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A COGNITIVE PERSPECTIVE ON BOUNDARY-SPANNING IS DESIGN

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Abstract

This paper examines social cognition processes in IS design teams that span organizational boundaries. We question the relevance of goal-driven process models of IS design, exploring evidence for a model based on convergence between the problem-space and the solution-space. We then develop concepts of design "framing", based on three different perspectives on social cognition: socially-situated cognition, socially-shared cognition and distributed cognition. These three perspectives are often conflated in studies of IS framing. The separation permits insights that are not possible with a combined perspective.

Findings are presented from a longitudinal, ethnographic study of boundary-spanning design in a midsize engineering company. These findings provide unique insights into the interior processes of boundary-spanning design. This study has significant implications for both the research and management of boundary-spanning design. We conclude that we may need a very different management process to the decompositional process employed for IT system design, that focuses on inquiry into organizational problems in a much more sustained way than is currently the case. We may also need to develop new models for assessing design progress, based not on the development of a "common vision" of the target system, but on the extent to which design group members share a common vision of organizational problems and the levels of trust that ensue.

1. INTRODUCTION

The IT component of information system development has been radically simplified in recent years. Many corporations are now attempting to jointly design business processes and IT systems, to integrate workflows and information flows across business processes. The majority of these efforts fail, because there is a fundamental contradiction in the way that we design this type of "boundary-spanning" information system (IS). Stakeholders need to establish common visions of design goals and information flows, but can only do this in situations where the context for doing these things is already well defined and stable -- so how can they do it in rapidly-changing or evolving development contexts?

Understanding why something is done in a specific way is often possible only within the culture and local knowledge of a specific work-group. We lack ways to share this understanding across workgroups, or even to determine what knowledge is significant for an effective IS design. The state of the art is that goal-directed processes and methods, that were developed to support well-defined technology design problems, are employed for ill-defined and emergent organizational IS design problems (Checkland and Holwell, 1998; Tenkasi and Boland, 1998). Most boundary-spanning design projects employ the type of design process used for IT system development. Goals for change are defined, requirements for a solution are specified, then the solution is implemented. But this approach is not appropriate for the design of information systems to support emergent knowledge processes (Markus et al., 2002). Problems that span organizational boundaries are highly subjective, political and difficult to articulate . For this type of IS, the goals for change evolve as the design proceeds. Stakeholders from different areas of the organization perceive organizational processes and goals in very different ways, so developing a shared vision of system goals and outcomes is difficult. Consequently, there is too little input from IS users and organizational stakeholders to define an appropriate system. We need to understand the knowledge-sharing processes that underlie this type of design, so that we can manage it effectively.

2. CONCEPTUAL BACKGROUND

2.1 The Nature of the IS Design Process

The dominant model of IS design in the literature is to view design as a process of hierarchical decomposition (Alexander, 1964). A consensus problem is agreed and goals are defined that will resolve the problem. Requirements for an IS solution are defined through an analysis of the gap between current performance and goals (Checkland and Holwell, 1998). We thus arrive at the traditional design "space" shown in Figure 1.

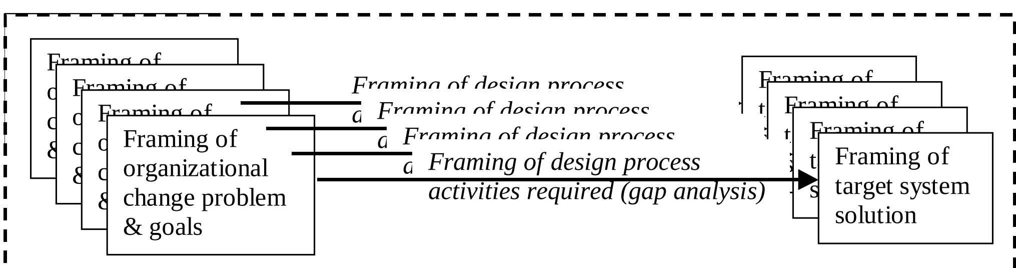

Figure 1: The Traditional Design "Space"

This approach suffers from three main limitations as a guide to the design of organizationally-situated information systems. Firstly, it is based on Simon's (1960; 1973) argument that ill-structured problems such as IS design are associated with a consensual and objectively-defined set of initial goals, that are associated with structures inherent in the situation, whereas recent studies indicate that design goals are political, subjective and negotiated (Boland and Tenkasi, 1995; Orlikowski, 2002). Secondly, it is based on an individual, rational model of problem-solving, whereas organizational IS design tends to involve group processes, constrained by their social and cultural context (Boland and Tenkasi, 1995; Faraj and Sproull, 2000; Preston, 1991). Thirdly, it assumes that goals and requirements for a solution may be defined (or agreed) early in the design process whereas empirical research tells us that IS goals emerge through the processes of design (Guindon, 1990a; Markus et al., 2002; Rittel, 1972a). Yet the traditional waterfall approach dominates IS design, even when it is patently inappropriate to the type of IS or the degree of organizational uncertainty (Barry and Lang, 2003; Fitzgerald, 2000; Gasson and Holland, 1996; Zhu, 2002).

Simon's (1973) assumptions of a goal-driven process have received remarkably little attention in the IS literature (Checkland and Holwell, 1998), yet empirical studies of IS design and its related organizational change reflect a much more subjective and contingency-based approach. Rather than being driven by the pursuit of a clear set of early goals, the design of an IS appears now to be viewed in the IS literature as improvisational and adaptational (Lau et al., 1999; Majchrzak et al., 2000; Orlikowski, 1996; Orlikowski and Hofman, 1997; Weick, 1998). In the “psychology of programming” literature, the behavior of experienced designers is categorized as “opportunistic” (Ball and Ormerod, 1995; Guindon, 1990a; Khushalani et al., 1994), as it appears to diverge from a breadth-first or depth-first decompositional strategy. An overarching goal or "vision" is pursued through the adaptation of new and partial (satisficing) understandings of the organization. Partial and ill-defined goals and sub-problems emerge through incremental interaction with the organizational context and are subject to continual negotiation. We therefore have a process that appears close to Suchman's (1987) description of situated action. But there is little in the IS literature that tells us how such "improvisational" design proceeds. There may be a clue in the psychology of design and programming literature, where considerable attention has been paid to the relationship between expertise and outcomes. Expert system designers have been observed to extrapolate empirical solutions from similar problems, rather than employing a goal-directed, solution seeking strategy (Curtis et al., 1988; Curtis and Walz, 1990; Guindon, 1990b;

Visser and Hoc, 1990; Visser, 1994). Empirical studies of dialogs between expert designers and their clients have revealed how designers reframe both the design problem and the solution when confronted with new information that conflicts with an implicit requirement for the design (Malhotra et al., 1980; Turner, 1987). Experts reuse known solutions, by identifying partial sets of requirements that fit with these solutions, incorporating implicit knowledge and implied requirements into the "framing" of new solutions (Guindon, 1990b; Malhotra et al., 1980). If requirements do not fit with available solutions, it is the requirements that are redefined, to save the cognitive effort of a new solution search (Guindon, 1990a, b). Far than being planned or guided, definitions of a design problem *and* solution converge in tandem (Darke, 1979; Turner, 1987). According to Turner (1987):

> " … problem definition and solution generation are not independent activities; they are interrelated. Consideration of potential solutions raises questions about potential requirements which then give rise to new requirements. Requirements and solutions migrate together toward convergence. The fragmentary nature of the dialogues suggest that they play an important role in stimulating cognitive processes, rather than solely conveying predetermined information." (Turner, 1987, page 100).

So design perspectives, or "frames" are not constant: they change and adapt, often on the basis of implicitly-formulated local contingencies, rather than rational analysis. Calling on this type of experiential knowledge imposes a lower cognitive cost than the analytical processes required for goal-directed cognition (Anderson, 1983). Convergent design appears to involve a high degree of experience-based, implicit knowledge (Malhotra et al., 1980; Schön, 1983; Turner, 1987). Turner argues that "the issue becomes identifying what guides the discrimination between significant and insignificant" (Turner, 1987, page 105). Design is thus viewed as the convergence between a conceptual problem-space and solution-space and we have the view of design shown in Figure 2.

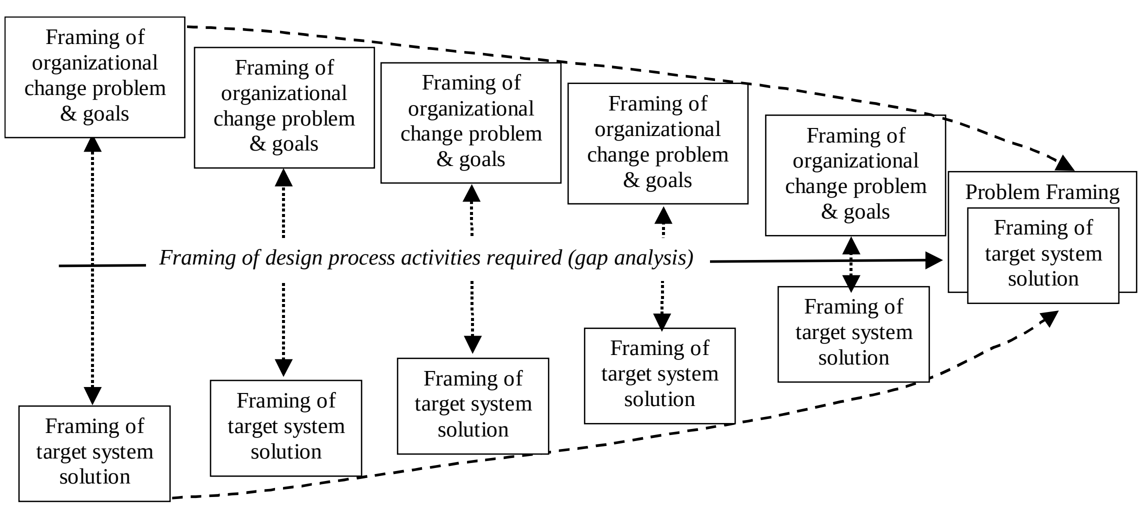

Figure 2: Design As Convergence Between Problem Space and Solution Space

We are therefore left with the following research question:

> Does the convergence model offer a convincing alternative to the decompositional model of design and, if so, how does the convergence of problem- and solution-space take place in boundary-spanning group design?

We have little understanding of how this process of convergence takes place in group design, or whether it offers a convincing alternative to the goal-driven models of design. Traditionally, IS design is assumed to depends upon intersubjectivity (cognitively shared understanding) for effective communication between team members to take place (Flor and Hutchins, 1991). But in design that spans organizational boundaries, knowledge of goals and solution requirements is distributed between stakeholders who possess different knowledge and expertise and so need explicit mechanisms for knowledge "framing" in terms that they can understand (Faraj and Sproull, 2000; Krasner et al., 1987). To understand this dichotomy, we examine IS design through the theoretical lens of three aspects of social cognition. We first examine design as socially-situated cognition, investigating the notion of design "framing"; then as shared cognition, investigating the extent to which a group design exists; and finally as distributed cognition, viewing the understanding of an IS design as distributed over members of the design group.

2.2 IS Design As Socially-Situated Cognition

Employing the lens of socially-situated cognition allows us to examine the ways in which internal knowledge structures shape how people interpret events in a particular way, or sensitize them to specific events and phenomena over others (MacLachlan and Reid, 1994; Winograd and Flores, 1986). Underlying any study of social interaction is the understanding that individuals inhabit a socially constructed world and through their actions, reproduce and give meaning to that world (Berger and Luckman, 1966; Kelly, 1955; Strauss, 1978; Weick, 1979). Individuals operate within distinct "social worlds" (Strauss, 1978, 1983) or "communities of practice" (Cook and Brown, 1999; Lave and Wenger, 1991): local workgroups possessing their own social norms, social expectations and specific genres of communication. But people are also members of *multiple* social worlds, as their work and personal experience intersects with the knowledge and interests of different groups (Strauss, 1983; Vickers, 1974). Thus, organizational "problems" are not consensual but emerge through interactions between the various social worlds to which decision-makers belong. Suchman (1998) demonstrates how shared work spaces are produced through interaction in joint work. She argues that centers of coordination in collective work are not pre-established but are continually redefined through interactions between technology, people and potential work-spaces. From an interactional perspective, organizational processes may no longer be viewed as static, but as "emergent knowledge processes" (Markus et al., 2002). An IS design can therefore be seen as the result of negotiation between multiple, socially-situated “worlds”, that represent reality in different ways to different people. The resulting IS reflects intersections between an overlapping set of individual and group perspectives, that shift and evolve as the design proceeds. Problem contents and boundaries are subjective, multiple and competing: "relevant" organizational problems are determined through argumentation and negotiation (Boland and Tenkasi, 1995; Rittel and Webber, 1973).

The study of the processes by which human beings individually and collectively interpret, bound and make sense of phenomena and social interactions in the external world originated in the fields of cognitive and social psychology. Human beings act according to internal, cognitive structures, variously referred to as schemas (Bartlett, 1932; Neisser, 1976), personal constructs (Kelly, 1955), scripts (Schank and Abelson, 1977) or mental models (Gentner and Stevens, 1983; Johnson-Laird, 1983), that permit them to make sense of the external world (Markus and Zajonc, 1985; Orlikowski and Gash, 1994; Weick, 1979). These structures become more complex, abstract and organized with experience: this is pertinent in the area of IS design, where experiential knowledge is valued because of the increased ability for abstraction (Vitalari and Dickson, 1983).

These concepts from the psychology literature converge, and are extended to social interaction, in the notion of a "frame" (Goffman, 1974; Tannen, 1993). The framing concept operates at the intersection of a psychological-cognitive and a social-behavioral approach to human interaction (Ensink and Sauer, 2003). People behave according to "structures of expectation" (Tannen, 1993) that guide how they predict and interpret the behavior of others. Such structures are partly culturally-predetermined and partly based on prior experience of similar situations (Boland and Tenkasi, 1995; Minsky, 1975; Schank and Abelson, 1977; Tannen, 1993). Individuals provide conversational cues, on the basis of which hearers are able to place the communication within a specific context. But an individual cannot contribute to a discourse without displaying their view on the subject matter. Thus, communications are framed both within a specific, situational context *and* from an individual perspective (Ensink and Sauer, 2003; Tannen, 1993). Individual frames are not static, but subjected to change during communicative and social interaction (Boland and Tenkasi, 1995; Ensink and Sauer, 2003; Eysenck and Keane, 1990). Employing a framing perspective allows us to conceptualize how similarities and differences in individual perspectives and understandings guide collective action.

2.3 IS Design As Shared Cognition

Groups of people who regularly work together on shared tasks have been observed to develop a repertoire of *shared* frames. Shared frames provide cognitive "shortcuts" that permit a group to share common interpretations of the organization without the need for complex explanations (Boland and Tenkasi, 1995; Brown and Duguid, 1991; Fiol, 1994; Lave and Wenger, 1991). The development of a community of professional practice, such as a design group, is contingent on the development of shared (or intersubjectively acknowledged) meanings and language (Lave, 1991; Prus, 1991). The use of specific language reinforces the extent of shared understanding within a work-group and allows them to reconcile competing or complementary perspectives (Lanzara, 1983; Prus, 1991; Winograd and Flores, 1986). For example, IT developers share a vocabulary that is often unintelligible to other workers, but which allows them to communicate and coordinate work, using shorthand terms such as "this is a blue screen error". IS design depends upon intersubjectivity for effective communication between team members to take place. Technical system designers, "successful in sharing plans and goals, create an environment in which efficient communication can occur" (Flor and Hutchins, 1991, page 54). This type of perspective-sharing requires not only shared knowledge, but also a shared system of sociocultural norms and values. Organizational framing is embedded within a local system of shared, socio-cultural values that make sense of "how we do things here" (Cook and Brown, 1999; Lave and Wenger, 1991; MacLachlan and Reid, 1994).

> " Knowledge and understanding (in both the cognitive and linguistic senses) do not result from formal operations on mental representations of an objectively existing world. Rather, they arise from the individual's committed participation in mutually oriented patterns of behavior that are embedded in a socially shared background of concerns, actions, and beliefs." (Winograd and Flores, 1986, page 78) .

Orlikowski and Gash (1994) studied the effect that the "shared technological frames" held by two groups of key design stakeholders, technologists and technology-users, had on the adoption and use of Lotus Notes. An analysis of the degree of congruence[1] between the different group frames permitted them to associate changes in how the new technology was implemented with the interpretations and interests of the different groups. By identifying various domains associated with framing perspectives, Orlikowski and Gash were able to locate differences between the belief-structures of technologists vs. users of the

[1] Frame congruence does not imply that frames are identical, but that they are related in structure (possessing common categories of frames) and content (with similar values in the common categories) (Orlikowski and Gash, 1994).

technology that related to different modes of use and expectations of IT strategy. They concluded that conflicts and difficulties may arise in technical change initiatives where members of the key groups involved hold technological frames that are significantly different.

Orlikowski and Gash (1994) argued that work-objectives and culture were sufficiently homogenous among members of their two stakeholder groups to assume a shared technological frame. But defining shared content depends upon the way in which the framing concept is itself defined: we need to examine what is shared, to understand the degree of frame congruence (Cannon-Bowers and Salas, 2001). Cannon-Bowers and Salas (2001) suggest that what is shared in studies of shared cognition falls into four categories: (i) task-specific knowledge, relating to the specific, collective task in hand; (ii) task-related knowledge, experiential knowledge from similar tasks, of how to perform the work-processes that are required; (iii) knowledge of teammates, i.e. who knows what; and (iv) attitudes and beliefs that guide compatible interpretations of the environment. In the Orlikowski and Gash (1994) study, the assumption of shared frames refers only to congruence in the fourth category, attitudes and beliefs that guide compatible interpretations of the environment.

Davidson (2002) extended the framing concept provided by Orlikowski and Gash (1994), by analyzing the process of frame sharing and the dominance of different frame domains within a group engaged in a collective task: the specification and design of an organizational information system. Through a thematic analysis of her data, she categorized various frame "domains" that resulted in a specific focus, excluding some design elements or issues from consideration and including others. In other words, adoption of a specific frame domain provided a conceptual boundary, or filter, to group discourse. Davidson found that different frame domains became salient to the group at different points in the process, resulting in the adoption of a different strategy towards the IS design. This use of the term 'frame domain' thus relates to an intersection of the task-related, experiential-knowledge category and of the attitudes and beliefs category defined above (Cannon-Bowers and Salas, 2001). At times when *the business value of IT* frame-domain dominated group discourse, this led to radical reconsideration of project requirements. At times when *the IT delivery strategy* frame-domain dominated group discourse, the group reverted to a more conservative definition of requirements, consistent with the perceived need to deliver a known product. Tensions between the assumptions underlying each of these frame domains led to much of the instability in IS design group members' understandings and agreement of the requirements for a new system. Changes in the group's dominant frame domain appeared to be triggered or accompanied by the adoption of a new group metaphor for the rationale behind the current design strategy.

From these studies, we understand that the development of shared frames may lead to more coherent group action and that the adoption of a new framing metaphor may reflect a shift in the dominant framing domain that triggers a change in group strategy. But we cannot assume shared frames just because group members share a similar culture (Krauss and Fussell, 1991). We also cannot assume the existence of a shared culture among design group members: recently formed groups, or groups with new members have diverse cultural values (Lave and Wenger, 1991; Moreland et al., 1996).

2.4 IS Design As Distributed Cognition

Star (1989) argues that the development of distributed systems should use a social metaphor, rather than a psychological one, where systems are tested for their ability to meet community goals. A social perspective requires the incorporation of differing viewpoints for decision-making. This accords with the position of many authors working on the problem of how to reflect the diversity of organizational needs in IS design (Checkland, 1981; Checkland and Holwell, 1998; Eden et al., 1983; Eden, 1998; Weick, 1987; Weick, 2001). Weick (1987) discusses how teams performing collaborative tasks require a requisite variety of perspectives, to detect all of the significant environmental factors affecting collective decisions. But this is balanced by the need for a homogeneity of culture, within which team members can trust and interpret information from other team members. A wide spread of experience must be expected to cause problems of group cohesion and productivity (Krasner et al., 1987; Orlikowski and Gash, 1994). Boundary-spanning design involves distributed cognition. Understanding within the design team is distributed: each individual can comprehend only a part of how the target system of human activities operates, as shown in Figure 3.

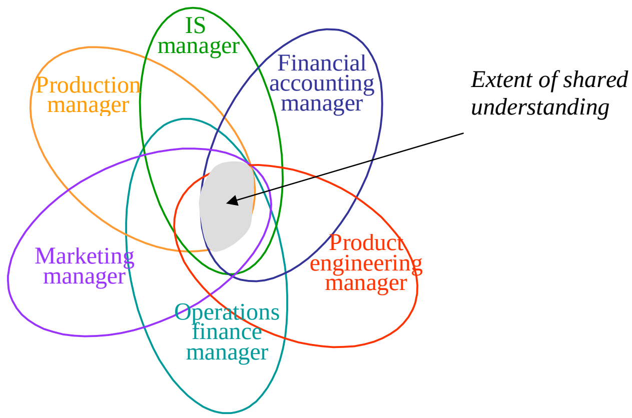

Figure 3: The Problem Of Distributed Knowledge Management

A distributed cognition perspective assumes that "heedful interrelating" between members of a cooperative workgroup is required for effective collaboration (Hutchins, 1995). Individuals need to have some interdependency, or overlap, with other individuals in their framing of what needs to be done and why. But the distributed cognition perspective takes the position that there is a lack of overall congruence between how individuals frame organizational work. Understanding is not so much shared between, as "stretched over" members of a cooperative group (Star, 1989). This provides an alternative to the assumption of shared knowledge in coordinated work:

> " Distributed cognition is the process whereby individuals who act autonomously within a decision domain make interpretations of their situation and exchange them with others with whom they have interdependencies so that each may act with an understanding of their own situation and that of others." *(Boland et al., 1994, page 457).*

A distributed cognition perspective allows us to conceptualize a theory of design that permits agreement and negotiated outcomes while recognizing that each individual group member's design understanding may be incomplete, emergent and not congruent with the understanding of others. Established workgroups develop an understanding of who knows what, that allows them to operate with heedfulness to others' tasks and the division of collective work (Moreland et al., 1996). But the coordination of organizational expertise in newly-established groups is complex and difficult, especially in groups that span organizational boundaries. People rarely know who knows what in large organizations (Carlile, 2002; Cramton, 2001; Pfeffer and Sutton, 2000). Knowledge of the organizational processes to be supported by an IS resides in people's heads, rather than in external procedures or documents (Brown and Duguid, 1994; Nonaka and Konno, 1998). It is embedded in practice, rather than being capable of articulation (Fiol, 1994; Schön, 1983). Individuals in boundary-spanning groups possess a diversity of backgrounds that makes it difficult to establish a common basis for understanding or communication

(Carlile, 2002; Cramton, 2001). This process is complicated by the competing claims to knowledge of different organizational groups (Compeau et al., 1999; Faraj and Sproull, 2000; Latour, 1987). Members of a boundary-spanning design group may not realize that they hold distributed knowledge or socially-constructed perspectives of a design and may perceive misunderstandings as the consequence of political differences (Gasson, 1999). In traditional work groups, there are experts on which the group may rely for guidance, whereas in the design of novel organizational information systems, perceptions of expertise are subjective and negotiated: there is a "symmetry of ignorance" (Rittel, 1972b). A study of software development teams performed by Faraj and Sproull (2000) indicated that the effective management of distributed cognition is significant in ensuring team effectiveness. While the possession of expertise did not directly affect team performance, the coordination of expertise was seen as critical to team success. Social integration was considered more important than having an expert on the team (Faraj and Sproull, 2000). But we do not understand how to coordinate and elicit relevant expertise, or even to identify what expertise is relevant, when the problem-space and solution-space as both viewed as emergent.

2.5 Research Questions

From the review of the literature above, we derived the following research question and three sub-questions:

Research Question: Does the convergence model offer a convincing alternative to the decompositional model of design and, if so, how does the convergence of problem- and solution-space take place in boundary-spanning group design?

Sub-questions:

1. How do individuals' design frames interact, to form a group "framing" of an information system?
2. Does a design group develop a shared design-frame over time? If so, what aspects of the design are shared?
3. How does a boundary-spanning design group manage and mediate distributed cognition?

These questions are addressed in the field study of a boundary-spanning design, presented below.

3. RESEARCH METHOD AND SITE

3.1 The Research Site

NTEL Ltd.[2] is a mid-sized engineering firm in the UK, specializing in the design, manufacture and sale of products to the telecommunications industry. The subject of this research was the co-design of business and IT systems for customer bid response. The company dealt with a small number of large customers. Products were customized from a pre-existing range of developed components and telecommunications systems, in response to customer invitations to bid for a specific project. The context of the study is shown in Figure 2, as a "rich picture" (Checkland, 1981), presenting activities, roles, relationships, interactions and context in an unstructured, diagrammatic form. As a company, NTEL felt that they were losing business to competitors because of poor responses to customer invitations to bid for new business. A potential customer invited a number of suppliers to submit a Bid for a customer project, detailing how each supplier proposed to fulfill the customer's requirements and at what price. Preparation of this document was performed by a loosely-associated team of people, assembled on an ad hoc basis from the main areas of the business. Functional delegates would work on an individual section of the Bid response document for a few days or weeks (depending upon customer deadlines) until it was ready to be dispatched. Problems with the current Bid response process were highly interrelated and situated in the political and cultural context. This situation therefore provided an exemplary situation in which to study complex, boundary-spanning IS design.

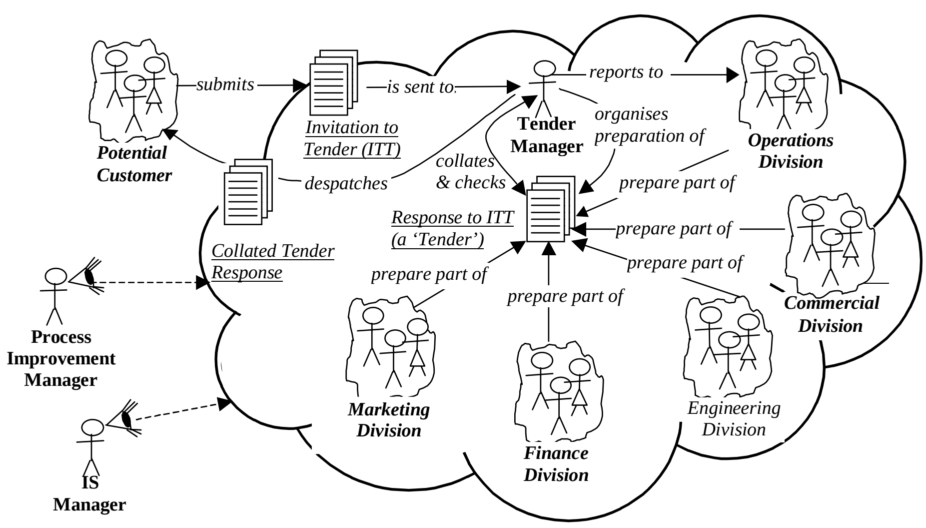

Figure 4: A Rich Picture Of The Context and Process Of Bid Response At NTEL

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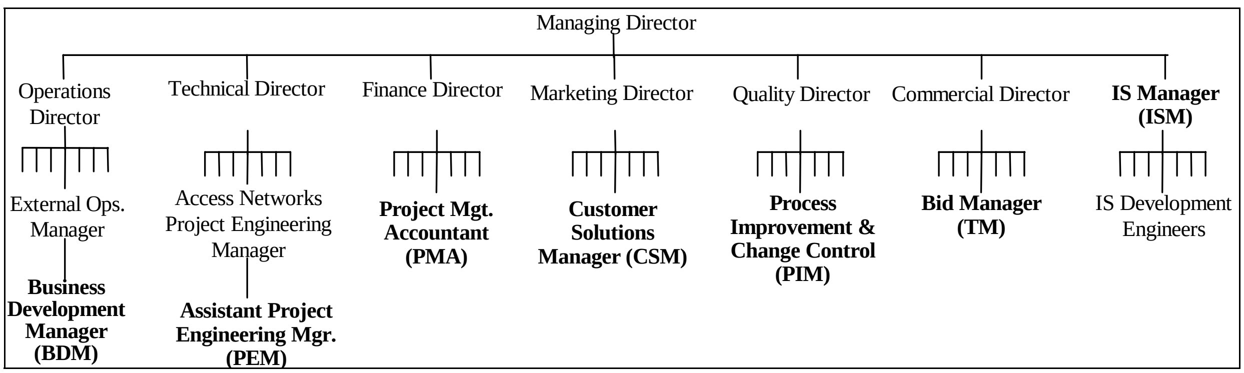
[2] Names of the organization, its departments, members and products have all been disguised.

A prior "business process redesign" initiative was reported to have failed because of a lack of commitment by participants. The IS Manager had therefore ensured active sponsorship by the Managing Director, who backed the IS Manager's requirement that functional managers should consistently allocate time for the core team members to attend the project meetings. Time was set aside for regular, two to three hour meetings, to be held twice-weekly. Team-members were selected who would have a positive attitude to organizational change from a wide area of functional responsibilities, but these were also largely selected on the basis of their ability to command respect, participation and "buy-in" from their respective workgroups, ensuring a collective ownership of the design. A company organization chart is shown in Figure 5. Participating members of the design team are shown in **bold type** in the diagram. The **abbreviations** shown are those used to differentiate between individuals in the discourse extracts and framing summaries that follow.



<u>Figure 5: NTEL Company Organization</u>

While the organization chart appears to show disparities in power between team members, all of those participating had an open and facilitative approach to the process that removed these barriers. The design team was led by the IS Manager and the Process Improvement Manager, who reported to the company Board of Directors. Other team members were representatives from each of the main divisions of the company: marketing, finance, engineering, operations and commerce. Each of these divisions was involved in the Bid process and all of the design group members had prior experience of the Bid process. The Operations division representative was the current Bid Process Manager.

The design project was initially intended to be a short and well-focused initiative, that would focus on "quick wins" over a period of approximately three months. The need for a more intensive design inquiry process in this type of project was a major learning point for the company. Including a period of organizational change management following the team's design meetings, the project as a whole lasted for eighteen months.

3.2 Research Methods

The analysis underlying the findings presented here was conducted using an ethnographic approach to data collection (Dourish and Button, 1998; Prus, 1991; Van Maanen, 1988). The philosophical position underlying the study was constructivist-interpretive (Denzin, 1998; Lincoln and Guba, 2000). As this study was intended to be a contextualist analysis (Pettigrew, 1990), data were collected and analyzed at three levels of human activity: individual cognition, group design processes and organizational constraints and enablers, following the levels of analysis employed by Curtis et al. (Curtis et al., 1988) in a contextualist study of the processes of large, IT development project teams. While this study operates at a group level, the focus of attention is how individual framing processes interact, to provide a group perspective of the design. Data collection was performed through four means:

1. An ethnographic study was performed, through participant observation of a boundary-spanning design team. I attended approximately half of the design meetings, over an eighteen month period, taking notes, making audiotape recordings and informally discussing progress and the design process with team members, at the start or the end of each meeting. Project documents were also collected and formed part of the data used for analysis.
2. Ad hoc interviews were conducted with various team members prior to and following each meeting, to track activities that occurred outside of the meetings and to understand organizational issues that had been discussed during the meeting.
3. Structured interviews were performed with members of the core design team, at three points: the beginning, approximately halfway through and towards the end of the design project. SSM modeling techniques (Checkland, 1981) were used to guide inquiry into the meaning attached to the design problem, target system objectives and required design processes, by individual team members, as discussed below.
4. A group workshop was facilitated by the researcher, halfway through the project. This workshop employed a variant of cognitive mapping (Eden et al., 1983; Eden, 1998), to understand the chains of cause and effect that led to certain outcomes and to construct shared models of the target system.

The data collection and analysis methods used to derive the findings reported here are shown in Table 1.

Table 1: Summary of Data Collection and Analysis Methods

Phenomena of interest	Data collection method(s)	Data analysis method(s)
Decomposition level of group design at different periods of the design process	Four design meetings selected for discourse analysis, spaced evenly through the period of the design.	Qualitative coding: levels of decomposition of individual contributions to group design discourse.
Individual design frames, for three "domains" of design: - the IS problem-space - the IS solution-space - how the gap between problem- and solution-space should be closed.	Interactive interviews using SSM techniques Discourse analysis of individuals' verbal contributions to design meetings at specific points in the process (beginning, middle and end).	Qualitative coding, based on three thematic concepts: - organizational problems to be resolved - goals and definitions of the combination of IT and work processes that constitutes the target IS - the design processes required.

An analysis of decompositional levels (Guindon, 1990a; Malhotra et al., 1980) was used in a discourse analysis of four design meetings, to understand how goals directed or emerged through the processes of design. These meetings were evenly distributed across the period of the design project, to provide a time-related view of changes in focus, taken by the group as a whole. A secondary coding of these meetings was performed to understand transitions in the design process. Individual perspectives expressed during the meeting were compared to the perspective adopted by the group, to understand how the group frame arose.

An analysis of individual design-frames was used to understand the extent to which these diverged or converged, during the course of the project. Frame analysis (Goffman, 1974; Tannen, 1993) analyzes discourse to interpret how an individual understands and responds to what is said by another individual. This is closely associated with the concept of symbolic interaction (Blumer, 1969). Individuals take action on the basis of the meanings that specific *things* have for them; these meanings are modified through social interactions. Prasad (1993) demonstrates how local (to members of different workgroups) interpretations of a symbolic reality guided the ways in which work was computerized. For example, the concept of "professionalism" was associated with three different sets of meanings that elicited different interpretations of what type of IS was required, from different actors at different times in the process. Interactive interviews were conducted, based on Soft Systems Methodology (SSM) modeling techniques (Checkland, 1981; Checkland and Scholes, 1990). The importance of assumption surfacing (Mason and Mitroff, 1981; Mitroff and Linstone, 1993) was indicated in the studies of interactions between IS designers and clients by Malhotra et al. (1980) and Guindon (1990a). Three capabilities of SSM modeling (Checkland, 1981) were of particular interest for this research study. The first focuses on separating concatenated definitions of change into separate "root definitions" that explore the change in terms of activities required to achieve it and therefore define implicit meanings attached to the change. The second is the concept of focusing on problem-based and goal-based change "systems" with separate models. The third is the exploration of the *Weltanschauung* (individual worldview), which justifies or defines the system of change in terms of its rationale and underlying problem-structure. This also reveals implicit understandings of how the individual's "world" works. Complex and ill-articulated perspectives may thus be split into a set of distinct definitions: multiple systems of human activity that reflect different problems, goals or processes. While SSM is normally used in facilitated group discussions, it was used interactively here, to guide interactive interviews with design group members. Participants were asked to define the way in which they would change the current situation, to achieve (i) their ideal target information system, (ii) their ideal design process and (iii) their ideal set of organizational changes. This reflected the three aspects of the convergence model, shown in Figure 2, above.

The assessment of cognitive frames is complex and there is no consensus on how the concept should be operationalized (Orlikowski and Gash, 1994; Robillard et al., 1998). Data from interviews and individual discourse in group design meetings were coded qualitatively (Denzin, 1998; Silverman, 1993), using a thematic comparison to discern similarities and differences between individuals' design frames. Where possible, interview data was used to validate design meeting discourse data and vice versa. The results from this analysis are presented below.

4. FINDINGS

4.1 The Extent To Which The Process Was Decompositional

To analyze to what extent the design group followed a decompositional method of analysis, individuals' contributions to design discussions at these four design meetings were coded according to the decomposition level of the design requirements discussed. Discussion related to administrative or social issues was omitted from this analysis, which followed the method used by Guindon (1990a, 1990b), although as Guindon's coding structure related to software program design, a coding structure was devised to suit the discourse relating to organizational system design. Verbal contributions to design discussion were analyzed according to five levels:

5. Top-level design (definition of high-level business process, overall system goal, or system purpose)

4. Second-level design (sub-process of high-level business process, or sub-goal, or specific problem with business process)

3. High-level detail (functional specification or type of information required)

2. Mid-level detail (process mechanisms or specifics of information flows)

1. Low-level detail (specifics of organization or detailed information description/example)

This analysis was conducted at the group level: that is, discussion between group members was analyzed, rather than individual threads of conversation. A "contribution" was analyzed in terms of the focus of statements or parts of a statement. A contribution sequence is shown here to illustrate how meeting contributions were analyzed:

PEM: We should be providing sufficient information, in clear and simple terms, to enable the decision makers to reach the correct decision. For example, Bob in Engineering uses a card-index file to give him the unit cost of each product and we could do something like that, but I don't think we should influence it too much. The amount of influence you put in there is very, very risky … I think the decision should be taken by the decision makers.	Level 5: overall system goal Level 2: process mechanism Level 4: sub-goal Level 5: overall system goal
CSM: yes but it does beg the question whether Engineering choose what the customer gets.	Level 4: problem with process
PEM: basically, it's the knowledge they're using, but engineering are anticipating, they're back up here *(he gestures at the design model diagram)* and I think they've got it wrong. I don't think engineering should do that.	Level 2: specifics of information flows Level 4: problem with process
CSM: see, that should be driven by -- this square, this is where we actually put some power into the new process, by saying -- you could actually pull out one issue that blows away nearly all the others, like that one there *(indicates information requirement in design model)*. What we would do is, we would actually end up making a recommendation that this is probably one of the most fundamental problems. At the moment we have no account management to drive it.	Level 4: sub-process definition Level 3: type of information required Level 5: system goal Level 4: specific problem/sub-goal

The expected average level of contribution, given the focus of each meeting is given in the "intended level of decomposition" column of Table 2. But verbal design contributions tended to average at a middle-level of decomposition, regardless of the purpose of the meeting or the episode of the design for which the analysis was made. The average contribution was at level 2.86, indicating a fairly even distribution of design-contributions at all levels, across the four meetings.

Table 2: Summary of Meeting Analysis By Contribution Decomposition-Level

Meeting	Episode of design	Purpose of meeting	Intended level of decomposition[3]	Average level of decomposition
A	1	overall system purpose & functions	4 - 5	3.28
B	3	detailed design of stage 1	3	3.05
C	5	detailed design of stages 2-6	3	2.75
D	6	implementation of stages 2-6	1 - 2	2.82

[3] According to the decompositional model used to manage the project.

There is some decline in the average level of decomposition, which may reflect the emphasis of the representation methods used at each point in time. But it is clear that the design was not conceptualized at the level intended for discussion in each meeting and also that it was conceptualized at many different levels of decomposition at the same time.

In fact, designers were still discussing many high-level ("what are we trying to achieve with this design?") issues, even when the design phase was supposedly drawing to a close, in meeting D. Design discussions did center around slightly lower levels, with slightly fewer very-high-level issues as time went by. But design discussions had a much wider-ranging, exploratory nature than the waterfall model of design would lead one to expect. Design contributions were made at all levels of decomposition, with rapid and wide swings between levels. These findings would tend to indicate that hierarchical decomposition does not explain the group process in this case. In fact, the group was still proposing and questioning very high-level goals and outcomes during the final stages of design. The average level of decomposition did decline slightly over the four design meetings analyzed, but still tended to be at variance to the level one would expect if the design process had been decompositional. One might predict the average decomposition level to be relatively high for the early meeting, middling for the two intermediate meetings and low for the late meeting, if design were decompositional. A representation of this analysis, composed of typical samples from each of the four meetings in sequence is given in Figure 6. Superimposed on the samples is an indication of the average level of decomposition which might be expected from each meeting.

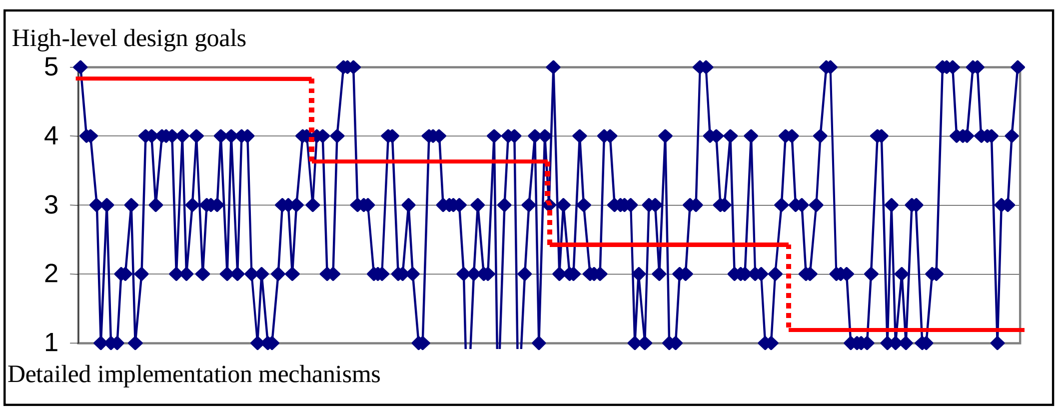


Figure 6: Decomposition-Levels of Group Discourse During Four Design Meetings

That the group recognized the inadequacy of decompositional design representations is reflected in this dialogue extract when the group were debating the IS Manager's proposal that group members use "structured" (i.e. decompositional) written system representations:

ISM: I would feel a lot more comfortable with a little more structure in the text against each box. If, in each box, if it said: owner, input, process, outputs, rather than a more ad hoc, textual, “this is what happens here” then I would feel that it was a bit more usable into the long term.

PEM: you normally work it the other way round. You say ‘what am I asked for’, ‘how am I going to do it’, ‘who do I need to do it’ and ‘what do I need in to me to achieve it’?

Given that a decompositional model did not explain the group design process, even when the process was explicitly managed according to a decompositional process model, the next section explores how individual design frames contributed to a consensus group framing of the design.

4.2 The Development Of Individual Design Frames

Design concepts developed and made explicit by individuals over the course of the project varied considerably. The seven core members of the design group were interviewed at the beginning, at approximately the middle and towards the end of the research investigation (at the end of the group design meetings, prior to the implementation stage). Participants were asked to provide explicit definitions for what they understood or "knew" about three framing "domains" (to use the term employed by (Orlikowski and Gash, 1994) and (Davidson, 2002)): (i) the organizational change problem, (ii) the target system to be designed, and (Iii) the required design process as they viewed it at the time. Findings from the interviews were also supplemented with elements obtained through a discourse analysis of design meetings from the relevant period during the project, where individuals did not express elements in sufficient detail and to act as a validation of their interview responses. Their explicit definitions were explored using Soft Systems Methodology techniques to understand how individuals framed design problems, target system objectives and the design process activities required - both explicitly and implicitly. This set of categories reflected the three aspects of the convergence model that was given in Figure 2, above.

4.2.1 The Design Problem

In the first two meetings of the design group, the problem was "agreed" among design team members as:

- A lack of relevant information for bid preparation, leading to inappropriate and incorrect product offerings and costing.
- Short-notice notification of invitations to bid by customer, leading to a "panic-driven" process.
- A lack of coordination among people allocated to prepare sections of a bid response, who each work for different functional managers (because of diverse knowledge required).
- Work on bid responses not seen as a priority by functional group managers, leading to late or incomplete preparation of bid sections by individuals.
- Different, often incompatible software applications used for document preparation, leading to poor quality and inconsistent bid response documents.

Definitions of the organizational "problem" to be resolved by the IS design project are summarized in Appendix 1, for the three points at which these were elicited. At the start of the project, it was clear that individuals interpreted the design "problem" in different ways, prioritizing specific aspects and (perhaps) understanding only some parts of the consensus problem. This is illustrated by the summary of individual problem-frames at the start of the project, shown in Appendix 1. Where possible, I have used participants' own words, to highlight the subtle differences in the ways that the problem was framed. Depending on their perspective and experience of the organizational context of responding to customer invitations to bid, some of the design group participants focused most on problems with the existing process, some on problems with information provision, and some on leveraging the customer relationship.

Towards the middle of the project, problem-definitions begin to show more overlap. Subgroups of 2-3 design group participants share the same perspective on many of the problems. But a detailed analysis of how they describe these problems shows that they still define them differently, with different components and causes. By the end of the project, it is clear that all participants agree on a major element: that they have failed to resolve all the problems of the bid response process. But there is a marked convergence of perspectives by this point. Most of the remaining design group members shared a deep appreciation of problems in common, although there are still some divergences in ascriptions of causality.

4.2.2 Goals For A System Solution

In the first two meetings of the design group, the design goals were agreed as:

- Maximize efficient use of resources.
- Improve bid turnaround time.
- Generate a bid response process model suitable for the expected growth in business.
- Improve the quality of bid responses.
- Identify interfaces across areas of expertise.

Target system solution goals are summarized in Appendix 2, for the three points at which these were elicited. Again, there was a wide variety of perspectives on that reflected different interpretations of issues and differing priorities. The existing bid process manager resolutely focused on an interpretation of "maximize the efficient use of resources" that focused exclusively on personnel allocation and work-tracking. The Customer Solutions Manager, on the other hand, defined this objective as the decision whether to bid or not bid on new business opportunities, depending on their strategic value to the company.

By the middle of the project, target system goals had converged in some respects, but not as much as one would expect, from the convergence in problem-definitions. A closer analysis of how target system goals were defined indicates that different design group participants understood only certain parts of the proposed solution. At this point, there was still a great deal of conflict about what should be done and how the problems that had been "agreed" could be resolved.

By the end of the project, there appears to be much closer convergence between participants' target system goals. However, a closer analysis shows that there is as much divergence as convergence about the goals of the designed IS solution. Again, it would appear that individuals only understood the solution in part. However, unlike their position in the middle of the project, design group participants appeared happy to delegate resolution of parts of the solution that they did not understand to other team members.

4.2.3 Required Design Process Activities

In the first two meetings of the design group, the process goals were agreed as:

- Define a new IS design process, to combine business process redesign with IT system support specification.
- Experiment with modeling and design elicitation techniques to support the new design process.
- Achieve company ownership of the design by disseminating information back to participants' functional groups and obtaining buy-in from these groups on major design decisions.

Definitions of the design process required by the situation are summarized in Appendix 3, for the three points at which these were elicited. When interviewing design participants, the required design processes were defined as what needs to be done from this point on, in the design. So this represents a "gap analysis" between problems and the envisaged target system solution.

Initially, definitions of the required design process were divergent, reflecting a deliberate emphasis on pooling expertise across the range of disciplines included in the membership of the design group. Diversity was encouraged, as leading to process innovation is design and so it is unsurprising that design process frames should diverge.

There was limited convergence towards the middle of the project, as group members suffered from the similar perceptions of their failure to deliver to management expectations, and a need to reestablish their credibility as a successful organizational group. Convergence around the "need to establish short-term objectives" element is particularly marked. Design process definitions are also more substantially defined (in detail) than the vague definitions of what needed to be done, that typified the start of the project.

It is surprising that definitions of what remained to be done diverged again, towards the end of the project. These also became more vague, focusing on the need for further investigation of a range of issues. In fact, the only element that individuals appeared to agree wholeheartedly upon, was the need for further design inquiry, on the eve of delivering the target system. But they were confident that their design was "workable", that it would solve the major problems that they had defined and that the solution would be a success. This apparent contradiction may be resolved by the observation that all of the design group members perceived the next step in implementing the design as delegating a specific part to other organizational actors, under the guidance of a specific design group member who was considered to be an 'expert" in that area of the design. Process training was delegated to the process improvement group, under the guidance of the Process Improvement Manager. Detailed information-support requirements definition for the IT system was delegated to the IT development staff, under the guidance of the IS Manager. Implementation of business strategy decision processes was delegated to a management team, under the guidance of the Business Development Manager. The Project Engineering Manager was delegated to guide product lifecycle strategy inputs to the bid response process. The Bid Manager was delegated to resolve issues of how individuals' work on bid response components could be tracked and managed. So the differing perspectives actually reflect a focus on the areas of expertise that each design group member had developed over the course of the design project. These also reflect a distributed model of understanding.

5. DISCUSSION

In the conceptual background section of this paper, we defined four research questions. Each of the sub-questions dealing with aspects of social cognition is discussed in turn, to address the overall research question:

> **How does the convergence of problem- and solution-space take place in boundary-spanning group design and does this model offer a convincing alternative to the decompositional model of design?**

5.1 How do individuals' design frames interact, to form a group "framing" of an information system?

From the findings presented above, it would appear that the most marked convergence appears to be in definitions of the organizational "problem" to be resolved by the redesigned IS. In common with Checkland (1981; Checkland and Holwell, 1998), we prefer the term "problem situation", as this reflects the complexity and diversity of elements that represent each individuals frame domain (as demonstrated in the definitions presented in Appendix 1). Goals for the target system design did not appear to converge to the same extent: these demonstrate a wide divergence. Definitions of the "gap" between problem and solution, as defined by remaining design task definitions, also appeared to diverge.

While some elements of both problem-space and the solution-space (target system) appeared to be consistent across different time-period, it is clear that individuals framed these elements with increasing sophistication as the project proceeded, reframing concepts to have different meanings and to reflect more detailed and partial understandings of what needed to be done. This is consistent with the development of individual design expertise: each design group member appeared to develop a specialism in an area of the design with which they felt comfortable, depending on their work-background and experience. This finding represents a very different model of expertise to that discussed in the organizational IS, software development and psychology of programming literatures, where expertise reflects a more uniform grounding in general technical interests and experience (c.f. Curtis and Walz, 1990; Guindon, 1990b; Malhotra et al., 1980; Markus and Bjorn-Andersen, 1987; Markus et al., 2002; Orlikowski and Gash, 1994; Orlikowski and Hofman, 1997; Robillard, 1999; Turner, 1987; Visser and Hoc, 1990). It would appear that boundary-spanning design processes operate differently to IS design processes conducted by groups where domain-specific (work or discipline-related) expertise is more uniform in nature.

5.2 Does a design group develop a shared design-frame over time? If so, what aspects of the design are shared?

The only framing domain where there was noticeable convergence of frame-definitions was the organizational problem definition. The other two framing domains showed considerable divergence, but in different ways. The target system objectives converged in some respects towards the middle of the project and appeared to converge from a superficial analysis of the terminology employed (e.g. "electronic document library") towards the end of the project. But a more detailed analysis revealed that different design team members defined these concepts differently, as demonstrated by the details summarized in Appendix 2.

It appears that, as the design proceeded individuals began to use shared metaphors, employing cognitive "shortcuts" that derived from a shared vision of the design. Appendices 1 and 2 show many of the same terms being used by different individuals. But these metaphors did not fully incorporate a shared understanding. When design frames were explored using techniques to elicit implicit and detailed information, it became clear that different individuals defined the same concept in different ways. This finding diverges from the assumptions of shared understanding found in the IS "framing" and psychology of programming literatures (*c.f.* Davidson, 2002; Krasner et al., 1987; Orlikowski and Gash, 1994; Walz et al., 1993). Prior literature assumes that the use of shared metaphors or terminology demonstrates shared understanding. It is clear from this study that such understanding is only shared in part.

5.3 How does a boundary-spanning design group manage and mediate distributed cognition?

Managers from different parts of the organization appeared unaware initially that they understood the same concept differently. They used similar terms to refer to radically different concepts. For example, the term "bid team management" was used by different people to represent a variety of constructs, from the organization of a team of people preparing bid response document sections, to the tracking and coordination of team work. However, this use of vaguely-defined terms may be more productive than it appears. For example, a striking finding (shown in Appendix 2) is that every single member of the design team used the phrase "virtual team" to describe the initial target system objectives, yet every single person defined how this team would operate (or why it was required) in a different way. However, the use of the term allowed the design group to work together on the assumption that they all wanted to achieve the same thing. This use of metaphors accords with Star's (1989) ideal type or platonic [boundary] object:

> " This is an object such as a map or atlas which in fact does not accurately describe the details of anyone locality. It is abstracted from all domains, and may be fairly vague. However, it is adaptable to a local site precisely because it is fairly vague; it serves as a means of communicating and cooperating symbolically-a sufficient road map for all parties. " (Star, 1989, page 49).

As the design proceeded, the use of common metaphors persisted, but individuals no longer defined their detailed target system objectives in terms of these. While the overall target system objective was still defined as "virtual team management" towards the end of the project by all group members, they were more aware that they meant different things by this term and no longer found this problematic. This would indicate that the coordinating mechanism provided by a common design metaphor had been replaced by another coordinating mechanism.

Definitions of the "gap" between problem and solution, as defined by remaining design task definitions, became more tightly defined towards the middle of the project, but then became more vague towards the end of the project. This reflects a pragmatic accommodation of the design group's distributed understanding of the target system and again demonstrates their awareness of a different coordinating mechanism. The key to the coordinating mechanism of boundary-spanning design appears to lie in what framing domain converged. It would appear from the way that the remaining design tasks were communicated that the group was able to develop high levels of trust, based on a shared definition of the organizational problem. Because the organizational problem domain was shared, the target system domain did not have to be understood in all of its complexity. As one design group member commented: "I know that Peter wants to fix the same things that I want to fix, so I'll trust him to sort out his end of the system [personnel training]".

5.4 How does the convergence of problem- and solution-space take place in boundary-spanning group design and does this model offer a convincing alternative to the decompositional model of design?

From the above findings, it would appear that decomposition does not explain the processes of boundary-spanning IS design. A distributed understanding of the target system appears to be mediated on the basis of trust between group members, based on a shared framing of *the organizational problem-situation*. This degree of trust mediates the negotiation of differing target system objectives across different group members. Allocation of responsibility for specific areas of the design appears to be based on an individual's expertise in a specific area of the design. Each design group member appears to develop a specialism in an area based on their prior knowledge of work-functions within the target system scope and by their specific area of disciplinary expertise.

This leads us to a design process model that is akin to the emergent strategic-planning model of Mintzberg and Waters (1985). This is shown in Figure 7. However, rather than being driven by emergent goals, this model is driven by emergent problem conceptualizations. In a sense, the two concepts are related, as a process goal is associated with the resolution of organizational problems. But in another, very important sense, this model provides a unique insight that diverges substantially from the definition of design goals employed in traditional perspectives of the IS design process, especially those based in the software development tradition.

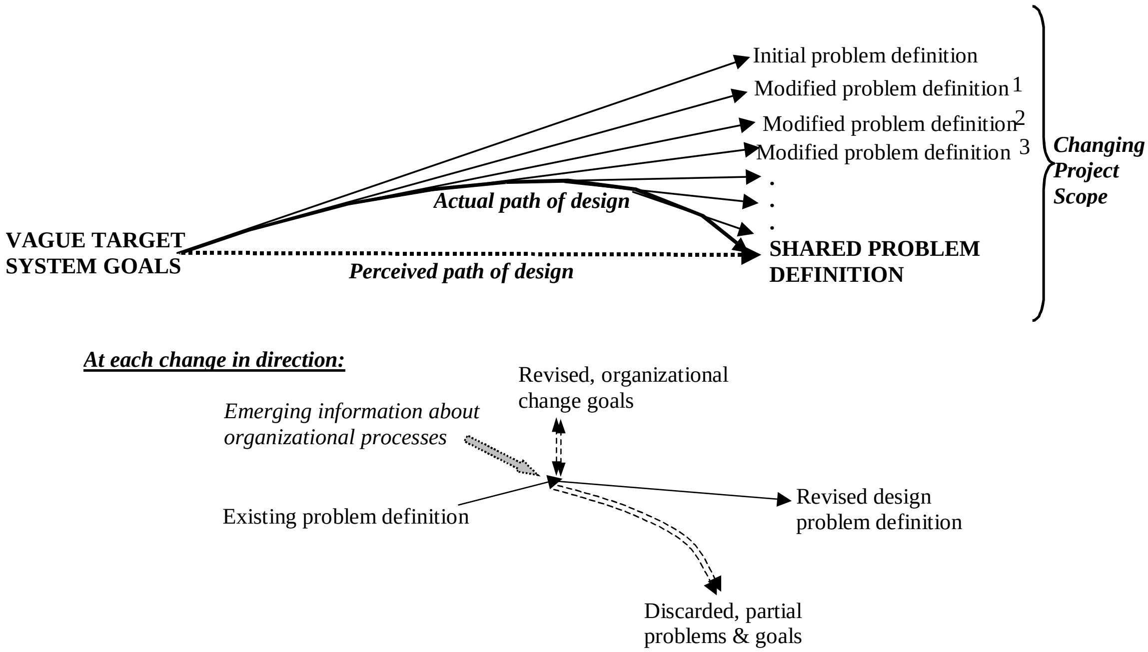


Figure 7: An Emergent (Improvisational) Model of Design

The three domains of the design that were explored in the interviews (target system objectives, design process activities required and organizational problem-definitions) reflect the three of the four categories identified by Cannon-Bowers and Salas (2001), respectively: (i) task-specific knowledge, relating to the specific, collective task in hand; (ii) task-related knowledge, experiential knowledge from similar tasks, of how to perform the work-processes that are required; and (iii) attitudes and beliefs that guide compatible interpretations of the environment. The third of the four categories of knowledge, knowledge of teammates, i.e. who knows what, was analyzed through an analysis of how responsibility was allocated to different group-members for different areas of the design implementation. Equating these framing domains allows us the insight that a shared perception of the attitudes and beliefs that guide compatible interpretations of the environment permits the negotiation of distributed perceptions of both task-specific knowledge and task-related knowledge. Knowledge of who knows what appears to be established through individuals' acquisition of expertise in specific areas of the target (application) domain during the design process.

6. CONCLUSIONS

Although it is unsurprising that shared perceptions of the attitudes and beliefs that guide compatible interpretations of the environment permit the negotiation of distributed perceptions of other aspects of the design, this is a new finding, related to boundary-spanning design groups. In such groups, the target system often proves too complex and wide in scope to be understood by one individual. Some mechanism must therefore be derived to negotiate the group's distributed understanding of the negotiated target "system" of organizational process changes and IT system changes. The relationship between organizational problem framing and the perception of shared beliefs and attitudes is critical in this process. Divergence in other aspects of the "design space" may be mediated by the delegation of responsibility for specific areas of the design, based on individual expertise that has been acquired during the design process. This is only possible because of the high levels of trust established by shared framing of the design problem.

The use of common metaphors was found to be misleading, as an indication of shared understanding (convergent framing) of the target system. However, the adoption of shared metaphors appears to serve a purpose. These provide a usefully vague coordinating mechanism for the group until sufficiently high levels of trust have been established for the group to delegate responsibility for understanding specific areas of the target system design and its implementation.

This study has provided unique insights into the interior processes of boundary-spanning design. In particular, an examination of the processes of social cognition from three separate perspectives -- socially-situated, individual design framing, socially-shared cognition, and distributed cognition -- has provided a view of design that has so far been absent from the IS literature. These three perspectives are often conflated in studies of social cognition. By treating them separately, we were able to derive insights that are not possible from the conflated view of social cognitive "framing" adopted in the IS literature.

The findings have significant implications for both the research and management of boundary-spanning design. It is impossible to draw definitive conclusions from a single case study, no matter how detailed. Further detailed studies are required: this level of detail will require substantial effort. If the findings are borne out in further studies, we need a very different management process to the decompositional process employed for IT system design. We need to focus on an inquiry into organizational problems in a much more sustained way than is currently the case. We also need to develop new models for assessing design progress, based not on the development of a "common vision" of the target system, but on the extent to which design group members share a common vision of organizational problems and the levels of trust that ensue.

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APPENDIX 1: PERSPECTIVES ON ORGANIZATIONAL CHANGE PROBLEM DEFINITION

	Start of Project
ISM	The IT system is going to manage the process of winning business from customers: - information support, to improve customer credibility and to target bid offerings - improved communication between bid team members - IT system will streamline process of making targeted offers to customers, to make the process faster and easier, with better quality bids and less input of manpower.
PIM	When the process was designed, the company did not have a Marketing Group. Now need to involve Marketing more closely. - The process has to cope with a change in business: we are now dealing with customers with whom we don't have a close relationship and so they cannot specify exactly what they want: we must do it for them. - A lot of our processes depend on personal knowledge of product and cost information. We need better sources of information, for bid preparation
CSM	We need to anticipate invitations to bid by gathering better customer intelligence. We need a system that will provide information for bid respondents to determine an appropriate strategy for the bid. This should focus on: - Product strategy (which products do we want to push, when and how?) - Customer strategy and tactics (which customers are considered strategic and how should we position offerings to this customer?) - Technical fit (what offerings are technically feasible and how should be bid products be configured?)
PEM	We need a system that: - provides the opportunity for consensus and bid ownership by groups other than Engineering - coordinates input from multiple organizational groups to prepare the bid response: technical, purchasing, operations, commercial, financial, training and quality - presents us with the information required to make a decision on whether to bid and how to pitch the bid.
BDM	The current process does not work, as the business has grown too rapidly: - We need to develop relationships with new customers and work out what they need. - We need to provide accurate cost-estimates, so we do not under- or over-bid on price (a *big* problem). - We need to track what customers have and what they are doing, so we can anticipate bids.
PMA	Core problems are a lack of wide ownership of bid processes, poor document management and tight timescales: - Process driven by engineering division. They positions product offerings inappropriately with respect to commercial marketing, so we lose business. - Bid preparation people do not have access to information required to cost bid offers appropriately. - Bid documents are not available in a form which allows them to be checked, so market positioning cannot be assessed before the bid is dispatched, there is a lot of wasted effort, duplicated work and last minute revision.
BM	The bid response process is out of control: - People agree to prepare sections of the response document and then do not deliver. - People do not have access to cost and product information, so they rely on local knowledge or make it up. - Functional group managers take people off bid response preparation to work on other things. - Everyone works for a different boss, so people don't talk to each other.
	Middle of Project
ISM	Bid response is too slow (does not satisfy Managing Director's expectations). Lack of ownership by functional managers for providing effort for bid response. Lack of planned resourcing for bids. No consistency in software applications needed to generate bid response sections (quality issue). Insufficient warning of bids. Poor information flows between people preparing sections (inconsistencies). Bid responses too mechanical - not geared to winning new business. Quality of cost estimation poor.
PIM	Inadequate resources: cannot cope with the volume of work in bid response. Focusing on volume, need to focus on quality and presentation of bids. No way of providing an appropriate response to immediate customer problems and needs (resourcing).
CSM	*Left company*

PEM	Senior management do not recognize that bid responses should affect "business as normal" if we are to win new business. Engineering group drive content of bid response (should be driven by Marketing Group). People have left, taking significant knowledge with them: we do not understand how the Marketing "front end" to bid response works, or wishes to work. Existing departmental boundaries within business lead to a "throw it [problem] over the wall" culture - little cooperation between divisions.
BDM	Most problems are external to the bid process, so we need to resolve problems at the interface: - Customer contact people do not notify Bid Manager of likely opportunities, so little notice of bids. - Cannot estimate product manufacturing and configuration costs accurately, so price estimates are wrong. - We have no idea how much the bid process itself costs, so we cannot decide whether to proceed with a bid response or not, on a rational basis.
PMA	Narrow focus on getting business - need to widen focus to include new customers, new business and new technology. Inadequate information for bid response, caused by lack of information recording in other business processes. People preparing bid response do not understand how their products are being used, so they specify inappropriate products for bid.
BM	The bid process is centered on the Bid Manager's role; it needs to be handled by the business as a whole. People do not know what is expected of them, so they all do different things to prepare a bid response. Bid response group is fragmented and uncoordinated, as they all report to different managers. Bid response is seen as 'somebody else's problem" by most managers, so difficult to meet timescales. Do not have the business and product information required to prepare bid responses.
	End of Project
ISM	People are adopting the process piecemeal - need way of ensuring standardized processes. Still little ownership of bid response - need to get sponsor (Managing Director) to achieve this. Marketing group are not committed to change - this is a show-stopper for bid response (customer intelligence-gathering component). Poorly-defined company information sources (business document contents).
PIM	No ongoing commitment to quality improvement - need a way of building process assessment into management of new system. No widespread ownership of bid response process. Process is still ill-defined: "we have to watch people doing it, to understand it".
CSM	*Left company*
PEM	People are adopting the process piecemeal - need way of ensuring standardized processes. Poorly-defined company information sources (business document contents). No widespread ownership of bid response process - this is a cultural and political problem.
BDM	No widespread ownership of bid response process - this is a cultural and political problem. No accountability in bid response process. No measurements or assessment of success in bid response process.
PMA	*Left company.*
BM	People are adopting the process piecemeal - need way of ensuring standardized processes. No widespread ownership of bid response process. Need more management commitment to assigning bid response (human) resources.

APPENDIX 2: PERSPECTIVES ON TARGET SYSTEM SOLUTION OBJECTIVES

	Start Of Project
IS	Provide an electronic document resource library to support bid response. Provide a system that will support a "virtual team". Implement a structured set of new work procedures, to allow process to be managed efficiently.
PIM	Achieve quick wins by resolving process inefficiencies and duplication of effort. Produce understanding for longer-term process management of bid response, by quality improvement team. Resolve immediate problems that affect the effectiveness of bid response, such as team management and information provision. Coordinate and manage a virtual team, working together on a bid response.
CSM	Support bid response process with improved customer intelligence. Improve effectiveness of the wider (scope) customer-interface and support function. Provide support for a virtual team, preparing different parts of a bid response.
PEM	Improving efficiency and effectiveness of business processes, especially advance warning and preparation. Devolve decision-making away from being centered on the Engineering group, to being distributed across the virtual team involved in bid response.
BDM	Improve process efficiency & effectiveness. Ensure targeted bids, tailored to customer needs. Assemble and manage a virtual team for bid response.
PMA	Devolve decision-making away from the center of the organization and creation of cross-functional 'virtual teams' to use individuals' skills effectively. Provide information for effective cost estimation, to permit pricing decisions to be made.
BM	We need to define a system that will allow control of the bid response virtual team. The new system will resolve operational problems, such as specific individuals' accountability for parts of bid response. We need to provide an information library, so can exploit historical bid information, to generate new bids.
	Middle Of Project
IS	Process effectiveness and efficiency: solve problems (adequate resourcing, consistency of process output, adequate preparation time, poor communication between participants, response at odds with business strategy, poor cost estimation) with current process, through process redefinition and formalization.
PIM	Need to find a way of managing changes in an ongoing way, as business and organization evolve .
CSM	*Left company*
PEM	Integrate bid response process with wider strategic business processes. Ensure wider ownership of bid process by management. Implement new Marketing processes to manage customer intelligence and support. Improve quality management, so QM team has power to improve the process on an ongoing basis.
BDM	Win business by widening the strategic focus of bid-process participants. Formalize/standardize the bid process, so that it becomes more "managed". Introduce more personal management into bid process, so that people are managed more effectively. Relocate bid process management in organizational structure, so that it resides across the two divisions most affected, to ensure management ownership.
PMA	Resolve serious weaknesses in related (interfacing) business processes, to support effective bid process. Integrate bid process into wider business processes, to ensure ownership and strategic direction. Provide a pool of people who are trained to respond to customer bids effectively. Improve strategic and tactical forecasting, to provide improved customer intelligence.
BM	Widen ownership of Bid response process to the "business as a whole". Increase participant commitment by formalizing assignment and tracking of work. Standardize bid response processes, so everyone does the same thing.
	End Of Project
IS	Need to implement formal customer intelligence gathering, to give notice of new bid opportunities. Incremental reorganization and change in work procedures and IT to improve process efficiency. Need for document management system, to enable bid-response components to be tracked, assembled and checked for consistency. Eventual provision of a historical database, to provide cost and other bid response information.

PIM	IT and management support for autonomous work procedures: “the business is continually shifting and moving, so our processes have to follow suit”. Provision of a document management system, to keep track of company documents. Sorting out "political" problems, such as customer intelligence. Ongoing process improvement and assessment.
CSM	*Left company*
PEM	Need to implement formal customer intelligence gathering, to give notice of new bid opportunities. Reorganization of work and the effective use of information to provide measurable gains in effectiveness. New management procedures to coordinate work across functions. More effective recording of product and customer-specific information, in company documents.
BDM	Effective IT and business support systems, especially in area of cost estimation. More personal approach to (human) resource management, with the recruitment of new staff to provide professional business management expertise and to gain commitment from the various functional managers. Up-to-date cost information and product strategy (lifecycle information) ready to hand, via electronic document library.
PMA	*Left company*
BM	Formal customer intelligence gathering, to give notice of new bid opportunities. Formalization of work-procedures to increase participant accountability for scheduling and quality of output. Information resource library, to provide historical data for cost-estimation and product configuration.

APPENDIX 3: PERSPECTIVES ON REQUIRED DESIGN PROCESS

Required design processes are defined as what needs to be done from this point on, in the design. So this framing domain represents a "gap analysis" between problems and the envisaged target system solution.

	Start Of Project
ISM	Improved process *and* IT effectiveness through achieving 'Quick wins', such as reducing bid response time or improving bid response task tracking. - Agree a common vision, then take a business process redesign approach to IS design, to achieve quick wins: - Define business processes to be supported, in detail - Define IT system information requirements (documents and other sources) - Model and decompose new processes and IT system requirements, aiming for "low-hanging fruit". - Manage ongoing sponsorship of change by the Managing Director, by keeping him in the loop.
PIM	"Looking at ways to work smarter and harder" - cutting down on bureaucracy: - Get the key players who actually do operate the process and define no more than six elements in the process, end-to-end. - Break each of these elements down into sub-elements, then draw a flow-chart or map of what actually happens. - Look for inefficiencies, process duplication and problems with the workflow. - Agree a common vision of the problems and what changes are needed for "quick win" gains.
CSM	Reconceptualize business processes, to achieve major organizational change: - redefine roles and responsibilities - define objectives and strategies of different process stages - define process mechanisms and information requirements - redesign IT system to support all of this.
PEM	Work out what we need to change, in existing organizational processes: - get agreement on the diverse definitions that people have of what needs to be changed - roll this around a bit, to argue what we can achieve in reality, that needs doing. - knock a few management heads together, so we can change the process at the interfaces.
BDM	Improve bid process effectiveness, by understanding what works in current practice. - Define information sources (company documents and repositories). - Define new processes and IT systems, to use these resources more effectively.
PMA	We need to work on radical reorganization and IT system definition: - Model new processes in detail, to understand what needs to be done. - Get buy-in from various managers, to make it all happen. - Model the IT system at a high level (the ISM's development staff will implement this) - aiming for a document repository.
BM	We are aiming for incremental improvements, mainly focusing on control of the process and efficiency. We need to define how the process happens now, as our procedures haven't kept up with business changes. We need to define an IT system to track and record the process.
	Middle Of Project
ISM	Overcome difficulties establishing a common vision, to agree a firm set of changes. Need to speed up design to meet management expectations, so work towards conformity of process and model representations. Need to establish external design groups to address process "interface" problems. Ensure commitment from design group participants.
PIM	Need to change expectation that business process design can be done part-time. Abandon concept of "quick wins" - need a longer-term strategy for process improvement, with an agreed delivery date and committed resourcing. Define clear, *short-term* goals for business process improvement, to provide direction for design process.
CSM	*Left company*

PEM	Need to move away from concept of bid response as a self-contained process, to address much more fundamental business integration issues. Change the design brief: we need to move away from political pussyfooting, towards “recommending ways of implementing change”. Need to deliver something, to improve credibility of design team. Need to define clear goals and an end-point to the design. Need to ensure that the design is implemented in full: so far, implementation of early stage design has been piecemeal, selective and inconsistent among different people.
BDM	Achieve a wider scope of design by involving a “wider constituency within the company”. Tightly define information and other elements feeding into the bid process. Need a less theoretical approach: we need a real-life Bid to observe, so we can see the process in action.
PMA	Widen focus, to consider all areas of the business. Prove that we have achieved something, so that we can aim for more radical organizational change. Widen constituency of people consulted for design process, to improve ownership and to generate more ideas.
BM	Specify a set of formalized procedures to enforce improved participation & commitment. Specify a document library, to provide information resources for bid responses.
	End Of Project
ISM	“At the end of the day, the best we can hope for is 80% success.” Need to work on cultural change: “taking people with you” - through training and dissemination of new procedures. "Obviously, this needs support from good IT systems - ones that have the right information". Investigation and definition of company information sources in more detail - delegated to IT staff.
PIM	“We have a lot more confidence about who should own what at this stage, so let's reorganize about the bits we know.” Need to "train the troops".
CSM	*Left company*
PEM	"Business process redesign means changing what people do. But to do that, we've got to change how the company produces documents, so they have the right information to do it." So need to investigate and define company information sources in more detail. Need to "train the troops" in new processes. Need to widen scope of bid response definition. Focus was too narrow, leading to missed opportunities for change.
BDM	Design process is about delegating issues to wider business groups, for *them* to expedite change. "We just provide direction - they sort it out." Need to "train the troops". Need more investigation, "to clear up outstanding issues of cost estimation, etc."
PMA	*Left company*
BM	Need a redesign of work-processes, but pragmatic about constraints on change and formalization. Need to "train the troops". Need to implement the work-tracking system, so delivery of bid response sections can be managed. This requires more investigation.