European Journal of Information Systems (2006) 15, 26–41

www.palgrave-journals.com/ejis

A genealogical study of boundary-spanning IS design

Susan Gasson[1]

[1] *College of Information Science and Technology, Drexel University, Philadelphia, PA, U.S.A.*

Correspondence:
Susan Gasson, College of Information Science and Technology, Drexel University, Philadelphia, PA, U.S.A.
Tel: +1 215 895 6398;
E-mail: sgasson@ischool.drexel.edu

Abstract
This paper presents the design of a business-aligned information system (IS) from an actor-network perspective, viewing non-human intermediaries jointly as inscriptions and boundary objects. This field study presents a situated view of IS design over time. The design process is assessed through analyzing the intersected activities of a team of seven organizational managers who were defining changes to business processes, information technology, and organizational roles and responsibilities. This view of design presents a very different view to the rational, analytical process that is usually encountered in the IS literature. Instead of an orderly progression, we see a trajectory of design definition, as the team responds to the contingencies and instrumentalities that prevail during the course of a design inquiry. These managers enacted a new reality through their interactions with external stakeholders, senior managers, specifications, procedures, business documents, and IT systems. This study provides much needed rich insights into the complexities of systems definition and negotiation, explaining the situated rationalities underlying IS design as the co-design of business and IT systems. A fifth form of boundary object is suggested by this analysis, which is based on the need to align interests across a network of actors.
European Journal of Information Systems (2006) **15,** 26–41.
doi:10.1057/palgrave.ejis.3000594

Keywords: information system design; actor-network theory; boundary objects; situated design

Introduction

In the information systems (IS) literature, IS design is typically presented as a predominantly rational process, where deviations from a hierarchical decomposition strategy are described as 'opportunistic' (Guindon, 1990; Ball & Ormerod, 1995). However, studies of IS design in context have argued that design requirements are situated, subject to local contingencies and socio-cultural norms that are not amenable to rational design approaches (Suchman, 1987; Greenbaum & Kyng, 1991). IS design and adaptation is now viewed as improvisational in much of the MIS literature, as IS professionals and stakeholders attempt to balance local conventions with global IT standards (Orlikowski, 1996; Macredie & Sandom, 1999).

This paper presents an alternative perspective of IS design: as a genealogical process that reflects the emergent negotiation of IS definitions and requirements across the boundaries between organizational interest-groups. The study reported here follows the trajectory of actions and interactions engaged in by a team of seven organizational managers involved in the co-design of business and IT systems. I draw upon theories of situated action and actor-network theory to analyze the design process

Received: 18 June 2005
Revised: 22 December 2005
Accepted: 3 January 2006

as the evolution of situated learning, to address the following research question:

> How do differing perspectives on the nature of the problem-situation and the scope of design inquiry and analysis affect the trajectory of information system design?

The format of the paper is as follows. First, I present the conceptual and theoretical basis for the study. Then I discuss the research site and method. Findings are presented, from a field study of design in context, conducted over a period of 18 months, in a midsize engineering company. A synthesis of the findings presents the actor-network trajectory that was identified and discusses its significance for how we conduct design. Finally, the wider implications for research and practice are discussed.

Conceptual basis

Competing perspectives of IS design

In the MIS literature, the term 'design' suffers from the adoption of competing and often conflicting models of the process. From the traditional perspective, the design process is intended to produce a logical model of a technical artifact (Hevner *et al*., 2004; Walls *et al*., 2004). This perspective uncritically adopts Simon's (1981) view of IS design as goal-directed, rational 'information processing'. Recent developments in methodology such as the Unified Modeling Language (UML) approach (Jacobson *et al*., 1999) formalize control over software engineering processes through modeling extant organizational structures: roles and user-interactions that start with a given form of technology applied to a given set of tasks. Software engineering approaches emphasize the separation of design and implementation, as this makes the labor process more controllable (Fowler, 2005). In the 1980s, it was discovered that prototyping frequently tended to become experimental in nature (focusing on technical stability) rather than evolutionary (focusing on stakeholder needs) (Floyd, 1984). Similarly, iterative lifecycle methods such as the rational UML approach are used predominantly to explore technical system requirements. The emergent understanding of the organizational context of design that accompanies iterative design leads to an undesirable outcome known as 'scope creep', that is carefully managed through change-control.

In real-world organizations, practitioners circumvent prescriptive recipes for action by applying IS development methods selectively and adaptively, transforming formal methods into '*methods-in-action*' (Fitzgerald *et al*., 2002). Uniquely, a practitioner-driven movement has arisen to formalize the lessons learned from many of these methods-in-action, resulting in the emergence of 'agile' methods that focus on adaptive development processes and that view requirements emergence as a desirable outcome. Adaptive systems result from the active participation and ongoing involvement of system users and other stakeholders (Beck, 1999; Schwaber, 2004; Fowler, 2005). Design and implementation are seen as two sides of an iterative process of learning, so agile methods such as Scrum are employed to wrap UML in a more adaptive, iterative process (Schwaber, 2004; Fowler, 2005). But whether traditional or adaptive methods are employed, when IS design is viewed as the production of a technical artifact, the design process focuses on how to derive a set of rules for action, to close the gap between current organizational performance and a set of consensual goals (Checkland & Holwell, 1998). The designer acts as an implicit *knowledge-broker*: a mediator between various organizational interests, negotiating and determining priorities (Boland & Day, 1989; Checkland, 1994).

IS design as situated learning within a political ecology

An alternative perspective on the design of organizational IS arises from a view that sees IS as supporting 'emergent knowledge processes' (Markus *et al*., 2002). This view requires the reconciliation of multiple, subjective, and conflicting problem definitions. Far from being ordered and analyst-centered, design from this perspective is a process of convergence between emergent problem and solution definitions that arise from multiple participants over time (Dorst & Cross, 2001; Bergman *et al*., 2002a). This requires meaningful user involvement, not just token participation. Such involvement is fraught with problems relating to power inequalities and the real *vs* token integration of user perspectives (Howcroft & Wilson, 2003; Lynch & Gregor, 2004). IS design routinely crosses political and knowledge boundaries within the organization. Any activity that affects organizational structures and boundaries is susceptible to debates concerning the legitimacy of various boundaries and perspectives (Markus & Bjorn-Andersen, 1987; Carlile, 2004). So boundary-spanning IS design lacks the predefined goals and assumptions that characterize artifact-oriented approaches. While the traditional paradigm of design focuses on the representation of a consensus, external reality, a contextually situated view reflects a local, negotiated reality based on mutual interpretations of business processes (Agerfalk & Eriksson, 2004). Situated, adaptive IS design incorporates both inquiry and closure processes. It requires the investigation and negotiation of distributed solutions to multiple, ill-defined and often partially conceived organizational goals. This results in incomplete specifications, as new organizational structures emerge through the process of design (Hooker, 2004). Learning becomes a core element of design, as IS professionals, managers, and stakeholders collectively frame and reframe partially understood organizational problems and socio-technical solutions over time (Davidson, 2002). The role of the IS analyst expands to embody an explicit *mediation of perspectives* in situated design. We move away from an individual, rational 'information processing' perspective, to see IS design as a collective, negotiated process of inquiry, situated within a specific political and social ecology (Bergman *et al*., 2002b).

Situated IS design as a trajectory of interactions

I resolve apparent differences between the two perspectives of design presented above by viewing design as the mediation of a knowledge ecology, where knowledge is embedded in the interactions between the various social groups that make up the organization (Bowker & Star, 1999). The nature of problem-definition and the legitimacy of certain types of problem-translation are defined by the socio-cultural norms of a local group (Lave & Wenger, 1991). Situated design involves a translation from the local to the global. The production and translation of socio-cultural norms that result in the alignment of diverse interests during the processes of design may be analyzed using actor-network theory (Latour, 1987). Actor-network theory recognizes the relationship between human and non-human mechanisms in the construction of socio-technical reality. Designers *inscribe* their interests into technical artifacts in ways that defines the role and use of these artifacts (Akrich, 1992). Technical artifacts, 'facts' and 'knowledge' may thus be seen as the end product of multiple processes of *translation* which occur over time as actors offer new interpretations of others' interests and channel people in different directions to serve their own interest. The processes of translation are mediated by non-human intermediaries or inscriptions that stabilize the meaning of artifacts and processes (Callon, 1986b; Latour, 1987; Star, 1992).

During IS design, the future meaning of work is translated by one group of organizational actors into the artifacts and inscriptions that they produce, to align the interests of other groups with their own interests. This translation of interests is often done unreflectively, without the intent to constrain the meaning of work for others (Akrich, 1992). For example, by defining 'best practice' in an organizational procedures manual, the interests of specific managers in having work performed in a certain way are translated into the procedures that people must follow in doing their work. The procedures manual circumscribes organizational work to the point that it becomes an 'immutable mobile' or an 'investment in form' (Latour, 1987; Star, 1992) – something that shapes definitions of work ways by providing an exemplar for future directions. By viewing a mediating artifact as an inscription of human interests, we may understand how power and influence are transferred or translated between organizational groups by means of networks of human and non-human actors (Latour, 1987; Callon, 1991; Law & Callon, 1992).

Intermediaries in an actor-network may also be viewed as boundary objects (Star, 1989):

> 'Such objects have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation.' (Bowker & Star, 1999, p. 297)

The design of IS to support emergent knowledge processes requires the integration into business processes of work-resources such as documents, representational-models, procedures and forms, and ISs. Such resources act as boundary-objects in an information ecology, mediating collaboration between organizational groups (Bowker & Star, 1999). Star (1989) proposed a taxonomy of boundary object types: (i) *repositories* permit differences in the unit of analysis used by different groups; (ii) *standardized forms, methods, and procedures* provide a shared format for solving problems across functions; (iii) *models* provide an abstraction that works for all knowledge domains; and (iv) *maps* provide common boundaries of analysis while permitting different internal contents. Carlile (2002) employed these categories to demonstrate different forms of knowledge exchange at the boundary between communities of practice. He argues that (i) *repositories* demonstrate an assumption that people understand meanings in the same way across the boundary; (ii) *standardized forms, methods, and procedures* demonstrate the need for a shared method to enforce a shared view of knowledge across the boundary; and (iii/iv) *models and maps* demonstrate the understanding that diverse perspectives across the boundary require negotiation and synthesis. An analysis of the mediating artifacts used in translation, in their role as boundary objects, permits an understanding of how collaborators view the knowledge-transfer problem at the boundary between organizational groups (Carlile, 2002).

IS design is accomplished through a *trajectory* of human interactions that is mediated and stabilized by non-human intermediaries such as documents, technology artifacts, or formal procedures. Design may be thus viewed as a sequence of states that represent stability and consensus on the meaning of an artifact for the local system of actors, work and technology (Hughes, 1987). Applying both theories – the translation of specific interests that is mediated by non-human intermediaries/inscriptions and the boundary-spanning knowledge-transfer that is mediated by boundary objects – permits us to understand the evolution of knowledge-transfer and influence that underlies a situated, boundary-spanning IS design process.

Research site and method

The subject of this research was the co-design of business and IT systems for the customer bid response process at NTEL Ltd,[1] a mid-sized engineering firm in the U.K. This situation was not only an excellent example of an emergent knowledge process (Markus *et al.*, 2002) but also combined IS and business process change design at an enterprise level to focus on design as a knowledge-ecology. NTEL specialized in the design, manufacture and sale of routing and switching systems to the telecommunications industry. The company traditionally dealt with a small number of large customers, but this situation was

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

rapidly changing as their market became more global and competitive. 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. NTEL felt that they were losing business to competitors because of poor responses to customer invitations to bid for new business. A potential customer would invite 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 group of people, assembled on an *ad hoc* basis from the main areas of the business. Functional delegates would work on individual sections of the Bid response document for a few days or weeks (depending upon customer deadlines) until it was ready to be dispatched.

The study followed the team activities of business process redesign and IT system definition over a period of 18 months, from the design conception, through inquiry and analysis, through several pilot studies, to the point at which the process changes and IT system changes were due to be implemented as an operational system. Research design emphasized an interpretive, naturalistic inquiry (Lincoln & Guba, 1985). Data were collected through an interpretive, ethnographic field study conducted via interrupted field observations (Van Maanen, 1988). I attended and documented, but was not an active participant in, design group meetings. Data collection and analysis activities are summarized in Table 1. The design of the study permitted comparison of data samples across time (Barley, 1990; Pettigrew, 1990). This provided an analysis of the design trajectory by identifying episodes of stability and consensus, where common themes of discourse were treated in the same way over a period of time (Hughes, 1987; Newman & Robey, 1992). The unit of analysis was the local actor-network perpetuated by the process of design.

The qualitative analysis focused on the way in which the local actor-network was formed and re-formed by the interests of other actors within the organization and the role played by artifacts produced during the design process. Artifacts were identified based on a language-action perspective of work as a knowledge culture: these included both material artifacts such as computer systems or documents, and symbolic artifacts such as metaphors and work-procedures (Knorr Cetina, 1999). Artifacts were analyzed in their dual roles: as constituents of an actor-network that mediated the design process (Latour, 1987; Law & Callon, 1992), and as boundary objects that served the sharing or translation of knowledge across various organizational groups (Star, 1989; Carlile, 2002).

Research findings

The design process was analyzed as six distinct episodes of team equilibrium (Newman & Robey, 1992), punctuated by rapid, brief disruptions during which the design goals were radically redefined. This was very different to the continuous stages of design that the teams were expecting. The six analytical episodes are compared to the predicted process stages in Figure 1a. Predicted stages were defined around planned stages of the life cycle (waterfall) model, whereas analytical episodes reflect major changes in IS design definition.

Episode 0: antecedent conditions to project

A previous management taskforce had examined the need for business process innovation at NTEL. They had failed to reach consensus on detailed recommendations for change and had been disbanded after a few weeks. The failure was viewed as due to a lack of clear business process improvement methods, by which detailed change recommendations might be analyzed. So this initiative combined business process change with IS definition and design, in an attempt to produce a 'structured' (guided) approach to the co-design of business and IT systems. The change project had the personal sponsorship of the Managing Director, aiming to explore ways of integrating business process redesign with ISs definition. A company organization chart is given in Figure 1b, with design team participants shown in bold.

The project design team was assembled by the IS Manager, who had been involved in the previous 'business process redesign' initiative and had retained three of the previous team-members for this project. By defining the scope of a new IS for responding to Bid invitations as relatively 'stand-alone', the IS Manager delineated a clear system boundary, which coincided with the boundary for the Bid-response group in the

Table 1 Data collection summary

Data collection event	*No./Freq.*	*Objective*
Design meetings	25 × 2–3 h meetings over 15 months	Attended approx. 50% of design meetings, to observe group processes of design and capture design representations
Management reporting meetings	5 × 1–2 h meetings	Observed formal reporting to senior management+organizational constraints
Ad hoc interviews	Weekly	Discussions with group members concerning events between meetings
Design documents and models	As issued	Analyze evolution of designed technology and business process products, and inscriptions
Follow-up interviews in person, by phone and email	Monthly, for 3 months after project	Follow-up on design implementation with various team members

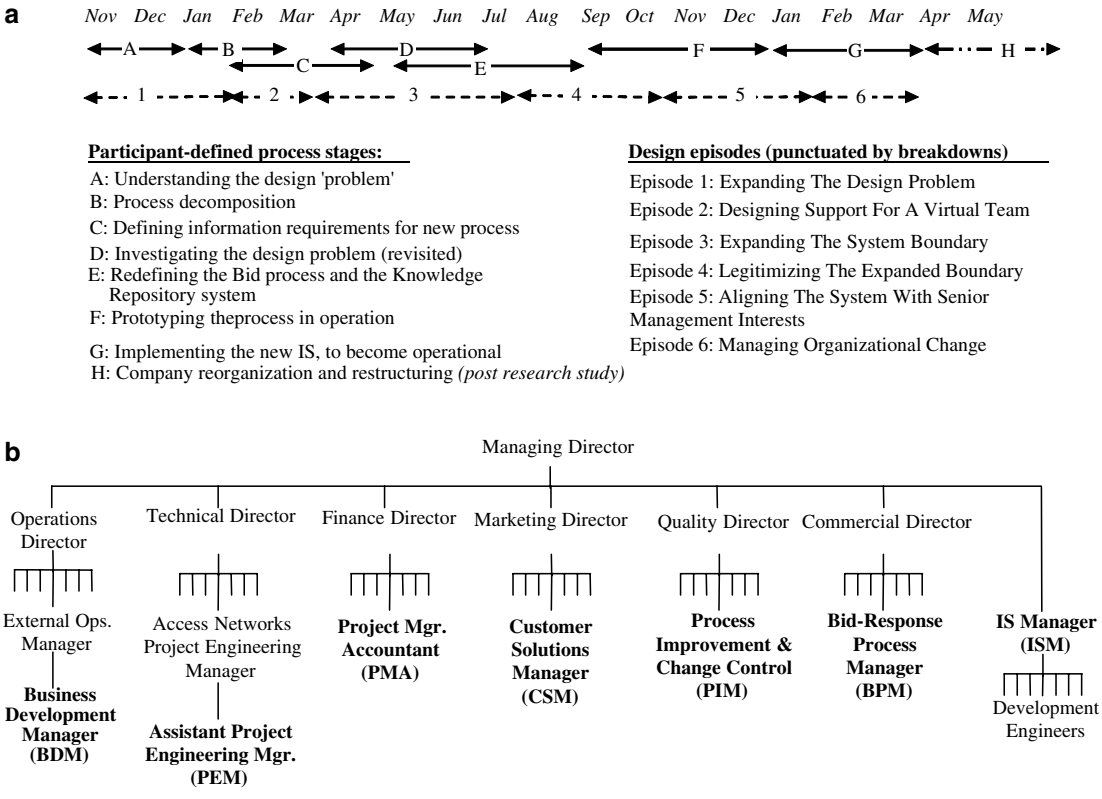

Figure 1 (a) Participant-defined stages of design *vs* transitional episodes. (b) Design team membership.

current organizational structure. He selected 'appropriate' and 'willing' people to fill the remaining places in the new design team. The IS Manager intentionally sought to constitute a network to every part of the organization. Through his selection of influential team-members, he had indirect access to every member of senior management (the company board of directors). The initial design network is shown in Figure 2, where dotted lines indicate reporting structures and solid lines indicate members of the design team reporting to the IS Manager.

Network relationships were intended to be bidirectional. Design team-members were briefed to consult with external stakeholders from their division to bring issues and design criteria to the attention of the design team. They were also asked to report back to their divisions on the IS design, to 'sell' the team's vision to a wider audience on an ongoing basis.

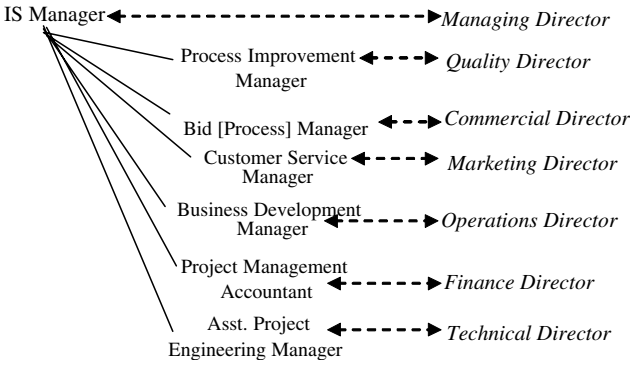

Figure 2 Design network at the start of project.

Episode 1: expanding the design 'problem'

The team brainstormed a list of tasks that the new process must contain and categorized these into a set of six high-level process stages. The team defined their goal as designing an *Electronic Document Library* to support a new bid process, redefined through business process redesign. This concept provided a unifying way of viewing the problem as support for autonomous decision-making. The team agreed that they preferred this to a formal, control-oriented solution as they wanted to avoid 'this big snake that goes through the organization', emphasizing individual autonomy. The IS Manager was well aware of the importance of the social network for political acceptance. He stated that 'we are looking to them [design team-members] to represent their peers and their bosses and that implies that they should be using them as sounding boards for the ideas and thinking that they'd bring to the meeting and that which they take away'. His active advocacy of the concept had the desired effect. Team-members began to view themselves as champions of the design within their functional groups, as well as representatives of those groups within the design team.

While the initial design objectives perceived by various team-members differed radically and were also substantially vague, the IS Manager perceived the design problem as relatively certain and well-bounded. He issued a memo to organizational managers, defining target system design goals as (i) ensuring the effective use of manpower and IT resources and (ii) achieving optimum use of electronic systems. This statement of design objectives embodied the personal objectives of the IS Manager in making the IS function central to business process redesign and represented the project to the company as a whole as formalizing Bid-response business processes using IT. The design team did not seem to see any conflict of interests: this memo provided a common focus for discussion and also served as a secondary network-strengthening mechanism, as shown in Figure 3. The double lines indicate network connections enabled through a non-human actor (in this case the statement of design objectives) and the arrow indicates influence to achieve the adoption of that person's perspective of (interest in) the design. Thus, Figure 3 illustrates two parallel networks of influence: interpersonal and mediated by the statement of design objectives.

Individual perspectives on IS goals differed radically between team-members. These appeared to stem from individuals' work-backgrounds:

> The Customer Solutions Manager comes at it from a reasonably broad experience in industry. How the heck he packs his understanding of the way business ticks in his young head, I have no idea … I've constantly underestimated his capacity to contribute, but I've seen him very much as a pragmatist, speaking from experience and a practical understanding of the way things tick, with a very high degree of vision.
> I expected the Bid Manager to be a lot more open minded and to demonstrate a lot more vision than he has. He has turned out through this exercise to be extremely protective of the status quo, because he manages this stuff … and I think, really, the only conflicts that come out within the group were because of his protectivism. (*IS Manager, commenting on team members' participation in design*)

The IS and Process Improvement Managers jointly led the design team, so their interests might have been expected to be aligned. They both saw the design process as one in which a joint business process and IT system design approach might be developed. But the IS Manager was interested in specifying the information flows and formal procedures that would form the basis for a new IT system, and so he wished to reduce the design scope through decomposition. The Process Improvement Manager had an interest in making business processes more effective, examining how problems arose, where there was duplication of effort, and where essential tasks were not being performed, so he wished to widen the scope through examining integration between business processes. The two perspectives were antagonistic to each other, although the two actors did not realize this and spoke as if they shared a common interest. However, while the Process Improvement Manager saw the design process as starting with process investigation, the IS Manager saw this as unnecessary as he viewed the bid process as relatively well-defined. As he could claim extensive design expertise, he was able to define the *meaning* of design for other team-members of the design group as 'starting with a blank sheet of paper':

> 'Never mind what the current process is, identify shortcomings and identify what functions you need in a process. Then, with a clear view of shortcomings and a clear view of functions needed, you design a new process.' *(IS Manager's definition of the required design process)*

Towards the end of this episode, the design team prepared a joint presentation to the Managing Director and the Board (senior management). They derived a top-level model for the design, defining the target system as consisting of 'six, sequential stages'. Their management presentation concentrated upon a single design problem, which was a subset of the multiple objectives published initially by the IS Manager. This goal was to formalize the work-process, in order to make its participants easier for the manager of the process to control.

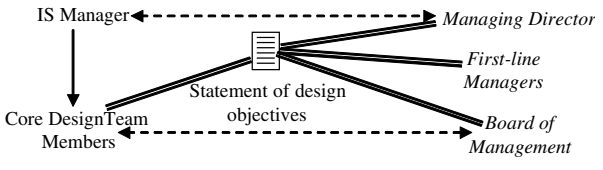

Figure 3 Effect of the statement of design objectives.

Episode 2: designing IS support for a virtual team

The team obtained permission from the Board to continue with the design. In developing the design, they redefined their design goal as providing support for a *Virtual Team* of staff from multiple divisions engaged in the preparation of a bid response document. This goal was based on the interests of the Bid Manager, who had an urgent problem with resourcing the current process. He competed for (human) resources against other functional managers, but his position in the organization was not sufficiently senior to command resources when required. It was clear that the design team did not understand the target system sufficiently well to be able to design more complex objectives and so was susceptible to the one person who did have the expertise to define the design 'problem': the manager of the current bid response process. 'Virtual Team support' was therefore translated into a need for management control of human resource allocation and reporting. The work of the virtual team would be coordinated and controlled by information technology. In this way, a secondary, potential actor-network (indicated by dotted, double lines in the diagram) was created, through which the design team influenced the actions of potential IS users, as shown in Figure 4.

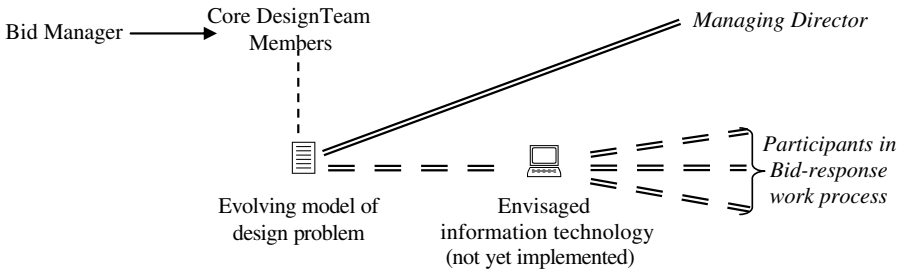

Figure 4 Direct and indirect actor-networks established by new design goal definition.

By defining the design goal as formalizing virtual team coordination and control, the team constrained the scope of the design process and raised the expectation in Senior Managers that the design would be relatively simple and deliver 'quick wins' through process automation. As a consequence, elements of the design that required radical organizational change were difficult to sell to Senior Managers, when the design team attempted to incorporate these later.

Both the design process and the representational forms employed for modeling resulted from improvisation. The IS Manager anticipated that defining organizational roles and responsibilities would result in conflict and competition at board level, with himself caught in the middle. His process 'recipe' (derived from an executive training course) was based on a hierarchical decomposition approach. Work-processes should be redefined in detail before organizational responsibilities were allocated. But other design team-members found difficulty in working at this level of abstraction and attempted to understand processes by defining who would do what and how. The IS Manager referred to this phenomenon as 'the specter of organization' and actively discouraged it – although he himself employed this approach on more than one occasion. Initially, the IS Manager had suggested computer-program process flowcharts to model business processes, as they represented 'the flow of activities, which help me to see the flow of information'. These proved ineffective for capturing the detail of the design, so team-members began to adapt a variety of representational techniques: 'plans' (a list of activities and interdependencies), information-flow diagrams, Pareto charts, and others. The flowcharts confused team-members as they represented flows of activity, but little else from what the Project Engineering Manager referred to as 'the morass of complexity that we need to explore'. He argued that their interest lay in learning how the information-flows affected process interdependencies, but the IS Manager wanted to focus on decomposing the design. The IS Manager therefore standardized the team's modeling techniques by introducing a new procedure: models other than flowcharts needed to be 'translated to flowchart representations'. The IS Manager saw the central problem of design as 'achieving and maintaining a shared vision'. As he was the only member of the team with IS design expertise, he was able to influence the choice of methods over the claims of the Project Engineering Manager, whose experience lay in product design. But in doing so, he constrained the effectiveness of the design process, by losing the richness, detail and variety of the representations needed to capture the design rationale at a time when the design team was focused on complex problem-investigation. A great deal of information was lost in translation: many issues had to be revisited, because the rationale behind the design had not been captured at the time when the initial decisions were made.

Team-members were under pressure from their functional managers to complete the design and were becoming increasingly confused by the complexity of the organizational processes that they were modeling. Then the team's marketing representative left the company. This severely impacted the extended actor network – in particular the degree to which the local network of design team-members could attach the global network of influential decision-makers.

Episode 3: expanding the system boundary

The team's input from and influence upon the Marketing division was now indirect, via the Managing Director to Marketing staff, through the organizational structure of the company, as shown in Figure 5 (dotted lines indicate organizational reporting structures; solid lines indicate the local network of the design-team). This created problems. There were emerging interdependencies between the bid response process and several strategic planning or customer intelligence-gathering processes performed by Marketing Division staff. But the initial statement of scope defined the bid-response process as external to, and separate from, the Marketing function. An implicit system boundary emerged, which guided design discussions, but was considered illegitimate for the purpose of formal design models and documents.

Because it remained implicit, the implications of the expanding system boundary were slow to be realized. For effective design of the Bid response system, the design team needed to understand many business processes, which lay outside of the explicit system boundary. There was a great deal of confusion, as team-members wrestled with these processes, seeing them as 'interfaces' to the design, but at the same time needing to redefine these processes. Eventually, the Project Engineering Manager

Figure 5 Local and global actor-networks following departure of marketing representative.

suggested that they had the power to redefine Marketing processes by redefining the documents produced by these processes:

> 'After all, you're the IS Manager. You're in charge of all the business document archives in the company. If you define what should be in a document, I can't see how anyone can disagree – provided the Managing Director backs you up!' *[Project Engineering Manager]*

This caused the IS Manager to come up with a conceptual resolution to the confusion. He originated the 'big-arrow/little-arrow' analogy, where strategic business-planning systems were seen as a 'big arrow', representing a product lifecycle, with a parallel set of two 'little arrow' lifecycles: the Bid response process that defined customer needs in terms of specific product configurations, and the order fulfillment process that satisfied these configurations. These systems were seen as interrelated, with information and activity interdependencies. The IS Manager legitimized the implicit system boundary within the local network of the design team, but did not attempt to formalize this legitimation through the global network of senior managers.

Team-members began to feel that the design was making progress, and they convinced functional-group colleagues that the new process would have a positive affect on their work. A pilot study of the designed processes defined so far (stages 2–4 of the six-stage process model had been defined in part) was a success. This increased the global visibility of the team's achievements and had the secondary effect of providing a fresh focus around which the local network of the design team could be mobilized. Global network attachment increased, as senior managers anticipated that the project would deliver substantial benefits.

Episode 4: legitimizing the expanded system boundary

Following the pilot study, the design problem began to seem less clear. Resisting and change to an area that he had only taken over a few months previously, the Marketing Director used the initial project scope definition memo as an excuse to constrain the design scope. He refused to replace the marketing representative on the team, to supply them with information, or to provide access to his staff. The only access which the team had to Marketing processes was to the company documents produced as output from these processes. The team spent many hours attempting to understand – at second hand – actual and potential information-flows within the company, based on these documents. The design now took on the nature of a spy novel. People would slip into the room, pass across a buff envelope with the words 'I have something you may be interested in' and then depart. Marketing managers were invited to talk with the design team on days when the Director was absent on business trips. A hidden network of middle managers appeared to be cooperating without their Director's approval, to extend the local network of the design team. The project design goal was redefined as gathering business intelligence. Eventually, the Managing Director exerted pressure on the Marketing Director to meet with the design team to discuss Marketing processes for customer intelligence gathering.

Less visibility was given to the design of the supporting IT system. Decisions concerning what type of information should be delivered and the technology mechanisms required to support information delivery were open to frequent debate. But the implementation of the system – the form which this technology would take and the way in which it would be used – was not discussed at all in team meetings. The IS Manager was delegated to define how IT should be used because other team-members were much less technically literate. He used this influence to subvert some team decisions: formalizing elements of the process that the team had decided not to formalize, or changing system information-gathering requirements where he felt these were inappropriate. So the IS manager was able to bypass the design team when the system was implemented, establishing an alternate network of influence, as illustrated in Figure 6.

Episode 5: aligning the system with senior management interests

There was increasing pressure from the global network of senior managers to bring the design to a conclusion. But as the team progressed towards more detailed design, they produced too much information to be captured on a flowchart. Team-members adapted an increasing variety of representations to supplement process flowcharts,

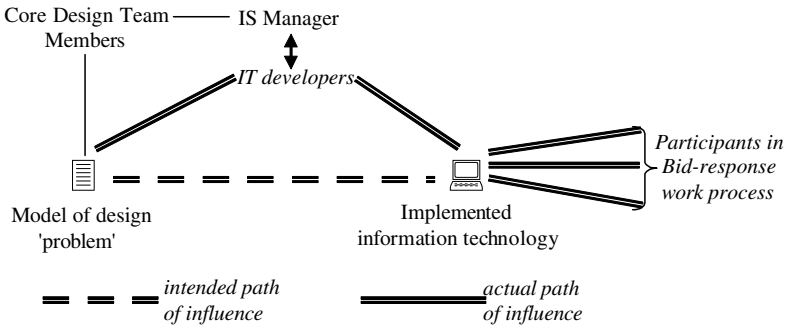

Figure 6 Direct and indirect actor-networks in technology implementation.

which the IS Manager, who argued that he wanted to establish a common language for the design, often misunderstood. The IS Manager introduced written process-specifications, as the 'standard' method of design representation. He saw functional specification as a fast way of moving towards system implementation through defining what team-members already knew about the design, without wasting time on new knowledge discovery. He wished to use these specifications as the basis for work-procedure training and management. The IS Manager's recommendation was adopted because of his experience in managing IS design projects. This view was helped by external pressures on the design team to complete. Global attachment to the design project was again declining, as senior managers disassociated themselves with the lack of progress. Team-members became demotivated and the Project Engineering Manager complained that team motivation was not helped by the 'legalistic' approach of functional specifications. This view was echoed by the Bid Manager, who argued that 'we need to understand the process before we write the words'.

Although written specifications provided a common language for process redesign, they did not provide a mechanism to inspire learning or capture design rationale. All team-members used a variety of visual mechanisms for this purpose, although they obviously felt constrained by the need to translate these into functional specifications that lost the richness of understanding. Several team-members commented that they found it difficult to remember, from meeting to meeting, what the functional process specification wording meant.

But the pressure on the design team from the global network overrode all other concerns. The Marketing Director now lobbied the Managing Director about the over-formalization of business processes. The Managing Director expressed concern when he realized that he was expected to record his own agreements with customers by using the IT system. So the global network once more became detached from the project, with senior managers muttering that the system had 'gone too far'. This caused a loss of morale – and a wish to dissociate themselves from the ire of senior management – among the local team of managers involved in the design. The IS Manager defined eleven design objectives, seven of which were to mobilize global support for changes to the gray area of design legitimacy between the formal and informal system boundaries.

Another process improvisation occurred: a pilot study was scheduled, not to test the design, but to investigate the problem further. The Process Improvement Manager commented 'we don't have to understand it – we understand it in detail through piloting it.' The pilot study became another mechanism for managing internal expectations: the team did not have to worry that they did not understand the design, as this would be solved by the learning that resulted from the pilot study. The team focused on documenting what they understood of the new system, rather than designing it, because the written specification format constrained their ability to innovate. As a consequence, the IS Manager lost the 'common vision' which he was trying to achieve.

The IS Manager attempted to increase global network attachment by increasing senior management confidence that the team were confident enough in their design to pilot it. The design goal was redefined for external consumption (and morale boosting) as 'getting the design into business as usual'. The team decided to pilot the stage 1 sub-system (which required changes to intelligence-gathering processes in Marketing). The pilot study was successful because members of the local network were able to mobilize support among the people who performed these processes. This had the desired effect. At a meeting with the Managing Director, it was agreed that the new stage 1 process would become 'business as usual'. The agreement formalized the procedures for gathering business intelligence that the Marketing Director had been resisting for so long, shown in Figure 7.

This was an irony that did not escape the team, who commented that the Managing Director had not realized what he was agreeing to. But now the need for design closure became critical to keeping the global network of influential decision-makers satisfied.

The Bid Manager was now able to influence design decisions disproportionately. Team-members depended increasingly on the knowledge of other team-members to provide process specifications, as shared understanding

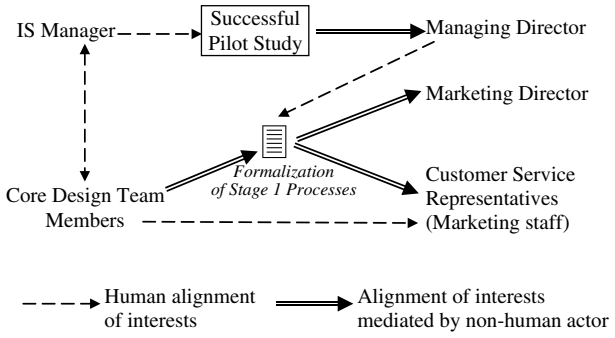

Figure 7 Alignment of interests as managing director accepts stage 1 process design.

of the design context was proving so difficult. The Bid Manager could argue for a course of action based upon his knowledge of existing system mechanisms without providing other team-members with any evidence. The design converged on incremental improvements within the existing process-boundary, as team-members failed to understand systems of activity throughout the expanded process and system boundary. Changes external to the formal boundary were relegated to future versions of the IS. Design meetings became less frequent and less well attended. When the second pilot study took place, the Bid manager 'was left holding the baby'. So the team had difficulty in deciding what, if anything had been learned from the study, or even whether it had succeeded in its aim of making the Bid response process more effective.

Episode 6: managing organizational change

Team-members felt personally liable for the project's success or failure – the high profile of the initiative and the large amount of time which it had taken meant that individuals felt their credibility in the company depended upon the project being seen as a success, as well as identifying with the team objectives through local network attachment. They felt that they needed to attach the global network of influential decision-makers to a greater extent. The local network mobilized again: team-members spent weeks attempting to define benefits that had resulted from the project and built a much more shared vision of the design through this process, which they presented to the Managing Director and senior company management.

The resulting actor-network is shown in Figure 8. An interesting issue was how the global network attachment was constrained by the initial statement of objectives: benefits were couched in terms of quantifiable efficiency gains (which could be considered 'wins', if not quick) rather than the less tangible, effectiveness gains that the team felt they had achieved. The IS Manager also sought to attach the wider global network through a program of training. Several design meetings were spent in discussions of how to 'train the troops', which became the new design goal. This enabled the team to mobilize a wider, informal global network of trained participants. The Marketing division remained outside of this network, as the Marketing Director appeared to have instructed them not to become involved with the initiative. One of the critical tasks towards the end of the project was exerting indirect influence upon the Marketing Director, via the informal actor-network constituted by shared reporting structures, as both the Marketing Director and the IS Manager reported to the Managing Director.

Information requirements for the IT system had been discussed from time to time in design meetings, but the team continued to consider it the responsibility of the IS Manager to translate these requirements into a suitable form. Team-members appeared daunted by having to deal with a technology, which they did not understand and felt confident that the IS Manager represented their interests in implementing the technology. Use of the prototype IT system had already become 'business as usual' in many areas of the organization and the team wanted to gain some credit for this, at the same time that they declined to learn about technological alternatives. Given the complexity of the design, it is unsurprising that non-technical team-members were happy to leave technology decisions to IT professionals.

Episode 7: post-study implementation

By the end of the project, the team had achieved a high degree of global network attachment and a reasonable degree of local network mobilization once more. Design closure was achieved through another accommodation of global network interests. The design team defined a division of labor that permitted each team member to implement that part of the design that he understood, while retaining informal team responsibility for evolving the design to include the more radical organizational changes that had been constrained by the original system definition memo. The critical task facing the design team appeared to be to lobby senior management for changes to Marketing systems. This lobbying, combined with a general perception that the company might lose potential business, triggered a radical reorganization of the company's structures. The company was described as 'more responsive and effective'. Several of the more radical work-process changes had been implemented in 'a secondary system delivery rollout'. A business improvement program is continuing, based on the design project approach developed by this team, so the strategy of focusing on global network attachment obviously succeeded.

The IS Manager recognized that representational methods did not support the activities of design and was searching for a computer-based representational tool to capture richer amounts of design rationale and detail at multiple levels of decomposition. Design-team members were positive about the design outcome, with the reflection that they should have spent more time investigating the design requirements and less time trying to capture them in writing.

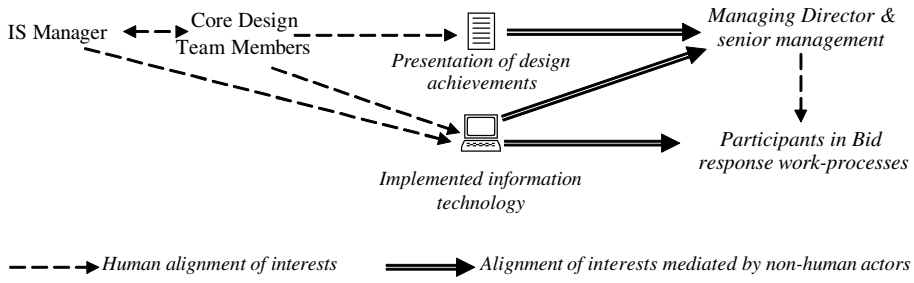

Figure 8 Attaching the global network through a definition of design benefits.

Discussion and synthesis

A trajectory of boundary-spanning IS design

Table 2 summarizes the main translations discussed in each design episode above.[2]

In many of these translations, meaning is framed by a single actor for other actors whose interests are represented or appropriated. The IS Manager was able to exert influence over the processes of design, not by exerting 'position power' (Etzioni, 1961), but largely by managing meaning for other actors in the process (Smircich & Morgan, 1982). Markus and Bjorn-Andersen describe how IT professionals typically wield *conceptual* power by forming others' expectations of what technology can do (Markus & Bjorn-Andersen, 1987). Other design stakeholders were also powerful in different ways. The Project Engineering Manager was able to exert conceptual power, managing meaning for other participants by mobilizing his extensive understanding of how strategic business processes worked, combined with an in-depth design expertise in different knowledge domains. But the IS Manager could always trump this, as he controlled the definition of legitimate design procedures and scope. The Marketing Director was able to exert position power in denying access to the resources required for design. The Bid Process Manager was able to leverage his knowledge of the existing process: this allowed him to define what the process should be when team-members ran out of time to investigate it further. It is significant that the two financial managers – the Project Management Accountant and the Business Development Manager, exerted much less influence than one would expect. This may be because of the 'symmetry of ignorance' (Rittel, 1972) among teams faced with a new type of problem. These actors possessed less expertise that could be adapted to a novel design process.

Two findings stand out. Firstly, symbolic artifacts such as metaphors tended to be used to standardize a process-form at the boundary between group community disciplines. For example, avoiding 'the specter of organization' became a boundary object that standardized the design rules of behavior across team-members with various degrees of prior exposure to IS design. Secondly, an analysis of the role of boundary objects as inscriptions in design has revealed a fifth type of boundary object, in addition to the four types defined by Star (1989). This is the definition of group membership, through which the interests of achieving ownership, or the alignment of others' interests with your own, may be achieved.

Carlile (2002) explains in detail how various form of boundary object negotiate the problems of knowledge-sharing at the boundary. This analysis has revealed a much more detailed perspective, which sheds light on how specific forms of boundary object that work at multiple levels of abstraction may be used to either hide the intention of an action (as is the case for several of the *map*-objects identified in Table 2), or to delineate and enforce collaboration across the boundary (as is the case for several of the *map*-objects identified in Table 1). It is interesting that when intentionality is taken into account, maps and models do not present the same opportunities for knowledge-translation, as Carlile (2002) supposes. Boundary objects also appear to operate at different levels to align or fragment the interests of the local network. Periodic goal redefinitions acted as inscriptions: boundary objects that mobilized the local network in an alignment of interests. But the periodic redefinition of design methods appeared to have fragmented this alignment. The design methods suggested by the IS Manager appear to have acted as investments in form (Star, 1989) that persisted long after they had been proved counter-productive – largely because they translated the process control interests of the manager in charge of the design-team.

Latour (1991) comments that any Actor-Network narrative should account for 'the progressive passage from the microscopic to the macroscopic', that is, account for the social structures that influence the course of local history. To attempt this account, the political trajectory of the NTEL design project is illustrated in Figure 9. The relative success and failure of a project is determined by the degree of control exerted by that

[2]In Table 2, the key to the 'actor' abbreviations in the translation of interests column is: *ISM* – IS Manager; *BPM* – Bid Process Manager; PEM – Project Engineering Manager; MD – Marketing Director; *Team* – members of the core design team, acting in concert; *IS Dept.* – technical developers working under the IS Manager.

Table 2 Significant translations of the design process at NTEL

Episode	*Inscription/boundary object*	*Translation of interests*	*Boundary object role*
0	Selection of problem boundary as coincident with current functional boundary	ISM: Attach global network of senior and middle managers by defining clear scope of impact	*Map:* Define boundary of collaborative scope
0	Selection of broad membership for design team	ISM: Achieving cross-departmental representation, by attaching global network to project team	*Membership:* Achieve boundary-spanning ownership of ideas
1	Memo: statement of design objectives	ISM: Alignment of interest in political visibility and appearance of control with interest of senior management in achieving a set of 'quick wins'	*Model:* Provide an abstraction that works for all knowledge domains
1	Six-stage process model	ISM: Formalize design deliverables	*Model:* Provide an abstraction that works for all knowledge domains
1	Defining design goal as designing an electronic document library	ISM: Associate business process goals with IT system goals	*Repository:* Permit differences in unit of analysis used by different groups
1	Defining design philosophy	ISM *vs* PIM: Definition of design as 'starting with a blank sheet of paper' *vs* definition of design as problem investigation	*Standardized forms and procedures:* Enforce common work practices across boundaries
1	Presentation to Managing Director	BPM and ISM: Formalize the designed work-process, in order to make it easier to control	*Standardized forms and procedures:* Enforce common work practices across boundaries
2	Defining design goal as providing Virtual Team support was therefore	BPM: Fulfill the need for management control of human resource allocation and reporting	*Standardized forms and procedures:* Enforce common work practices across boundaries
2	Avoiding 'the specter of organization'	ISM: Definition of design scope, by excluding political & structural design issues from discussion	*Standardized forms and procedures:* Enforce common work practices across boundaries
2	Standardizing design representations to use process flowcharts	ISM: Formalize the local work-process, to establish a common vision and to make it easy to translate to computer system design	*Standardized forms and procedures:* Enforce common work practices across boundaries
3	Defining coexistent implicit and explicit system boundaries	Team: Resolve conflicts between legitimate design scope and required scope of inquiry	*Model:* Provide an abstraction that works for all knowledge domains
3	Redefinition of Marketing processes via document definition	Team: Gain access to knowledge that lies outside the legitimate scope, while retaining global network support	*Model:* Provide an abstraction that works for all knowledge domains
3	Defining design goal as big arrow-little arrow process design	ISM: Align the local network (design team) around a unifying concept	*Map:* Define boundary of collaborative scope
4	Specification of two systems: explicit and implicit processes	Team: Proceed with inquiry while appearing to proceed with design closure (attach global network)	*Model:* Provide an abstraction that works for all knowledge domains
4	Defining design goal as gathering business intelligence	ISM: Align the local network (design team) around a unifying concept	*Map:* Define boundary of collaborative scope
4	Refusal to accept legitimacy of emergent design scope	MD: Attach global network support by mobilizing significance of original design scope specification	*Map:* Define boundary of collaborative scope
4	Redefinition of documents produced as output by Marketing	Team: Achieve Marketing business process changes without actually needing to redefine processes	*Model:* Provide an abstraction that works for all knowledge domains
4	IT system definition	ISM and IS Dept.: Determine formal information processing needs without interference from local network	*Model:* Provide an abstraction that works for all knowledge domains
5	Adoption of written process specifications	ISM: Formalize the local work-process, to establish a common vision and to make it easy to translate to computer system design	*Standardized forms and procedures:* Enforce common work practices across boundaries
5	Defining design goal as getting the design into 'business as usual'	ISM: align the local network (design team) around a unifying concept and reattach the global network by promise of design closure	*Model:* Provide an abstraction that works for all knowledge domains
5	Managing Director agrees that stage 1 process will become 'business as usual'	Team: Attach global network of support to indirect control of Marketing processes, by redefining document-outputs	*Standardized forms and procedures:* Enforce common work practices across boundaries

Table 2 Continued

Episode	*Inscription/boundary object*	*Translation of interests*	*Boundary object role*
5	Pilot study	Team: Reattach global network by maintaining external visibility	*Model:* Provide an abstraction that works for all knowledge domains
5	Defining processes based on current work procedures	BPM: Attach local network to status quo, rather than submit to change	*Standardized forms and procedures:* Enforce common work practices across boundaries
6	Presentation of design achievements to Managing Director & senior mgt	Team: Attach global network by making achievements visible	*Membership:* Achieve boundary-spanning ownership of ideas
6	Defining design benefits in terms of quantifiable efficiency gains	Team: Attach global network by aligning interests with production of 'quick wins'	*Membership:* Achieve boundary-spanning ownership of ideas
6	Defining design goal as 'train the troops'	Team: Attach wider global network through education	*Membership:* Achieve boundary-spanning ownership of ideas
7	Division of labor to complete design	Team: Attach global network through alignment of interests with senior management need for closure	*Membership:* Achieve boundary-spanning ownership of ideas
7	Defining work procedures for 'a secondary system delivery roll-out'	Team & ISM: Align local network interests in radical change with global network reorganization needs. Raise IS function visibility of more radical work-process changes	*Standardized forms and procedures:* Enforce common work practices across boundaries

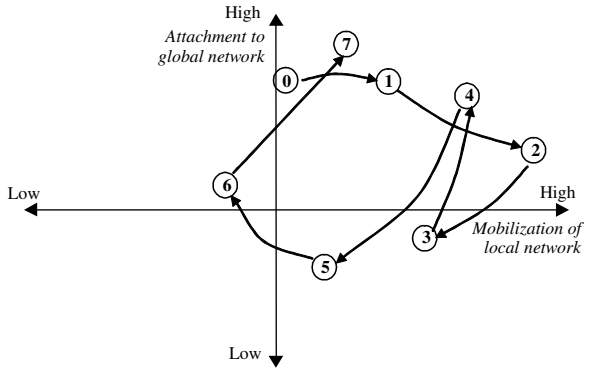

Figure 9 A political trajectory of the NTEL Design Project.

project over the local and global networks (Law & Callon, 1992; Lea *et al.*, 1995). A position in the top-right quadrant represents a 'solid, indispensable project'; a position in the bottom-left quadrant represents a 'weak, disaggregating project' (Law & Callon, 1992).

Immediately prior to the start of the project, during Episode 0, attachment to the global network (the network of external stakeholders and influential decision-makers within the organization) was high. The Managing Director was an active sponsor of the initiative and its advocate at Board meetings. But mobilization of the local network (the design-team) was relatively neutral. The IS Manager saw his main task at the start of the project as mobilizing the local network by 'achieving a common vision' within the team.

During Episode 1, the local network was mobilized to better effect. Design team-members viewed themselves as champions of the design within their global, functional groups, as well as representatives of those groups within the design team. They mobilized a local network of support for the project, acting as intermediaries between the project team and functional managers and workers.

In Episode 2, the attachment of the global network to the project waned, as the design did not appear to be producing the expected 'quick wins' for senior management. Team-members were enjoying the intellectual challenge of the design process, so the mobilization of the local network was increasing as the global attachment decreased. The extended network of contacts shown in 0 was not as effective as the IS Manager expected. He expressed his frustration at team-members' unwillingness to 'share' design issues with colleagues and managers and to feed back issues that affected the design.

During Episode 3, local network mobilization dropped as design team-members tussled with how to deal with the implicit organizational design boundary that emerged through the process of defining process and system definitions in detail. Global network attachment also declined as the project failed to deliver benefits within the expected timescale. It is interesting that the *indirect* actor-network mediated by the statement of design objectives (Figure 3) proved more influential with senior decision-makers than the *direct* actor-network access to senior management, which the team could leverage through organizational reporting structures. This indicates the role which expectations play in the design process: a primary focus of the direct actor-network was to limit the expectations raised by the indirect network that had preceded it.

During Episode 4, the implicit design boundary was legitimized to some extent by redefining the design goal in such a way that it became legitimate to inquire into Marketing processes. This permitted the local network of participants to be mobilized through subversive design

activities that proceeded without the knowledge of the Marketing Director, achieving the design-progress required for the global network to become more strongly attached.

During Episode 5, the situation was reversed. The Marketing Director successfully leveraged the actor-network mediated by the original statement of design objectives to represent the informal extension of scope established through the human actor-network as illegitimate. He lobbied members of the global network and caused a major disassociation from the design by both local network members and global network supporters.

During Episode 6, when the local network morale and mobilization were at their lowest ebb, the team resorted to a strategy of division of labor to achieve closure at all costs. This succeeded in reattaching the global network of influential decision-makers, even through they had to sacrifice their more radical design objectives to achieve this. The global network was attached more firmly through a program of training, which introduced new stakeholders to the rationale of change – these stakeholders in turn lobbied their senior managers to support the change.

In Episode 7, the sacrifice was resolved by aligning the design interests with those of evolving the IT systems. The more radical process changes were introduced incrementally to achieve this alignment, at a time when the global network attachment was strongest, following the success of the first round of design-related change.

These findings illustrate the tension between the need to attach the global network (to maintain positive external visibility) and the need to mobilize the local network (to achieve a coherent design). Satisfying the needs of the global network meant a constant search for design-closure and a strategy of problem reduction/simplification, while the needs of the local network could only be satisfied by a strategy of problem complication, with a longer timescale. This resulted in a dialectic: when the interests of inquiry dominated the process, it proved easy to undermine the team by referring back to the original statement of scope. When the interests of closure dominated the process, critical design tasks were neglected and the team became over-dependent upon 'issues of fact' (Markus & Bjorn-Andersen, 1987). This may be true of all complex design initiatives. It indicates the need to manage expectations with an iterative process that delivers interim benefits, while permitting regular inquiry and learning about the organizational context of IS design.

Limitations of the analysis

A limitation of actor-network theory is its concentration upon intentionality. Given the analysis of translations, it is easy to perceive the whole world as planned and intentional. With this awareness, I attempted to examine each translation thought to be significant for the intention, as well as the embodiment of interests, permitting unintended outcomes to surface. The analysis of inscriptions as boundary-objects permitted a validating perspective that mitigated the assumption of intentionality by viewing inscriptions as knowledge-transfer mediation artifacts.

This analysis draws upon only part of the concept of the actor-network as described in sociological studies of the evolution of technological artifacts in society (cf. Latour & Woolgar, 1979; Callon, 1986a, b) as it excludes the wider social and business environment of the design initiative, to focus on internal, organizational influences. This weakens the analysis from the perspective of actor-network theory in the sense intended by Latour (1987), making it more akin to the diffusion model of technology which he presents than the evolution model, as external processes of evolution are omitted. But the intention was to explain the (subjectively and in retrospect) *significant* links between translations: to tell a story of how the design evolved in the context of this particular design team.

Conclusions and implications

The genealogical analysis has demonstrated the ways in which different and incompatible elements of the 'web' of organizational computing, processes, and ISs (Kling & Scacchi, 1982) were joined in practice and how these elements evolved. It also demonstrates how normative mechanisms may be established for recording a design and may continue to be used even when they are patently inadequate, in the context of a community of social practice. Star (1992) argues that 'investment in form' – the intersection of practice and distributed knowledge – may be extremely difficult to change in practice. The above analysis is a *prima facie* example of 'the ways in which people pragmatically use and commit to particular forms and conventions; as time goes on, the commitment to the form itself may overshadow the pragmatics of particular contingencies' (p. 406). It also demonstrates how management control interests may be embodied in non-human artifacts, such as standards, documents and IT systems.

The implications of this study for research are that we need to consider both artifacts and procedures of design as immutable mobiles (Latour, 1987). Design does not take place in a vacuum: the interim deliverables produced by collaborative teams inscribe the interests of particular groups and ensure that these interests are transferred to the next stage of design. The implications of this study for practice are that design deliverables are political objects that need to be considered carefully for their impact on the external network of decision-makers. These artifacts and definitions should be kept as plastic as possible, during the early stages of design, to prevent constraints on the scope of the design during later stages.

This analysis has shown how the translation of interests, through social arrangements and technical artifacts was achieved in the construction of a network of system design practice. For any initiative that spans multiple business functions and disciplines, it is difficult

to achieve a consensus on what needs to change and why. Stakeholders with different backgrounds and expertise define business process objectives and IT system needs in very different ways. The inability to negotiate and communicate these differences is a major obstacle to developing a shared vision of IS problems and solutions. People are often unaware that they understand the same area of work differently, especially as they use the same terms to describe different concepts. So the change process becomes a battlefield. We need approaches to business IS definition and design that permit IT professionals, users and managers to see the 'big picture' of how their knowledge and needs relate to others', so that they may negotiate a consensus view quickly and with minimal conflict. But the process does not stop there. For complex systems of change, views evolve as stakeholders become more aware of the wider implications of their work. An effective IS design needs to negotiate a changing consensus around evolving IT system and business process definitions.

About the author

Dr. Susan Gasson is Assistant Professor in the College of Information Science and Technology, Drexel University, U.S.A. Following an industry career in systems design, project management and systems architecture consultancy, she earned her MBA and Ph.D. at Warwick Business School in the U.K. Dr. Gasson is a member of the ACM, the AIS, and IFIP Working Group 8.2 (Organizational Aspects of IS). Her research interests focus on the management of collaborative knowledge processes to specify and design boundary-spanning organizational information systems. Her work has been published in leading journals and conferences including the *Journal of Computer-Mediated Communication, the Data Base for Information Systems,* the *Journal of End User Computing*, *Journal of Information Technology Theory and Application*, *the International Journal of E-Collaboration*, and *ICIS*. She is the author of a chapter on 'Rigor in Grounded Theory Research' in *The Handbook Of Information Systems Research*. Dr. Gasson was the recipient of a prestigious NSF Career Award in 2004.

References

AGERFALK PJ and ERIKSSON O (2004) Action-oriented conceptual modelling. *European Journal of Information Systems* **13(1),** 80–92.

AKRICH M (1992) The De-Scription of technical objects. In *Shaping Technology/Building Society: Studies In Sociotechnical Change* (Bijker WE and Law J, Eds), pp 205–224, MIT Press, Cambridge, MA.

BALL LJ and ORMEROD TC (1995) Structured and opportunistic processing in design: a critical discussion. *International Journal of Human-Computer Interaction* **43(1),** 131–151.

BARLEY S (1990) Images of imaging: notes on doing longitudinal field work. *Organization Science* **1(3),** 220–247.

BECK K (1999) *eXtreme Programming Explained: Embrace Change*. Addison-Wesley, Reading, MA.

BERGMAN M, KING J and LYYTINEN K (2002a) Large scale requirements analysis as heterogeneous engineering. *Scandinavian Journal of Information Systems* **14,** 37–55.

BERGMAN M, KING J and LYYTINEN K (2002b) Large scale requirements analysis revisited: the need for understanding the political ecology of requirements engineering. *Requirements Engineering Journal* **7,** 152–171.

BOLAND R and DAY WF (1989) The experience of systems design: a hermeneutic of organisational action. *Scandinavian Journal of Management* **52(2),** 87–104.

BOWKER GC and STAR SL (1999) *Sorting Things Out: Classification and Its Consequences*. MIT Press, Cambridge, MA.

CALLON M (1986a) The sociology of an actor-network: the case of the electric vehicle. In *Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World* (Callon M, Law J and Rip A, Eds), pp 19–34, Macmillan Press, London.

CALLON M (1986b) Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. In *Power, Action, and Belief: a New Sociology of Knowledge? Socioogical Review Monograph 32* (Law J, Ed), pp 196–233, Routledge and Kegan Paul, London.

CALLON M (1991) Techno-economic networks and irreversibility. In *A Sociology of Monsters. Essays on Power Technology and Domination* (Law J, Ed), Routledge, London, U.K.

CARLILE PR (2002) A pragmatic view of knowledge and boundaries: boundary objects in new product development. *Organization Science* **13,** 442–455.

CARLILE PR (2004) Transferring, translating, and transforming: an integrative framework for managing knowledge across boundaries. *Organization Science* **15,** 555–568.

CHECKLAND P (1994) Systems theory and management thinking. *American Behavioral Scientist* **38(1),** 75–91.

CHECKLAND P and HOLWELL S (1998) *Information, Systems and Information Systems: Making Sense of the Field*. John Wiley & Sons, Chichester, U.K.

DAVIDSON EJ (2002) Technology frames and framing: a socio-cognitive investigation of requirements determination. *MIS Quarterly* **26(4),** 329–358.

DORST CH and CROSS NG (2001) Creativity in the design process: co-evolution of problem–solution. *Design Studies* **22(5),** 425–437.

ETZIONI A (1961) *A Comparative Analysis of Complex Organizations*. Free Press, New York, NY.

FITZGERALD B, RUSSO NL and STOLTERMAN E (2002) *Information Systems Development: Methods-In-Action*. McGraw Hill, Maidenhead, UK.

FLOYD C (1984) A systematic look at prototyping. In *Approaches To Prototyping* (Budde R, Kuhlenkamp K, Mathiassen L and Zullighoven H, Eds),Springer-Verlag Books, Berlin.

FOWLER M (2005) The new methodology. *Software Development Magazine*, Dec. 2000. This version last updated 13 Dec. 2005. Available online at http://www.martinfowler.com.

GREENBAUM J and KYNG M (1991) Introduction: situated design. In *Design At Work: Cooperative Design of Computer Systems* (Greenbaum J and Kyng M, Eds),Lawrence Erlbaum Associates, Hillsdale, NJ.

GUINDON R (1990) Designing the design process: exploiting opportunistic thoughts. *Human-Computer Interaction* **5,** 305–344.

HEVNER AR, MARCH ST, PARK J and RAM S (2004) Design science in information systems research. *MIS Quarterly* **28(1),** 75–105.

HOOKER JN (2004) Is design theory possible? *JITTA: Journal of Information Technology Theory and Application* **6(2),** 73–82.

HOWCROFT D and WILSON M (2003) Participation: 'Bounded freedom' or hidden constraints on user involvement. *New Technology, Work, and Employment* **18(1),** 2–19.

HUGHES TP (1987) The evolution of large technical systems. In *The Social Construction of Technological Systems* (Bijker T, Hughes T and Pinch T, Eds), pp 51–82, MIT Press, Cambridge, MA.

JACOBSON I, BOOCH G and RUMBAUGH J (1999) *The Unifed Software Development Process* (2nd edn). Addison-Wesley, Reading, MA.

KLING R and SCACCHI W (1982) The web of computing: computer technology as social organization. In *Advances In Computers* (Yovits MC, Ed.), pp 1–90, Academic Press, New York.

KNORR CETINA KD (1999) *Epistemic Cultures: How the Sciences Make Knowledge*. Harvard University Press, Cambridge, MA.

LATOUR B (1987) *Science in Action*. Harvard University Press, Cambridge MA.

LATOUR B (1991) Technology is society made durable. In *A Sociology of Monsters. Essays on Power Technology and Domination* (Law J, Ed), Routledge, London, UK.

LATOUR B and WOOLGAR S (1979) *Laboratory Life, The Social Construction of Scientific Facts*. Sage Publications, Beverley Hills, CA.

LAVE J and WENGER E (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, Cambridge, UK.

LAW J and CALLON M (1992) The life and death of an aircraft: a network analysis of technical change. In *Shaping Technology/Building Society: Studies In Sociotechnical Change* (Bijker WE and Law J, Eds), MIT Press, Cambridge, MA.

LEA M, O'SHEA T and FUNG P (1995) Constructing the networked organisation: content and context in the development of electronic communications. *Organization Science* **6(4),** 462–478.

LINCOLN YS and GUBA EG (1985) *Naturalistic Inquiry*. Sage Publications, Beverly Hills, CA.

LYNCH T and GREGOR S (2004) User participation in decision support systems development: influencing system outcomes. *European Journal of Information Systems* **13(4),** 286–301.

MACREDIE RD and SANDOM C (1999) IT-enabled change: evaluating an improvisational perspective. *European Journal of Information Systems* **8(4),** 247–259.

MARKUS ML and BJORN-ANDERSEN N (1987) Power over users: its exercise by system professionals. *Communications of the ACM* **30(6),** 498–504.

MARKUS ML, MAJCHRZAK A and GASSER L (2002) A design theory for systems that support emergent knowledge processes. *MIS Quarterly* **26(3),** 179–212.

NEWMAN M and ROBEY D (1992) A social process model of user-analyst relationships. *MIS Quarterly* **16(2),** 249–266.

ORLIKOWSKI WJ (1996) Improvising organizational transformation over time: a situated change perspective. *Information Systems Research* **7(1),** 63–92.

PETTIGREW AM (1990) Longitudinal field research on change: theory and practice. *Organizational Science* **1(3),** 267–292.

RITTEL HWJ (1972) Second generation design methods. Reprinted in Cross N (Ed), *Developments in Design Methodology* 1984, pp 317–327, John Wiley & Sons, Chichester. Interview in: Design Methods Group 5th Anniversary Report, DMG Occasional Paper 1, pp. 5–10.

SCHWABER K (2004) *Agile Project Management with Scrum*. Microsoft Press, Redmond, WA.

SIMON HA (1981) *Sciences of The Artificial* (2nd edn). MIT Press, Cambridge, MA.

SMIRCICH L and MORGAN G (1982) Leadership: the management of meaning. *Journal of Applied Behavioural Science* **18(3),** 257–273.

STAR SL (1989) The structure of ill-structured solutions: boundary objects and heterogeneous distributed problem solving. In *Distributed Artificial Intelligence*, Vol. II (Gasser L and Huhns MN, Eds), pp 37–54, Morgan Kaufmann Publishers Inc., San Mateo, CA.

STAR SL (1992) The trojan door: organizations work and the open black box. *Systems Practice* **5(4),** 395–410.

SUCHMAN L (1987) *Plans and Situated Action*. Cambridge University Press, Cambridge, MA.

VAN MAANEN J (1988) *Tales of the Field*. University of Chicago Press, Chicago, IL.

WALLS JG, WIDMEYER GR and EL SAWY OA (2004) Assessing information system design theory in perspective: how useful was our 1992 initial rendition? *JITTA: Journal of Information Technology Theory and Application* **6(2),** 43–58.