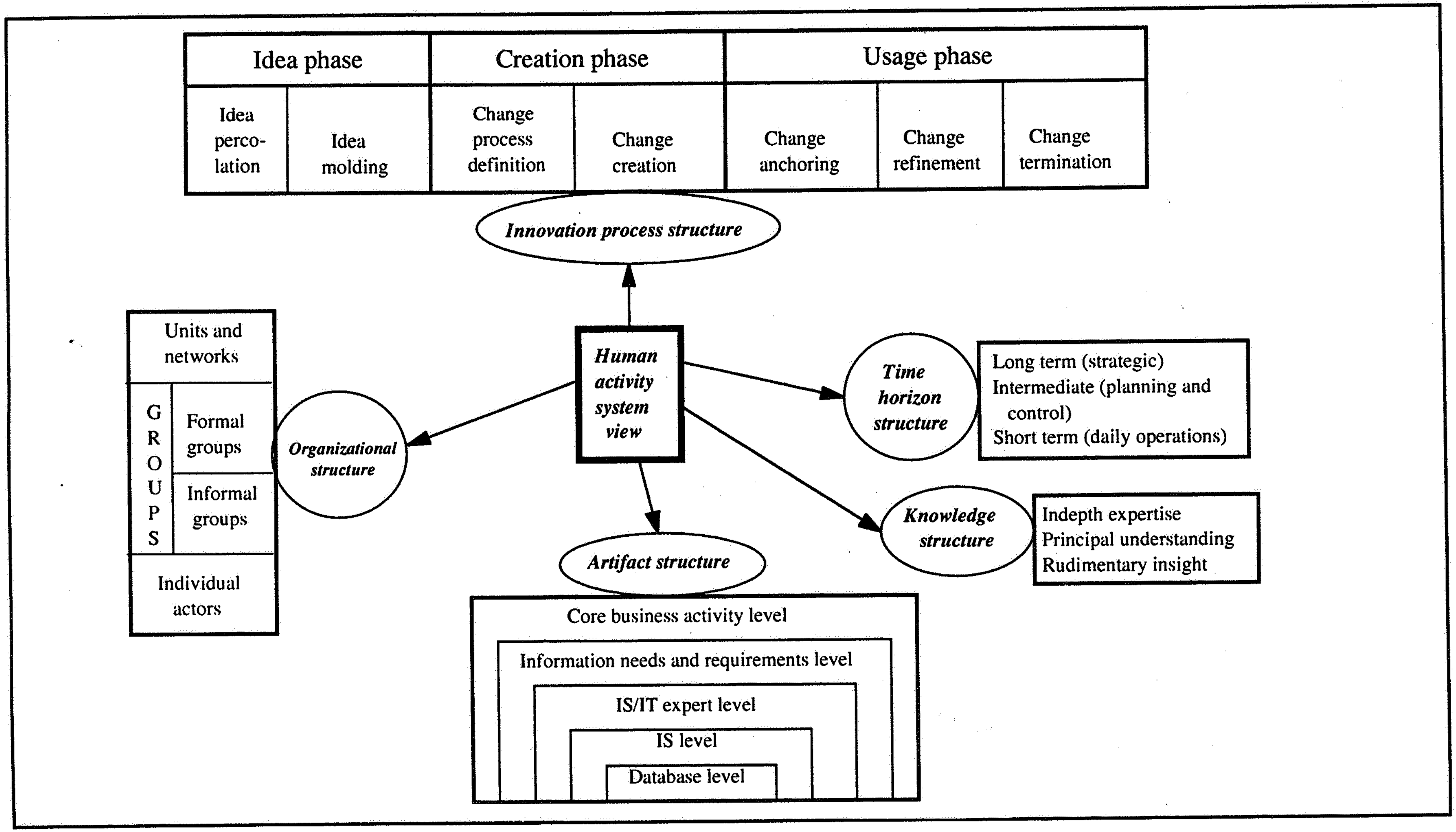

Figure 1: The IS Innovation Framework: Key Issues and Key Issues Structure

particular set of key issues and structural parts involved. For example, a brainstorming activity in an IS strategy project is the idea percolation in a formalized, top-down IS innovation process, the time horizon may be a mix of long term, intermediate and short term issues, within the knowledge structure it may combine indepth expertise as well as principal knowledge, within the organizational structure the participants form a contemporary formal group, and among the elements in the artifact structure core business concerns and information needs and requirements may be the main focus. Because research findings directed at particular interactions often are overlapping or inconclusive, the framework does not include lines among key issues and their structure.

The framework can be used as a checklist to map the elements actors include in their innovation undertakings and increase the awareness of IS innovation aspects not yet considered. It can be used as a vehicle for identifying actors' perceptions of key issues and key issues structure.

Suggested Future Trends Within IS Innovation

The framework in Figure 1 can also serve as a vehicle to develop integrated models for a single IS innovation process and multiple IS innovations.

Single IS Innovation Process

As a starting point, let us consider a particular application (for example, a payroll system) and its innovation process. Every one of the five key issues are relevant in this context. However, since an integrated model presented on paper only can represent three key issues and their structure, a choice has to be made. This choice depends on what the actors involved regard as the most important key issues. My own understanding and experience with systems development efforts, leads me to suggest that most actors would select the innovation process structure, the organizational structure and the artifact structure. Parallelling the partial derivation technique in mathematics, the key issues of time horizon and knowledge are treated as constants, see Figure 2.

This model is similar to traditional "systems development" models in respect to including phases. However, while most systems development models contain the detailed phases (for example, information analysis, technical analysis and implementation) within the creation sub-phase, Figure 2 includes macro oriented phases from application birth (idea percolation) to termination. The innovation model may help actors understand the application in its complete IS innovation

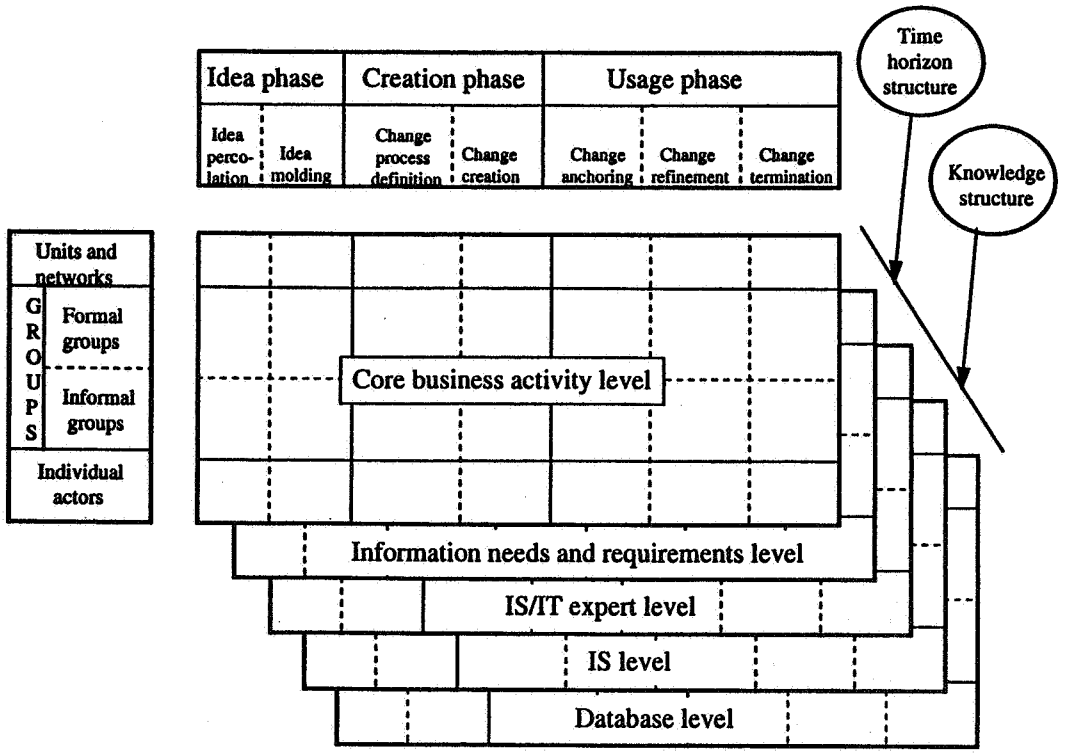

Figure 2: Model for a Single IS Innovation Process

life-cycle.

Most systems development models describe in depth the tasks that should be carried out within each detailed phase. The innovation model presented here does not contain such tasks but shows the interactions among innovation process structure, organizational structure and artifact structure. Each cell in the model represents one specific combination of the three key issues. Traditional systems development tasks can be mapped into the innovation model, showing a way to carry out the analysis for a specific cell or how integration among cells can be achieved. The innovation model can be used to check the completeness of a specific systems development approach and point to areas it does not cover.

Multiple IS Innovations

The distinction made between the creation phase and change refinement in the usage phase may not be as distinct as portrayed; that is, an innovation process may not be linear. Additionally, multiple IS innovation processes may unfold simultaneously over time.

The Validity of Linear IS Innovation Models

In most cases, systems development projects develop through a highly iterative and recurring process (Weinberg, 1992). More often than not, planned sub-phases are never executed and other sub-phases

critical to successful project completion emerge because of unforseen needs or personal preference. The emerging sub-phases may be intuitively recognized and carried out without ever becoming a formally recognized part of project planning and control.

The proposition that radical IS innovation occurs in the creation phase and that only incremental IS innovations are possible in the usage phase may be questionable. Through increased quality management and IT tool flexibility, the ability to make radical changes to an IS currently in use may be possible to the degree that it would be difficult to differentiate between the degree of change introduced through the initial creation of an IS and the degree of enhancements added to the IS system in the usage phase. In principal terms, the challenge is to build systems that can suggest new directions for action based on detection of shifts in the change rate (Walls, Widmeyer, and El Sawy, 1992). A signal that this may be the case is the increased focus on concept and tool selection in the creation phase, rather than perceiving information requirements elicitation and programming as the most important systems development issues (Dekleva, 1992).

On a strategic level, dividing the IS innovation process into a creation phase and a usage phase might be even more problematic. Van de Ven and Poole (1995) show that a business strategy may develop in four distinct ways (life-cycle, teleological, dialectical and evolutionary) or in any combination of these four. Among the alternatives, only the life-cycle approach is a more traditional task based phase-linear model. A recent *Business Week* report on business strategy planning among major US Fortune 500 companies stated that the business strategy process is no longer viewed as a top-down logical planning and control activity (Byrne, 1996). CEOs understand that multiple business strategies emerge within a system where power, responsibility and knowledge are distributed throughout the corporation.

If IS strategy is an integral part of the business strategy (as suggested by Morton, 1991; Banker et al., 1993; Davenport, 1993), then we would expect that an IS strategy develops like a business strategy. Apparently, this is not the case. IS professionals talk about IS and business strategy integration but forward phase-based linear models for IS strategy development that are not a plausible extension of business strategy evolution. Ciborra (1993) found that most IS strategies were extensions from major applications, an observation that indicates that IS strategies are not developed in accordance with the dominant linear IS strategy thinking.

The IS innovation processes unfolding in the change refinement sub-phase within the usage phase may be more complex and more important than previously thought. The model presented in Figure 3 reflects this on the strategic as well as application level.

Simultaneous IS Innovation Processes

In regard to the link between IS strategy and application development, the common view is that the outputs from the strategy process (for example, the IS/IT infrastructure, development policies, project prioritation, and educational strategy) direct how applications should be developed and used. Although highly desired, a smooth integration among the strategic, tactical and operational levels has always been problematic (Keen, 1991).

From the beginning of IS strategy completion until the completion of application development, business needs and strategy may change. A company may have hired new people with more knowledge and different agendas, and key people may have left. IT may have improved, creating new possibilities. Although members of an organization may understand that substantial changes have taken place, they may not see the need or have the energy to initiate another round with IS strategic thinking.

These considerations are incorporated in Figure 3.

The stippled line from the strategic level change creation sub-phase to the IS level and database level (see Figure 1 - artifact structure) indicates that this connection may not be as dominant as traditional IS strategy models portray it. Additionally, the two-sided arrow lines from the strategic level change refinement sub-phase and the application level change creation sub-phase to the IS level and database level, denotes that the coupling between the strategic level and the application level is complex and may be unidirectional. The line pointing from the IS level and database level to the application level change refinement sub-phase indicates that the principal IS/IT design features determine the degree of change that can be made.

We must expect that the more organizations adapt organic organizational principles, the more difficult it becomes to develop and maintain appropriate couplings among these elements. We critically need more research into strategic and application IS innovations and how these levels interact.

Conclusions

The objective to develop a holistic view of IS innovation may be an undertaking that even Sisyphus would recognize. However, the increased technological and business pressures to create integrated IS within less time, require conceptual IS innovation understanding to guide research and practice.

Based on the systems thinking "human activity system" view, the first challenge was seen as identifying key issues. It is obvious that the chosen five key issues are exactly that - and five is not a magical number. Although they were derived from a literature study, it cannot be said that they emerged from a complete and rigorous investigation.

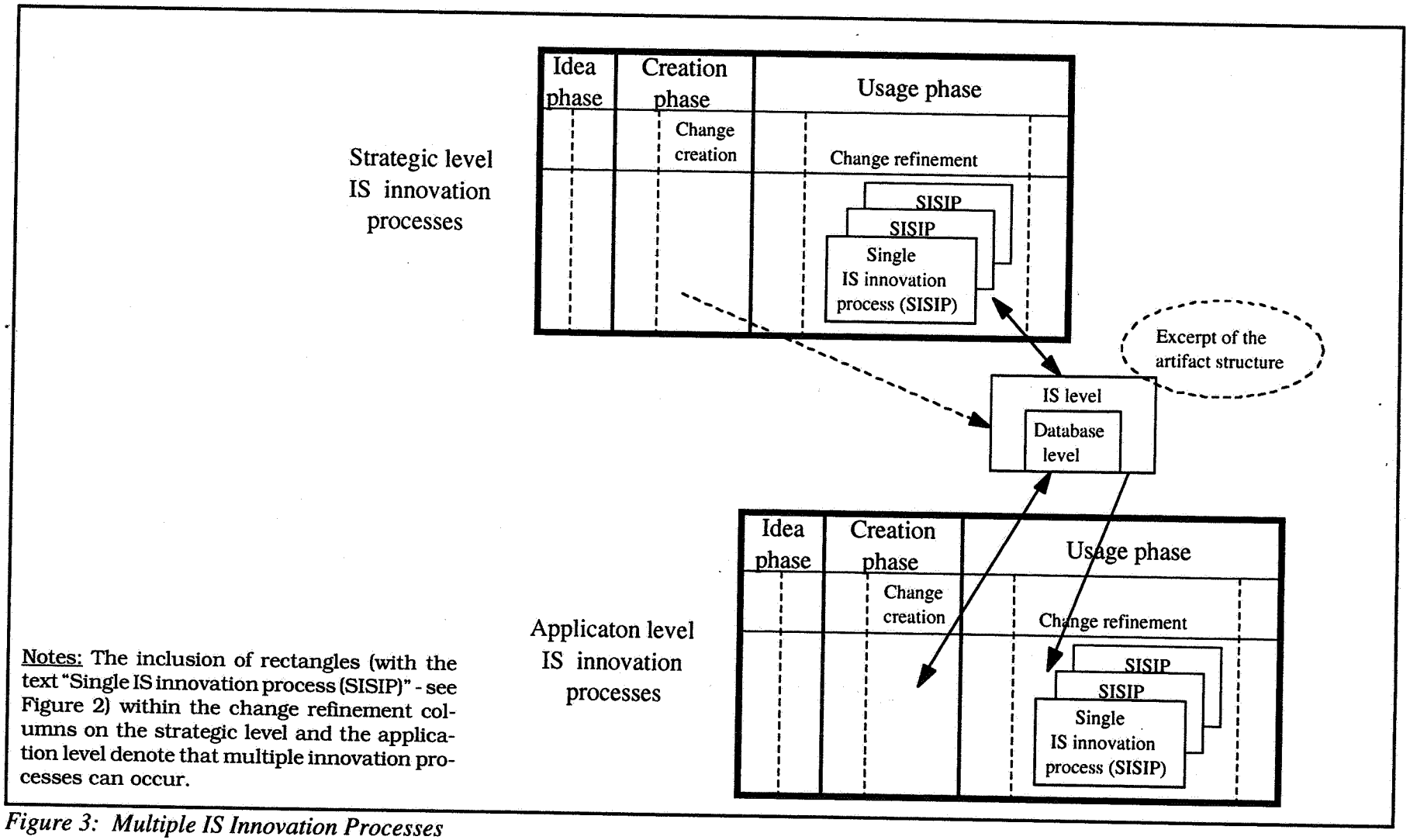

Figure 3: Multiple IS Innovation Processes

They mainly serve as an illustration of the topic areas a set of key issues might cover.

The second point made was that people interpret key issues in specific ways. The key issues structures presented in this chapter are examples of how key issues might be understood. Despite the fact that our interpretations determine later action, these structures are frequently not made explicit. The effect of unclarity at this level is that the critical thinking behind an IS innovation process cannot be properly communicated and shared. Consequently, development efforts run the risk of uncoordinated or unfocused intuitive actions. It is a sobering fact that people will do as best they can when necessary.

The interactions among key issues and their structural elements are too numerous to be represent in one model. Therefore, the framework in Figure 1 was used to develop a partial innovation model for three of the five key issues (see Figure 2). The model's strength is that it is logically derived from the framework. Rather than including detailed phases and tasks, as is the case in most traditional IS application development models, the IS innovation model shows the possible interactions among the IS process structure, the organizational structure and the artifact structure. The innovation model is robust because it does not depend on differences in methodological scope or technological specialties.

An obvious limitation is that the innovation phase structure displays its phases as a linear sequence (from idea percolation to change termination). As discussed, there is ample evidence that many IS innovation processes do not progress in this manner. The models presented here are macro level analyses. Taking theater plays as an analogy, the present material addresses the thinking behind the determination of the play plot and staging. The micro level, that is, the detailed script and actor interactions are not discussed.

Since the innovation model incorporates the innovation process from birth to termination, and not just the creation phase as in most systems development models, it provides an opportunity to discuss the more complex phenomenon of the combination of innovation in the creation phase and innovation in the change refinement sub-phase, as shown in Figure 3. In a strategic IS innovation setting, versus an application development effort, the relative importance of innovation in the creation phase and innovation in the change refinement sub-phase may vary. The question was also raised whether stand-alone IS strategy processes play the vital role many authors claims. The forces and sources determining the IS strategy that organizations should follow may be more varied and complex than traditionally thought.

This chapter has suggested that more attention should be paid to key issues, key issues structure and the IS innovation process view that logically can be derived from these. The IS innovation view must

have power to portray single as well as multiple IS innovations. These issues are exciting research questions that need our attention.

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