

4 Framing Wicked Problems in Enterprise-Systems Innovation Project Groups

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INTRODUCTION

Organizations are increasingly focusing on the design of organizational information systems that incorporate both business process and information technology (IT) change, to achieve alignment between business and IT objectives. These information systems (IS) span functional boundaries and business units, requiring many different disciplinary, organizational, and political interests to be negotiated and multiple, diverse ways of working to be reconciled. Organizational IS design, especially when this spans functional or business unit boundaries, conceptualizes and implements changes to the organization and practices of work, as well as technological change. IS managers thus need to balance the need for actionable, objective definitions of IT-related change with a need for radical, boundary-spanning inquiry into what needs to change (Engeström, Engeström, and Karkkainen 1995; Liu, Sun, and Bennett 2002). In the organizational and MIS literature, we have an increasing awareness of the emergent nature of IT-systems definition and its embeddedness within wider processes of organizational problem solving and business-process change. The term *information system* is used here to mean an integrated social system of organizational actors, using information to perform purposeful activity, who may or may not use computer-based technology to facilitate their work and to provide information (Silva and Hirschheim 2007). Following the use of the term in other fields, such as architecture, product design, or graphic design, the term *design* is viewed here as the complete process of conceptualizing, developing, refining, and evaluating an artifact-related solution to a problem, rather than as a single stage of the IT systems development life cycle (Lawson, 2000). Increasingly, the critical processes of boundary-spanning design take place “upstream” of the development life cycle waterfall model. Organizational change and problem-solving projects drive business process change and provide “early requirements” for IT systems development. This form of design involves emergent knowledge processes, for which goals emerge during the process of design (Markus et al., 2002). As I will argue below, it involves a dialectic between the processes of inquiry and processes of closure, whereas the typical IS design method focuses exclusively on closure.

Contemporary business enterprises are knowledge-intensive firms, which are composed of multiple communities of practice, each of which employs highly specialized technologies and knowledge domains. These groups span multiple organizational boundaries: administrative, geographical, functional, and product-line related. In engineering companies, for example, winning a new contract involves collaboration between accountants, marketing, product design, engineering, production, customer support, and corporate planning strategists (Gasson 2006). This means that knowledge about what needs to change, to produce effective processes, is difficult to share. Enterprise change involves the design of emergent knowledge processes, through which technology and organization are mutually constituted and explored (Markus, Majchrzak, and Gasser 2002). Successful collaboration in such groups must integrate or reconcile many different ways of interpreting, representing, defining, and resolving problems, which are situated in the various contexts of work spanned by the group of enterprise design participants.

This chapter deals with how members of enterprise-level project groups tasked with organizational and IT-related change collaborate and share knowledge to achieve mutually satisfying outcomes. Change management groups are typically referred to as “business process reengineering project groups” or “enterprise systems taskforces.” They recruit senior middle managers from multiple business areas and functions, to redesign business processes and to define the IT systems changes required to support new ways of working. I employ a sensemaking view (Weick 1995) of organizational design project groups, focusing on the processes that various participants use to make sense of and interpret organizational phenomena, to understand how change occurs in the business enterprise.

COMPETING MODELS OF DESIGN AND CHANGE PROCESSES

Structured Design (Hierarchical Decomposition of Requirements)

The dominant process model underlying both organizational and technological design is Simon’s (1973) normative model of ill-structured problem solving. In this model, a designed solution results from the analysis of a consensus problem definition and a set of goals for its resolution. *These goals derive from structures inherent in the situation* (Simon 1988, 1996). Because human beings cannot cope sufficiently with complexity, analysts unconsciously bound and select the set of variables, constraints, and goals that they consider as relevant to the design problem, to produce a “satisficing” solution. A set of consensual goals for change is agreed, then the analyst engages in a process of problem structuring and compositional means-end analysis—a “gap analysis” of requirements for change achieved through a comparison of relevant elements of the current situation

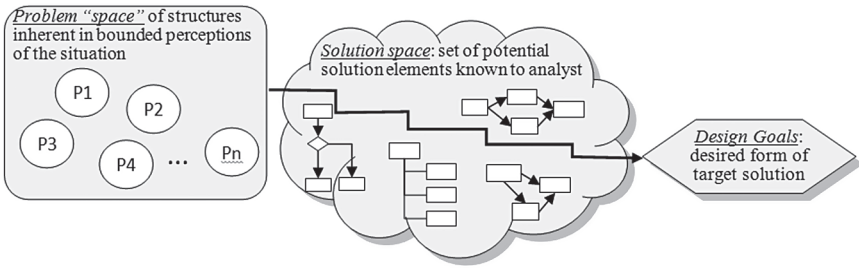


Figure 4.1 A Traditional Model of the IS Design Process (Adapted from descriptions in Simon, 1973; Simon, 1996)

(the problem space), with the desired situation (the design goals). A solution space, consisting of alternative (often partial) solution elements known to the analyst, is structured around a hierarchical decomposition of the structures inherent in the problem space¹. This process is shown in Figure 4.1.

This structured analysis model of problem solving underlies most views of organizational change today. The model underpins the waterfall model (analysis based on hierarchical decomposition), which is still used to manage the majority of IS design and development projects (Barry and Lang 2003). The most significant problem with this model is that it assumes that the structure of the problem space is given, i.e., *inherent in the situation*. The stopping point for design from this perspective is thus when a set of solution criteria based on this problem structure—the design or change goals—are satisfied.

The inappropriateness of applying a goal-directed model to complex organizational change situations appears to have escaped attention (Checkland and Holwell 1998). Organizational change problems are wicked problems (Rittel and Webber 1973). These have no definable stopping point, as wicked problems are systems of interacting, subjectively defined problems that resist disentangling or definition. So the problem structure and goals for change are subject to interpretation and negotiation, reflecting many different points of view (Dorst 2006). In addition, the inability of a normative (rational) model to scale up to collaborative processes at the enterprise level appears to have escaped attention. One person’s benefit is another person’s problem. Structured decomposition may be appropriate for the design of a technology artifact, whose role and purpose is well understood. But the paradigm of means-end analysis embedded in goal-directed design grants certain problem-definitions an objective existence, privileging these over other interpretations. We need alternative models that cater to the emergent nature of organizational goals, problem definitions, and solutions.

Opportunistic Design

In contrast, we have a more organizationally situated literature that reflects goals as evolving, as groups of design participants and other stakeholders

interact. Following from Mintzberg's model of strategic planning (Mintzberg and Waters 1985) and Suchman's concept of situated action (Suchman 1987, 2007) the organizational change literature provides us with an alternative view of goals and change planning. In this literature, goals most frequently reflect *post hoc* reasoning about the meanings and problem structures perceived in the situation after change has been implemented (Lave 1988, Nardi 1995). Actors engaged in boundary-spanning change projects redefine the problem periodically, based on reflective, experiential learning. This changes both the design goals and the locus of change. Organizational problems are situated within a specific social context and culture which require knowledge that is local, often implicit, and embedded in locally originated work practices and assumptions (Brown and Duguid 1992; Lave and Wenger 1991). Goals emerge through reflective interactions with the social context of the problem and through designer-stakeholder dialogue (Boland and Tenkasi 1995; Carlile 2002; Markus et al. 2002). Designers are "thrown" into a situation where local actors understand and assume problem elements, solution constraints, and criteria for a solution that are embedded in the experience of the organization and its evolving goals. They must engage with local practices and meanings, to acquire an understanding of the generic subjectivity (taken-for-granted understanding) that is shared by other design participants and stakeholders with whom they interact (Weick 2004). It is with this understanding that we seek an alternative model of the design process—one that fits with the reframing of problems and solution search that appears to underlie emergent knowledge processes.

Empirical evidence from studies of the early stages of software design suggests that experienced designers appear to be "opportunistic" in their use of contextual information to identify problem-structures, based on partial solutions taken from their experience of similar problems (Ball and Ormerod 1995, Guindon 1990). Design problems appear to be defined around available solutions—designers extrapolate solutions from previously encountered problems, incorporating implied requirements into the framing of new solutions. If there are no solutions available for a design problem, as currently defined, *the problem may be redefined to fit available solutions* (Dorst and Dijkhuis 1995; Turner 1987). The lack of a "structured" approach does not mean that design lacks a systematic process. From the evidence presented, the answer appears to lie in a model that parallels the "garbage can" theory of problem solving, which presents organizational change as a complex interaction between four independent streams of events: "a collection of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be the answer, and decision makers looking for work" (Cohen, March, and Olsen 1972, 2). Perhaps designers do not analyze the problem space at all, but just identify plausible solution fragments and collectively fit these to an evolving problem-space bricolage?

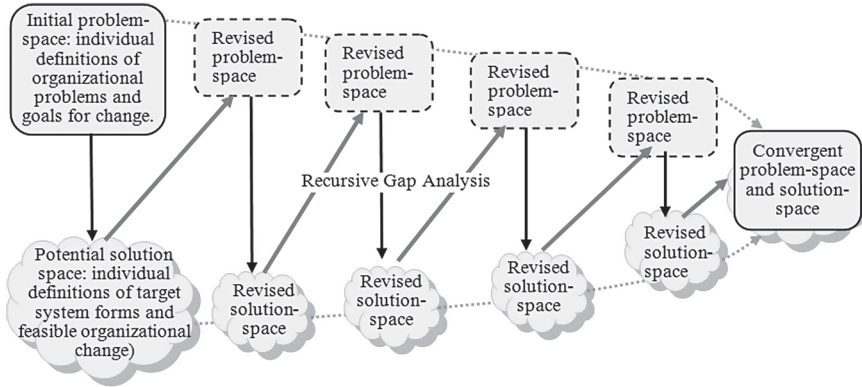


Figure 4.2 Design as a Convergence Between Problem Space and Solution Space

Convergent Design

Halfway between the ordered universe of structured decomposition and the opportunistic anarchy of bricolage lies the convergent design model, shown in Figure 4.2. This model, originated from studies of early software program design, views design as the coevolution of a problem space and a solution space (Maher and Poon 1996; Poon and Maher 1997; Maher and Tang 2003). A similar process of convergence has been observed in think-aloud protocol studies of creative product design (Dorst and Cross 2001).

A convergence model seems to provide a convincing explanation for the lack of an ordered decomposition strategy in “opportunistic” design analysis. But if we wish to apply this model to group processes, we face the issue of scalability—a process model derived from studies of individual cognition may be overly simplistic for group collaboration, especially when this involves stakeholders from multiple backgrounds and functional disciplines. A collective evolution of the design solution space is explored by Bergman, King, and Lyytinen (2002), who distinguish between the solution space as it exists now (i.e., the ecology of functional requirements that solves current perceptions of the problem structure) and a potential, future solution structure that results from analyst deliberation. But this perspective treats the problem space as negotiated rather than evolutionary: it does not deal with the evolution of *perceived* problem structures discussed in the previous section. Experienced analysts are subjective in their definition of the problem space and actively recognize learning outcomes as they proceed with a design. Individuals develop a richer understanding of the problem space as they proceed with a design; this process is multiplied in group design, and so disagreements and breakdowns in group consensus occur, during which the group must reassess what they know and consider what new information they can assemble between them (Gasson 2006; Gasson 2007). The next section presents an

epistemological lens—how group processes of framing take place—to allow us to explore what model we might adopt if we account for the multiplicity of perspectives that present themselves in boundary-spanning groups.

BOUNDARY-SPANNING COLLABORATION AS ORGANIZATIONAL SENSEMAKING

Three Levels of Socially Situated Cognition

The creative processes underlying joint sensemaking “emerge from a process of negotiating multiple and potentially competing interests between different communities or groups within the organization” (Drazin, Glynn, and Kazanjian 1999, 286). A stable (accepted and incorporated) design does not need to be based on the establishment of common understandings but rather on the intersection between different positions and perspectives (McLaughlin et al. 1999). This involves the elicitation and sharing of organizational knowledge about the meaning of work practices across multiple organizational and domain boundaries (Carlile 2002, 2004). The meanings that we attribute to business processes and technology are defined by reference to culturally situated *frames* or mental models: the adoption of specific frames of reference, which derive from our experiential learning, our membership of specific interest groups or communities of professional practice, and our organizational affiliations (Goffman 1974; McLoughlin, Badham, and Couchman 2000).

We need to employ multiple levels of analysis in any exploration of sensemaking processes, in order to reflect the complexity of real-world innovation and to account for interaction effects between levels (Drazin, Glynn, and Kazanjian 1999). Weick (1995) defines four levels of sensemaking in organizations:

1. An intrasubjective (cognitive) level, which represents an individual, internal view of organizational reality;
2. An intersubjective level, which represents tacitly shared frames of reference that are constructed through joint participation in shared work practices;
3. A generically subjective (collective) level, which represents a commonly accepted (consensus) view of organizational reality; and
4. An extra-subjective, cultural environment, which provides a well of background knowledge from the extraneous environment that enables or constrains meanings.

I employ the first three distinctions here, categorizing three levels of socio-cognitive framing: (i) the individual level of cognitive framing, (ii) the group level, which defines joint frames, and (iii) the organizational level,

which reconciles distributed frames across knowledge domain boundaries. A socio-cognitive analysis would exclude the extraneous level, as this provides a generalization of social reality that is far distant from individual and group framing (Cecez-Kecmanovic and Jerram 2002).

Individual Framing and Organizational Learning

The internal, cognitive structures that guide human perceptions and their interpretation of reality are variously referred to as interpretive schemas (Bartlett 1932; Neisser 1976), personal constructs (Kelly 1955), cognitive scripts (Schank and Abelson 1977), or mental models (Gentner and Stevens 1983; Johnson-Laird 1983). These belief structures, or frames of reference, permit individuals to make sense of phenomena or events in terms of their own, individual interpretation of reality (Goffman 1974). They make sense of events and determine how to act as a consequence of an automatic “ordering” of reality, which we refer to as sensemaking (Weick 1995). A frame analysis examines how individuals and groups place a communication or interpret an event within a relevant context and interpret its meaning. Frames may be analyzed by means of discourse analysis (Tannen 1993; Ensink and Sauer 2003). By examining language terms, constructs, and metaphors, it is possible to understand how various people take a position on, or interpret the subject of, discussion in different ways. A specific frame embodies a set of expectations that constrain action and the scope of change: this tends to lead to “automatic” or unquestioned action or a resistance to change (Tannen 1986; Goffman 1974; Winograd and Flores 1986). To change a situation, we need to break frame: making explicit and questioning the dominant frame that stakeholders in that situation inhabit, causing them to reframe the situation (Goffman 1974; Tannen 1986). Design reframing may be triggered by cognitive breakdowns (Winograd and Flores 1986). Heidegger (1962) argued that objects and their properties are not part of an objective reality, but become apparent only in the event of breaking down, in which they change from “ready-to-hand” (used automatically) to “present-at-hand” (requiring reflection). Breakdowns can be used constructively in design: a breakdown is “a situation of non-obviousness” (Winograd and Flores 1986, 65). The breakdown uncovers an aspect of the design task and is a source of learning. For example, IS analysts appear to define a system according to implicit assumptions that are not questioned or realized until they conflict with explicit user requirements, during user interactions (Malhotra et al. 1980; Urquhart 2001). So a breakdown may be the mechanism by which an individual breaks out of or adapts an existing design frame to include new evidence.

To examine what triggers a breakdown, we employ the concept of cognitive dissonance. When there is a discord between incompatible belief structures, for example when an individual’s assumptions of how a process works are inconsistent with how the individual is rewarded for performing that process, the individual experiences cognitive dissonance (Festinger 1957).

People avoid exposure to information that is likely to increase dissonance and are more likely to change their attitudes and beliefs to accommodate behaviors to which they have already committed than to change their behavior (Festinger 1957). Members of socially cohesive groups appear to experience dissonance reduction that brings about a commitment to new methods and ideas, even when these conflict with previously held beliefs (Nelson and Coopriider 1996). So one would expect group members to display increasing individual commitment to group perspectives, as social disparity is reduced.

Shared Framing and Group Consensus

When people habitually work together to achieve common aims—for example, the production of corporate accounts or the design of new products—we term this type of group a community of practice. Members of a community of practice tend to develop systems of shared values, belief structures, culture, and norms that govern how group members behave, interact, and communicate. These shared understandings provide a framework for action that allows group members to take shortcuts in communication and decision making—they implicitly know “how we do things here” without the need for debate or agreement (Lave and Wenger 1991). This results in shared frames that encompass not just how work is done, but why, defining shared rationale, and by whom, defining role allocations within the group (Brown and Duguid 1991). Shared frames represent a negotiated order that permits group members to operate cohesively, wasting less effort in resolving individual differences (Walsh, Henderson, and Deighton 1988). The critical issue for enterprise innovation is that each member of a boundary-spanning group belongs to a different community of practice. A typical enterprise systems design group might include accountants, product design engineers, production managers, marketing representatives, human resource managers, and information systems professionals. Each of those individuals will prioritize frames of reference that are salient to their own functional community of practice and may not understand the frames of other participants in the group. The result is a set of frames that intersect sufficiently for group members to discuss problems and solutions with some degree of commonality, but which provide only a small degree of shared understanding, as shown in Figure 4.3. This is why accusations of political game-playing are so common in boundary-spanning groups. Various individuals simply do not understand that they use the same words differently than members of other functional groups, or that they perceive the basis for their joint agreement differently, based on the scope and logic that derive from frames commonly employed within their own community of practice (Gasson 2005).

It is important to distinguish between intersubjectively shared group frames and consensus, as consensus depends on joint framing, which is distributed

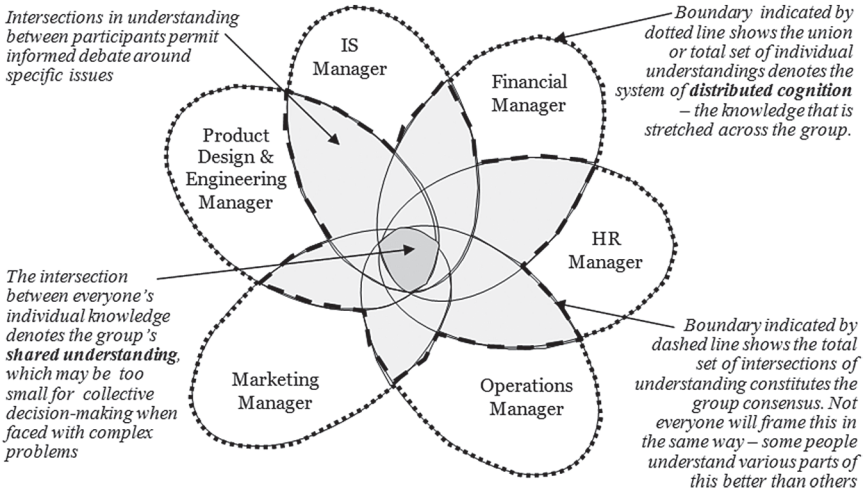


Figure 4.3 Intersections of Understanding and Knowledge in Boundary-Spanning Groups

across the total set of intersections of understanding in Figure 4.3, rather than shared framing. Individuals in boundary-spanning change projects build these intersections of understanding through argumentation and debate, during which they negotiate shared interpretations of phenomena and “scripts” for how to act in various circumstances (Rittel 1972).

Organizational Framing and Generic Subjectivity

At the organizational or boundary-spanning level of analysis, we cannot assume cognitively shared understanding just because group members share a similar organizational culture (Krauss and Fussell 1991; Miranda and Saunders 2003). As we saw above, shared understanding depends on a history of developing shared practices, frames, and values. Boundary-spanning collaborations rely upon consensus, which does not require the shared belief structures required for intersubjectivity. Instead, consensus accommodates the perspectives of others when these do not entirely conflict with one’s own. As Fiol comments, “Meaning . . . encompasses multiple dimensions. Consensus may develop around one dimension of meaning and not around another.” (Fiol 1994, 404–405).

Consensus-building is emergent and multidimensional. The knowledge required for complex change is often distributed across many different people, and it is difficult to predict what knowledge will be required for specific areas of change (Markus, Majchrzak, and Gasser 2002; Fiol 1994). In boundary-spanning groups, members of multiple communities of practice negotiate a set of common belief structures—a framework for action that

allows them to interpret reality consistently and to act effectively as a group (Walsh, Henderson, and Deighton 1988). To achieve this, boundary-spanning groups must engage in both “perspective taking,” the ability to reflect upon and reframe the familiar to open up new insights and understandings, and “perspective making,” the ability to evolve joint language, methods, theories, and values, and a framing rationale for change (Boland and Tenkasi 1995). But to engage in either of these mechanisms, we need ways of communicating our perspectives to others.

Repeated engagement in boundary-spanning group work processes produces a system of distributed cognition, where understanding is *stretched across*, rather than shared between, collaborating individuals from different functional groups (Lave 1988). Boundary-spanning groups develop shared work practices that are mediated via a web of well-defined functional roles. These systems of interlocking routines allow boundary-spanning groups to negotiate the intersections of individual understanding that result—and require divergent framing perspectives to be reconciled only when this is necessary for the coordination of joint work processes or outcomes (Boland, Tenkasi, and Te’eni 1994; Hollan, Hutchins, and Kirsh 2002; Star 1989). The interlocking work processes and routines engaged in by members of boundary-spanning groups produce a form of generic subjectivity that allows group members to interpret organizational events and phenomena in the same way (Weick 1995). These “generic frames” leverage the intersections of understanding built over time to provide a common language for collaboration, reducing misunderstandings and conflict, even in enterprise-spanning, problem-solving, and design groups.

Punctuated Equilibrium in Boundary-Spanning Framing

Given that boundary-spanning groups do appear to develop a common language for collaboration over time, it is odd that organizational problem-solving and IS design groups often appear to follow a process of “punctuated equilibrium.” This term is derived from studies of evolution, where biological adaptation is associated with short, rapid disruptions to long periods of equilibrium during which the form remains stable. The concept has been applied to the evolution of organizations, explaining why firms periodically restructure or reorganize their technology infrastructure (Sabherwal, Hirschheim, and Goles 2001; Silva and Hirschheim 2007).

There is some evidence that relatively stable, generic frames in boundary-spanning groups are punctuated by disruptions that cause the group to completely redefine their problem and as a consequence, rethink their solution. Gersick studied a number of project groups, from MBA student groups involved in three-month course projects to organizational groups involved in four- to six-month change initiatives. She hypothesizes that reframing is driven by group perceptions of time constraints, observing that there is always a major redefinition of the problem structure midway through the project

duration (Gersick 1991, 1988, 1989). A similar type of punctuated or interrupted process has been observed in user-analyst system requirements definition (Newman and Robey 1992) and in larger-scale studies of heterogeneous IS requirements analysis (Bergman, King, and Lyytinen, 2002). But these studies focus on relatively heterogeneous groups and do not delve into the detail of how or why disruptions occur. To investigate this issue in boundary-spanning collaboration groups, we need an analytical lens that explores not only the evolution of problem and solution spaces over time, but also the catalysts that drive an evolving design consensus across design participants and stakeholders from multiple knowledge domains. The following sections explore the processes underlying enterprise-spanning business process and information system design through the examination of a longitudinal case study.

CASE STUDY: THE UNIVERSITY STRATEGIC ENTERPRISE SYSTEM

Organizational Context

This case study explores the framing processes of a group of strategic senior managers engaged in the definition of financial and enterprise systems in a U.S. university (*not the author's own institution*), over a period of two years. Representatives from various areas of university operations were involved, as shown in Table 4.1. The Taskforce was assembled by the director of information services and the university registrar, in response to a perception that the university's enterprise systems (ES) were inadequate for financial management and reporting. The university employed an ES that was used by many similar institutions, but which had not been fully implemented due to political considerations. Several functional groups, in particular human resources, were suspicious of the introduction of an overarching administration system, viewing this as an attempt to impose control over their group culture and practices.

The issue facing the Taskforce at the start of the study was how to manage the introduction of new degree programs. Taskforce members raised the issue that strategic planning was influenced too much by opportunities offered by community interest groups and international non-government organizations (NGOs). From the perspective of the information services group, this was a strategic management issue: new programs were announced before the various administrative groups had time to evaluate the implications or prepare for program administration. The university registrar and the manager of admissions complained that students were often recruited to programs for which no classroom location, instructor, or facilities were available. The dean of finance saw this as an admissions management issue: students were recruited at the last minute, in order to ensure the program's financial viability, so there was a high degree of uncertainty about

Table 4.1 Taskforce participants

Regular Attendees:		
Director of Information Services	Executive Director of Student Accounts	University Registrar
Dean of Academic Affairs	Director, Office of Student Accounts	Associate Registrar
Dean of Finance & Operations	Director of Financial Aid	Financial Systems Manager
Coordinator of Special Projects	Manager, Admissions & Student Services	Senior Systems Analyst
Director of Marketing (or delegate)		
Ad Hoc Attendees:		
University President	Executive Dean (Academic Programs)	Program Administrators
Academic Deans & Administrators	Program Sponsors (External Community Organizations & NGOs)	Academic Committee Chairs

class sizes. The director of information services argued that many programs included textbooks and computers in their tuition costs and there was insufficient time for these to be ordered. Financial aid group members often found that degree eligibility requirements (e.g., the number of instruction weeks in a specific academic year) were not being met—even though recruiters had promised students that they would be eligible for financial aid.

EPISODES OF ENTERPRISE SYSTEM FRAMING

Episode 1: Exploring New Program Procedures

The Taskforce met frequently to explore the timeline for new programs and to determine the arrangements that needed to be made at various points, including changes to Enterprise System configuration. The *Process Timeline* provided a consensus frame for the group—both in terms of its role as a negotiation object and also in terms of its ability to embody a boundary-spanning framework for action. This framework provided a sufficiently abstract “script” for the problematized business process (the introduction of new degree programs) that members of the various groups involved could agree to this without it conflicting with individual perspectives of how the process would be conducted. In particular the Timeline, shown in Figure 4.4, aligned the interests of various groups in coordinating boundary-spanning arrangements.

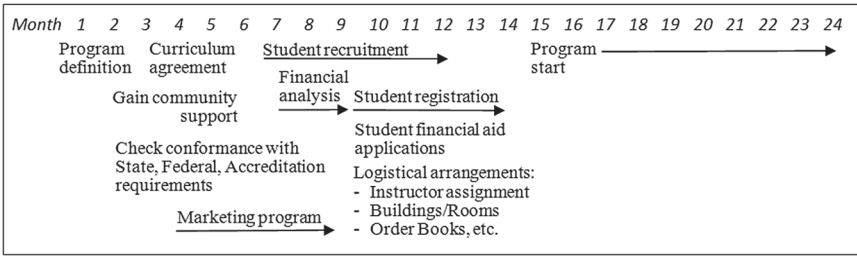


Figure 4.4 New Program Process Timeline

On the surface, the Timeline—and its embedded formalized procedures—appeared uncontentious. Taskforce members clearly recognized the need for coordination and control across a wide range of related functional groups and were willing to accommodate some changes to their processes in return for the quid-pro-quo of their information needs being met (i.e., obtaining sufficient warning of student numbers and details to do their job). But the ways in which detailed information needs were framed diverged greatly between group representatives. The information services group saw the key issue as one of coordinating transient information about student and program arrangements that the Enterprise System could not cope with—for example ordering printed course materials and booking rooms for classes in advance of formalized registration. The university registrar framed the issue as one of ensuring that students were registered in time for the degree start. The financial aid group framed the key issue as one of processing and validating financial aid applications prior to registration. The university financial controller’s office framed the issue as ensuring that the new program was economically viable in advance of its start. Each of these frames led to a variety of ad hoc, informal arrangements that allowed groups to coordinate operations, but bypassed the formal information system. A shared spreadsheet of student status allowed the financial controller’s office to anticipate class size, student services to order printed materials in advance of formal registration, information services to reserve rooms, and the financial aid office to check student applications. But none of these information sources could be trusted—the spreadsheet version used by various groups often disagreed and a whole host of informal coordinating processes were required to make this process work, in addition to the formal processes agreed upon by the Taskforce.

Disruption to the fragile consensus around a standardized Process Timeline frame arose when feedback from various faculty committees and external stakeholders led to a realization by the Systems Taskforce that the attempt at standardization had failed. A Taskforce workshop was held, to explore the problems faced in new program introduction. The information services director attempted to generate procedure flowcharts that reflected the “big picture” of program administration across all affected groups.

This failed, as each member group framed the issues very differently. Each group framed a number of special cases—many disagreements arose around which should be accepted as legitimate and which not. The aggregated set complicated the flowchart to the point at which the wider group agreed it to be unusable as a shared representation of procedures.

Episode 2: Framing Coordination Issues

Conflicts arising from the breakdown of the standardized Process Timeline frame were resolved in the next Taskforce meeting, when members brainstormed how to address major differences between academic program formats. They agreed that the solution to resolving differences should lie in *standardizing the format of new academic programs*. Taskforce members identified four different types of program calendar: Semester Programs, Certificate Programs, Quarter Programs, and Ad Hoc Programs. A new University Calendar, shown in Figure 4.5, was standardized around these program formats. Start-date ranges for each type of program were defined and program introduction requirements were formalized in terms of the lead time required for the various program types within each category. The student accounts and financial aid groups were especially active in this episode, leading discussions about standardization needs and explaining their information requirements in great detail.

When the standardized calendar was introduced, it appeared to have an immediate effect. Operations to coordinate work between groups were simplified, student aid issues were reduced, and the longer planning lead times were felt to have led to higher quality across various academic programs. But as the administrative year proceeded, there appeared to be an increasing number of exceptions to these program formats—formalized for historical program continuity, or to meet the needs of specific community groups.

The *disruption* to the program format standardization frame occurred because of an increasing frustration across the global network of coordinated

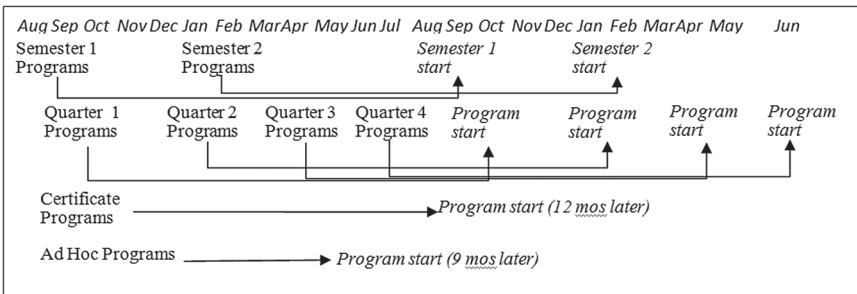


Figure 4.5 A Process Calendar for Four Standard Program Formats

groups and stakeholders, reflected in some quite heated exchanges in Taskforce meetings. There was also increasing dissatisfaction from strategic planners. Both the executive committee and the university president were pushing for an expansion of the university's strategic plan, to take advantage of opportunities offered by private funding agencies and expand outreach to underserved areas of the U.S. This led to a tension between the regulating influence of the "standardized" program formats and the way in which new program requirements were framed as fulfilling the university mission—even when they did not conform to a standardized format. There were rising tensions around how this could be accommodated.

Episode 3: Invisible Expansion of the Problem Boundary

After a series of disagreements in Taskforce meetings, the constraints of four standardized program formats were rejected. New programs were created that did not accord with these formats and that had shorter lead times than required for effective planning. The various groups represented on the Taskforce agreed that they would *implement contingency procedures to deal with exceptions*. In adopting these, the Taskforce approved an expansion of the regular scope of activity with activities that lay outside of their normal business process boundary. These contingency procedures were viewed as short-term "interfaces" and were largely taken over by information services and the registrar's office, expanding the scope of both groups.

The implications of this expanding, implicit information system boundary were slow to be realized. The increasing complexity of operations was obscured by the information services group, who developed short-term workarounds for each group. They made phone calls to warn student services that action was required, provided interim calculations of student numbers to the registrar's office, and fed student data to the financial aid office for aid application processing and to the financial controller's office for planning purposes. In effect the information services group became a de facto coordination system, operationalizing the implicit frames of various Taskforce members to bypass the formal Enterprise System and business processes based on the standardized calendar. When the group mapped out the systems used to support enterprise decisions, shown in Figure 4.6, they appeared genuinely shocked.

Disruption to the contingency frame occurred as the complexity of the "workaround systems"—as these came to be called—introduced a sense of urgency into Taskforce group meetings. It became clear that the Taskforce needed a way to enforce the use of the formal Enterprise System, as no one had a clear picture of what was happening with the new programs—whether they were financially viable, whether they met the course-credit and calendar requirements that would enable students to obtain financial aid (a key criterion for open-access programs), and whether these programs were

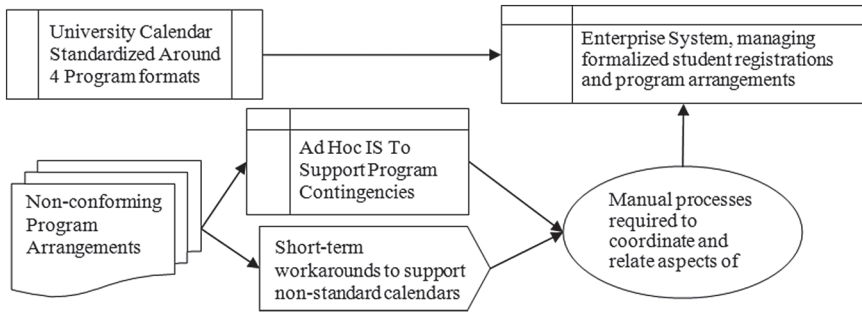


Figure 4.6 Process Workarounds Resulting from Enterprise System Inadequacies

even fulfilling local community objectives. Many disagreements centered on how to obtain a “big-picture view” and how to regain control of program planning. It was clear that consensus had broken down, as members of each functional group blamed the others for “allowing so many workarounds to creep into the system.”

Episode 4: Exploring the Breakdown of Planning

Matters came to a head when external program accreditation was threatened, because the new programs did not conform to the credit or delivery requirements agreed with the national accreditation board. The threat to accreditation refined the minds of everyone, not least members of the Systems Taskforce. When the group mapped out planning procedures for new programs, they were shocked to discover how much more complex these had grown since the institution of the standardized program calendars. It proved impossible for the Taskforce to model these procedures—there were so many special cases that the director of information services observed that they were modeling “a calendar per academic program.” The variety of academic programs was reviewed and the Taskforce agreed to abandon the calendar approach to evaluating programs, as this produced a false sense of security. Instead, they adopted a *standardized form of program cost structure* as their consensus solution. This was represented as shown in Figure 4.7.

The program cost structure embodied a key concern of Taskforce members—that programs were being expanded without any analysis of the cost implications—and provided a script for coordinated action. An analysis of indirect program costs was performed by each group involved—Taskforce members appeared shocked to discover the cost implications of program expansion. Various Taskforce members volunteered to discuss cost implications with individual Deans, with strategic managers, and with other stakeholders. The Taskforce worked on analyzing the costs of a failure to standardize the university calendar in detail. The “informal cost structure” form presented a new coordinating object for the group. They were

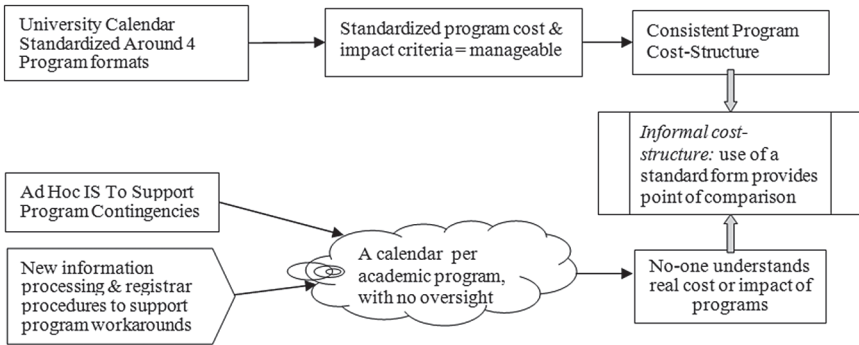


Figure 4.7 Role of “Informal Cost-Structure” Form in Reconciling Programs

continually surprised by the totals reported, as various Taskforce members volunteered to investigate the costs of time and resources spent on ad hoc program workarounds. These totals made a huge impression on strategic managers—the university president instructed the Taskforce to “take control of the situation.” But it was clear that the key problem lay with the president and other executive decision makers, who disowned responsibility for their continued initiation of nonconforming, ad hoc programs. The Taskforce group debated how to manage this, but could reach no conclusion.

Disruption to the cost-reconciliation frame came with the news that accreditation was threatened by the failure of recent academic programs to meet accreditation requirements. The lack of conformity with calendar credit requirements, national evaluation, and quality criteria had led to pressure from a major undergraduate program accreditation board. There were several heated meetings, as Taskforce members debated how to manage the situation and who should take responsibility for change. In the end, the university registrar took control of the situation and met with the president to discuss how to manage the situation.

Episode 5: Aligning a Standardized Calendar with Senior Management Interests

The Taskforce received instructions from the executive board to explore what needed to happen for the university to *standardize around a single program calendar*. Taskforce members now realized the need to develop a universal set of procedures that would formalize coordination across the various groups involved in program administration, as shown in Figure 4.8.

The external crisis allowed them each group involved to resurrect problem-formalization frames that had been rejected by other groups during Episode 2—for example, the financial aid office insisted that a formal coordination framework should include twelve weeks’ notice of individual student registrations prior to start of the academic program year. Eventually, the Systems

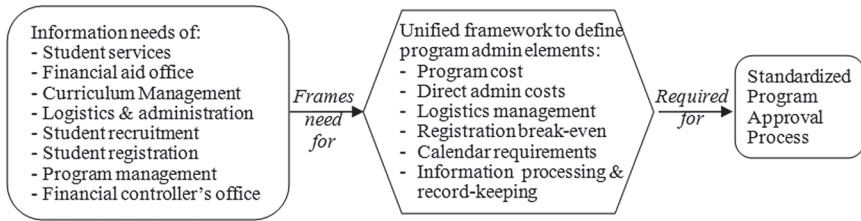


Figure 4.8 Strategic Planning Frame Indicates Need for Effective Coordination Framework

Taskforce standardized around a single academic calendar, with two program variations (semester and quarter) and a uniform start week for all programs. This allowed programs to conform to both accreditation and financial aid requirements without further checking. A set of standardized procedures and templates was created for new programs and courses, without conformance to which programs would not be approved. It was the “would not be approved” frame that provided the unifying script embedded in this framework.

Disruption to the strategic planning and coordination frame came about when the introduction of the standardized program approval framework caused problems. Recruiters felt that they were being cheated of the opportunity to recruit late students, and some compromise had to be made to keep this group on board. Executive decision makers had to be monitored carefully and reminded of the implications of abandoning the standardized calendar and procedures—whenever they attempted to do so, under pressure from community organizations to provide open-access programs. There were ongoing tensions between the needs of accreditation conformance and the way in which the university mission, to provide open access to education, was framed. In the end, these were resolved by the information services director, whose group had devised the workarounds that had previously caused so many problems. He (and other information services group members) appeared mortified by the realization that they were to blame for enabling the escalating costs of program nonconformance. The information services group developed an informal cost estimation system (a detailed spreadsheet) that reflected the true costs of introducing a new academic program, based on the cost estimates generated during Episode 5. Each time a new program was planned, the cost estimation spreadsheet was used to reflect the true costs of introduction. This reduced the nonconformance of new programs to the standardized calendar formats to almost nil. By disrupting the *strategic mission* frame (“open access requires responsive, ad hoc program creation”) with an adapted version of the cost-reconciliation frame used in Episode 4, they were able to introduce a collective breakdown that made the group realize that they genuinely needed to formalize their “standardized program approval” procedures by means of changes to the Enterprise System—which was why the Taskforce had been assembled.

Episode 6: Implementing Enterprise System Changes

Predictable conformance to the four program formats for a standardized calendar and procedures allowed changes to be defined to the Enterprise System, so that this could implement the contingency planning functions that the information services group had been supporting with the ad hoc IS, shown in Figures 4.6 and 4.7. Once the information services group reframed the problem to demonstrate that various nonconformities could be defined with short-term system codes for legacy program completion, Enterprise System limitations were no longer a constraint. It appeared that the main barrier to coordination had simply been an unwillingness to invest IT development time and resources without some expectation of stability in the way that the new system was framed across groups.

As shown in Figure 4.9, the Taskforce rapidly defined a vision of change that would enable the Enterprise System both to track formal program planning and administration and to manage the informal practices required for program planning and student recruitment to work. For example, it was now possible to track student status before their registration was completed and at times when they were registered for a program but not yet registered for specific courses. This allowed planning to take place for facilities and logistics much earlier, ensuring a higher quality of delivery with fewer problems. The external accreditation board was presented with the new planning process and appeared satisfied that the university’s programs were stable and well managed. Student satisfaction also increased, as financial aid application was simplified and became more certain. Not least, the cost structure of programs was reduced drastically, providing major benefits to the university and allowing it to fulfill its mission more effectively.

Summary of Case Study: The Wicked Problem-Solving Process

In this study, the Financial Systems Taskforce group defined the financial information system to register students for courses and evaluate their eligibility for financial aid at the start of the problem-solving process. They

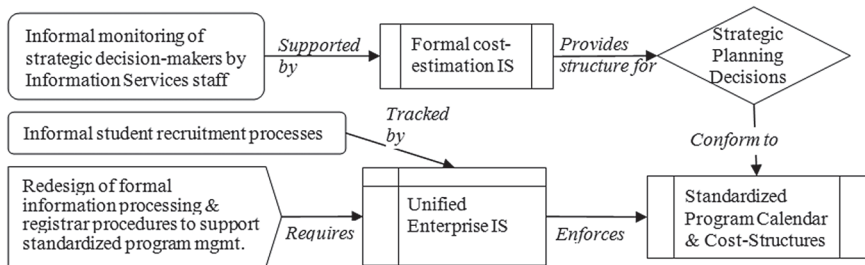


Figure 4.9 Framing Enterprise-Spanning Coordination as Combination of Informal and Formal Procedures

all agreed what this would mean, in terms of providing a framework for action that defined coordination procedures across groups. So the financial information system provided a unifying vision of the solution structure that allowed various stakeholders to frame subcomponents related to their individual sphere of operations. As the Enterprise System definition and implementation proceeded, however, shortcomings in the unifying vision were exposed. These were dealt with by a series of episodes in which Taskforce members appeared unwilling to face conflict in challenging the consensus solution, punctuated by rapid disruptions during which some external trigger forced them to adapt their consensus problem frame.

In each episode, short-term accommodations were implemented to deal with deficiencies of the solution in practice until external pressures indicated that the unifying vision was no longer adequate to provide a solution. At this point, a collective breakdown occurred, where debates around the unifying vision introduced more complexity in order to encompass the evolving, more complicated frames of individual group members (who introduced lessons learned from the failure of the previous frame). The result of each breakdown in equilibrium was not a more detailed model of the solution, but an abstraction that encompassed a wider range of individual member frames. The implications of this are explored below.

CASE STUDY SYNTHESIS OF BOUNDARY-SPANNING GROUP PROCESSES

Punctuated Equilibrium Around Unifying Visions of the Problem Space

The Enterprise System design project described above proceeded as a series of episodes, punctuated by rapid disruptions to group alignment around a dominant consensus frame. Shared understanding across disciplinary or work-group domain boundaries in each episode appears to have been coordinated around a representation of the target Enterprise System that allowed group members from diverse backgrounds to understand the high-level solution structure in the same way. This mechanism reflects the “primary generator” concept identified by Darke in her study of architectural design, where a material exemplar provided a conceptual metaphor for the designed solution, around which they could construct a shared vision of design requirements. For example, designing around a ranch-house concept allowed architects to envisage the house in a consistent way as they partitioned the work between team members that is required to design the frame for the house, the placement, the dimensions and style of doors and windows, the supply of utilities, the interior partitions and decorations, and so on. The “primary generator” provides a unifying solution frame that allows everyone to envision the solution in the same way, in order to distribute work on the basis of a shared understanding (Darke 1979). So we can understand

the primary generator in terms of a meta-level solution structure that allows group members to apply an internally consistent set of criteria to the evaluation of solution elements that will change this structure.

It was observed that representations of the Enterprise System structure and its accompanying business processes did not change very much throughout the course of the project—if anything, this appeared to act as a constraint on change, as the IT systems group did not wish to implement software changes until they had confirmed that these would apply for the long term. So while the primary generator vision provided a meta-level frame—a shared perception of the Enterprise System solution structure—around which suggested design changes could be evaluated, it did not appear to evolve the solution space (the range of alternative design possibilities) available to the group. It would appear that the complex nature of the wicked problems faced by design group members precluded joint exploration of a single solution space. Instead, each group member appeared to explore a different solution space. Where these intersected, it was possible to build alliances that evolved the design, as external triggers for change required a replacement to the consensus problem frame—what I will call the unifying vision. So our process of punctuated equilibrium appears to revolve around a consensus problem space, rather than the solution space suggested by studies of individual design processes. Each unifying vision represented a deep appreciation of salient aspects of the problem structure (the organizational situation), which were relevant to how the group framed the rationale for change at that point. At the end of each design episode the unifying vision evolved, to be replaced by a more complex representation that incorporated salient aspects of the situation not dealt with by the previous consensus frame. This process of incremental design framing allowed the group to collaborate around a satisficing understanding of the problem, while deferring a shared understanding of the detailed solution to that time when the unifying vision broke down.

In this form of punctuated equilibrium, disruptions to shared understanding occurred on a regular basis in this case study, rather than at the halfway point proposed by Gersick (1988). This may perhaps be explained by the complex nature of this change initiative, compared to the relatively structured tasks faced by Gersick's (1988, 1989) problem-solving groups. As complexity is typical of enterprise-level codesign initiatives, the pattern of repeated disruptions appears more convincing, reflecting wicked problem structures that are appreciated in more detail as the group's distributed understanding of the situation evolves.

It has been noted that both problem and solution definitions emerge through interactions with the social context of inquiry, which includes other design participants, stakeholders, and users, as well as artifacts, documents, norms, goals, and local work practices (Boland, Tenkasi, and Te'eni 1994). This produces "surprising" information, which leads to the reframing of the design problem in unpredictable ways (Dorst and Cross 2001). In her synthesis of punctuated equilibrium studies, Gersick discusses the changes

to group perceptions of what she calls “deep structure.” But in common with most treatments of design or problem-solving processes, she treats the notion of deep structure as a frame that encompasses the solution space:

Deep structure is a network of fundamental, interdependent “choices”: of the basic configuration into which a system’s units are organized, and the activities that maintain both this configuration and the system’s resource exchange with the environment. Deep structure in human systems is largely implicit. (Gersick 1991, 15)

In contrast, the deep structures represented by this group were of the problem space. Each episode of design was accompanied by a graphical representation of the problem structure faced by the organization or design group—a unifying vision of the organizational situation rather than a model of the designed solution. Once a unifying vision was proposed to the group, it was accepted simply because one or more individuals could provide an analogy that enabled group members to visualize the relationship between organizational elements that comprised their current understanding of the wicked problems that they faced. This pattern represents problem-solving and design processes in prior studies of groups attempting wicked problem resolution (Gasson 2006, 2007, 2011, 2012).

Collective Breakdowns and Distributed Understanding

Each episode of design was terminated by a fairly rapid and disruptive period of conflict, which was only resolved when it was demonstrated to the group that the previous unifying vision had broken down. It was noticeable that the Taskforce attempted to avoid conflict, going to great lengths to avoid confrontations that would reveal divisions in the ways that details of the problem or solution space was framed by individuals. The transcripts of group meetings are littered with phrases like “let’s agree to disagree on that issue” or “we need to put that one aside for another time.” But when faced with external pressure to agree on detailed requirements for change, the Taskforce group experienced a collective breakdown, similar to the individual breakdowns discussed by Heidegger (1962) and observed by Winograd and Flores to be central to individual design progress (Winograd and Flores 1986). The collective breakdown forced the group as a whole to understand that their conceptual model of the problem was inadequate—and to reconceptualize how they framed organizational “reality” as a consequence.

As the design proceeded, the degree of shared understanding across the group did not appear to increase much, if at all, because the complexity of the organizational problem was too great for one person to understand. However, as individuals collaborated in framing joint design goals and solutions, the intersections of understanding between individuals appeared to increase—which meant that they developed joint (if not collective) ways

of framing design issues with other individuals. This manifested itself by means of alliances between Taskforce members as the change initiative progressed—in contrast with early episodes where hardly anyone could agree about what the critical change issues were. Alliances between two or more members of the Taskforce seemed to be effective in exerting pressure on recalcitrant stakeholders who did not buy into the prevailing consensus, such as executive managers who ignored constraints in initiating new academic programs, or representatives of various functional groups who did not completely agree with the salient consensus frame. The result was that individual problem frames appeared to be aligned around the salient consensus frame for a substantial portion of each episode of design.

Increasing intersections of understanding also seemed to lead to higher levels of trust between Taskforce members. People deferred to each other's expertise more frequently in later episodes of the change initiative and would often suggest that one of their Taskforce colleagues “run with the idea,” rather than debating every change in detail as they had in early episodes. This is especially interesting as typically, models of group cognition posit that groups depend on social cohesion to achieve shared understanding (Cannon-Bowers and Salas 2001). But similar indications are also emerging from studies of social interdependence in education (Johnson and Johnson 2009). It appears that distributed cognition relies upon the development of sufficient trust between individuals to enable effective problem partitioning in the implementation of a designed solution. Of course, trust building itself depends on the establishment of those intersections of understanding that support distributed knowledge in boundary-spanning groups. It seems that partial alliances around shared cognition are more feasible than collective understanding, in boundary-spanning groups faced with wicked problems.

Three Levels of Framing in Boundary-Spanning Groups

The resulting process appears to involve the coevolution of a designer's problem frame and the set of partial solutions available to them, until these merge to provide a target system design. But the process observed is more complex than the coevolution model shown in Figure 4.2, which is suggested by studies of individual design processes (Dorst and Cross 2001, Maher and Poon 1996, Poon and Maher 1997, Maher and Tang 2003). The model in Figure 4.10 shows interactions between three levels of design framing observed in this study.

At the highest level of framing, we have an evolving primary generator vision of the enterprise system *solution space*. This provides a consensus abstraction around which the group can frame design goals. It is replaced periodically, to provide the conceptual basis for a new, shared understanding as the problem structure evolves. The primary generator reflects an abstraction of the solution space, as understood by the group as a whole. The design group defined the solution for their financial planning problems as a

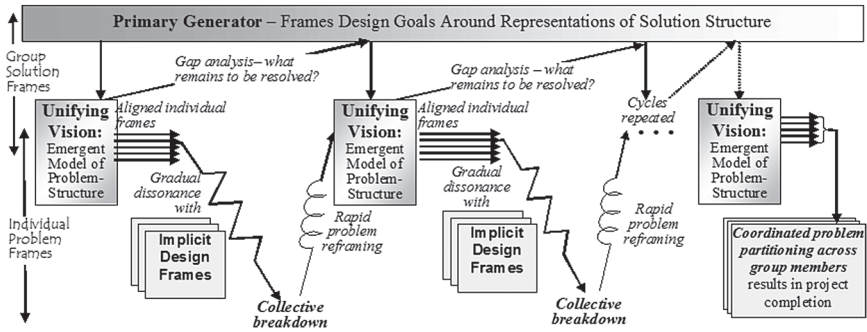


Figure 4.10 Multilevel Goals and Spaces In Design

standardized calendar, then standardized program formats, then as a set of contingencies for workarounds, and so on. None of these were particularly radical, in terms of changes to the Enterprise System, and none appeared to affect overall framing of the solution space, except in very small details.

The second level of framing is defined by a series of unifying visions of the group problem frame, each of which is developed and built on the previous one. In the case study presented here, each unifying vision represented consensus around the organizational and process structures that were most salient to the current focus of the design problem space. These did evolve in each episode, to incorporate aspects of the problem situation that reflected new issues of concern, while retaining previous structures. The design group defined the problem space around a process timeline, then explored the implications of four standard program formats for the process timeline, then explored process workarounds resulting from Enterprise System inadequacies, and so on. So each unifying vision was more complicated and encompassing than the previous one, to reflect group learning about the wicked problem situation. While the primary generator reflected a relatively homogeneous and slow-to-evolve solution space, the unifying vision reflected an emergent and progressively-more-complex problem space.

The third level represents the implicit design frames held by individuals: fragments of design goal definitions, beliefs about the nature and structure of the problem situation, and ideas that provide partial design solutions. In each episode, a unifying vision of the problem structure initially provided a consensus frame around which individual design frames could be aligned. But as each episode progressed, the unifying vision proved inadequate when compared with the implicit frames—encompassing design goals, problems, and partial solutions—held by individual group members. Group members’ attempt to reconcile consensus frames with their implicit frames led to increasing levels of cognitive dissonance—the feeling of discomfort that results from attempting to hold two or more conflicting cognitions (ideas, beliefs, or values) simultaneously (Festinger 1957). There would be a rapid

period of conflict, as individuals attempted to resolve their cognitive dissonance by reframing the details of the design solution. Taskforce group members were observed to be very accommodating in absorbing obvious differences between their own problem frames and those of other group members in order to avoid explicit conflict. It appeared that learning was seen as an explicit objective of the process at the individual level, and this only resulted in severe dissonance when an *external pressure*, such as the need to report to influential decision makers, or the external threat of losing accreditation, needed to be resolved. When this occurred, a collective breakdown would result. Each breakdown introduced a conceptual vacuum that led to a rapid, collective search for a substitute unifying vision, through a brainstorming process that developed ideas and integrated individuals' concerns into a more complex, richer unifying vision. A new unifying vision would only be acceptable to the group if it was accompanied by a visual problem-structure model that encompassed the concerns that individuals were trying to resolve, at an abstract level. The group would continue its debate and search for a unifying vision until one or more group members were able to conceptualize the problem-situation visually, in a way that satisfied the majority of individual concerns.

Negotiations, Bridging, and Breakdowns in Boundary-Spanning Design

So how did an accommodation take place between members of various established communities of practice (stakeholder groups) across the organization? Members of multiple communities of practice *negotiated* a set of common belief structures—a framework for action that allowed them to interpret reality consistently and to act effectively as a group (Walsh, Henderson, and Deighton 1988). The boundary-spanning group observed here engaged in both “perspective taking,” the ability to reflect upon and re-narrativize the familiar to open up new insights and understandings, and “perspective making,” the ability to evolve a joint language, methods, theories, and values, and a framing rationale for change (Boland and Tenkasi 1995). Most design methods focus on perspective making—the representation of designed solutions, in terms of changes to business processes and IT systems. But this study has indicated the critical role played by perspective taking—the definition of a joint problem space around which the group can negotiate the rationale for change.

To engage in boundary-spanning consensus building, the group needs ways of communicating their perspectives to others. They achieve this by constructing a visual representation of the *problem structure*—a unifying vision—that can act as a straw man in negotiations between groups. This causes implicit assumptional frames to surface, so that they can be examined and subject to debate. Winograd and Flores (1986) argue that the use of specific boundary objects, such as design-solution representations, may

trigger a *breakdown* in individual understanding, allowing the designer to reflect and learn about the context of the design. This study indicates that representations of the problem structure are the key boundary object required for effective design in boundary-spanning groups.

Boundary objects are objects that are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. (Star 1989, 46)

An effective boundary-spanning problem representation must therefore be sufficiently vague (weakly structured) to mobilize consensus around the rationale for change, but specific enough (strongly structured) when applied to individual cases. As group understanding of the organizational situation evolves, this specificity is tested in more detail and its unifying power is lost. This leads to disruptions in the consensus and replacement with a more sophisticated boundary object that can maintain a “common identity” across a wider range of circumstances.

Most studies of design groups simply assume that individual understanding—how the design problem and solution are framed—scale up to group design. But group relations change when conditions and deliverables change. Organizations faced with dynamic conditions must develop interdependence mechanisms: coordinating their activities across diverse group boundaries, developing trust mechanisms, and coming to rely on a social network of collaborators who view the organization very differently from themselves. An Enterprise System design group necessarily deals with wicked problems that span the organization. It involves representatives from diverse workgroups, disciplines, and functions. Its processes will involve conflict simply because group members need to negotiate a diversity of organizational problem frames, the existence of which they are unaware. This will result in repeated breakdowns in joint group sensemaking (Weick 1995). Early in the group’s existence, negotiating trust relationships may require methods that do not directly challenge individual assumptions and frameworks of interpretation. But over time, trust between boundary-spanning group members appears to result from the ways in which collective breakdowns are negotiated, bridged, and reconciled. With sufficient trust comes the ability to engage in problem partitioning, the process by which various aspects of the problem are delegated to individual group members for their resolution. The stopping point of boundary-spanning groups is not reached when the group achieves shared understanding of the problem or its solution, as this is not feasible for the wicked problems faced by boundary-spanning groups. Instead, the stopping point appears to depend on a boundary-spanning group building sufficient levels of interpersonal trust for problem partitioning to take place. Trust is achieved by means of joint participation in collective

learning, as the boundary-spanning group becomes a community of practice (Lave 1991). The implication is that, instead of the solution-oriented problem closure that is typically emphasized by design methods, we need to develop methods that emphasize joint participation in collective learning about the organizational problem situation.

CONCLUSIONS

This chapter examined the ways in which boundary-spanning groups engaged in Enterprise Systems change negotiate collective understanding. The design of organizational information systems provides a good example of a wicked problem, as systems of technology are embedded in an organizational context and procedures that must also change, requiring negotiation around a diverse set of perspectives (Rittel 1972). Enterprise Systems change projects involve participants from many different business areas and functions, who are required to engage with substantive issues of organizational and IT-related change over a long period of time, with repeated disruptions to group consensus. Because of this, participants share very little understanding of their “common goals.” They assemble a jigsaw puzzle of process elements, based on ways of framing the situation that at best are poorly understood by participants from other functions or workgroups, and at worst are viewed by others as political game-playing. It is against this background that we need to find alternative methods for managing organizational change and design.

The case study discussed above reveals the significance of problem representations to achieving shared understanding. Taskforce members tested their individual solution frames against a shared representation of the problem structure—not the designed solution. Boundary-spanning design, in the form of collaborative organizational inquiry, appears to proceed via a set of episodes that were coordinated around unifying visions of the problem structure. To be useful in coordinating group inquiry, a unifying vision needs to act as a boundary object against which individual frames can be tested. It must be defined at a sufficiently abstract level that it does not conflict with individual problem frames (based on local workgroup practices, conventions, and norms), but have sufficient unifying power to maintain a common identity to which the whole group can relate. It must also act as a “negotiation object” in that it must be capable of adaption as group understanding evolves. Each disruption in group consensus leads to the unifying vision being replaced with a new problem-structure representation, which encompasses a wider set of concerns while also integrating issues of previous concern. Each unifying vision does not replace the prior vision—it complicates it.

I presented a multilevel, punctuated equilibrium model of boundary-spanning design in Figure 4.10. This model has critical implications for theory and practice in the management of boundary-spanning design and problem-solving groups. Unlike much of the work on distributed cognition

(e.g., Stahl 2000; Zhang and Norman 1994; Hollan, Hutchins, and Kirsh 2002), this chapter argues that boundary-spanning group work does not result in a collective (cognitively shared) model of outcomes, nor does it result in designed artifacts that embody joint knowledge frameworks. Instead, the knowledge frameworks underlying design depend on social networks of distributed understanding—an understanding which resides firmly in the heads of individuals. Rather than depending on social cohesion to achieve joint understanding, it appears that distributed cognition relies upon the development of sufficient trust between individuals to enable effective problem partitioning in the implementation of a designed solution. Trust building enables the group to reach a natural stopping point, where the labor of implementing enterprise-spanning business process and IT systems change can be divided among those group members who are most familiar with each area of change. As Weick argues, the contemporary, corporate focus on achieving short-term goals tends to impede enterprise-spanning collaboration, simply because it focuses on organizational control at the expense of adaptation:

Control drives out innovation, organization becomes synonymous with control and generic subjectivity becomes sealed off from any chance for reframing, learning and comprehension of that which seems incomprehensible. (Weick 1995, 73).

NOTE

1. The concepts of *problem space* and *solution space* derive from the psychology of programming and design literature. Initially, the problem-space concept was proposed as part of an algebraic representation of external problem structures that existed independently of the analyst (Newell and Simon 1972). More recently, the concepts have been used more fluidly, to denote a mental model or conceptual “space” of potential design problems or solutions that underlie the selection of specific design attributes (Dorst and Cross 2001). The concept is developed further by Bergman, King, and Lyytinen (2002) to distinguish between the solution space as it exists now (i.e., the ecology of functional requirements that solves current perceptions of the problem structure) and a target solution space (the set of solution elements that are implemented in the target system).

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