IS PLANNING AND SOCIO-TECHNICAL THEORY PERSPECTIVES

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Abstract.

Information systems (IS) as a combined social and technical area (Lee, 2004) and there are numerous variations within socio-technical theory of how to understand the general relationship between the two sides. The aim of the paper is to discuss of a number of socio-technical theories and how they can provide perspectives on information systems planning. The outcome of the paper is a discussion of the implication for information systems planning using models and concepts for the socio technical field, with a special focus on the social shaping of technology area (Mackenzie and Wajcman, 1999).

Keywords: *information systems planning, socio-technical theory*

1 INTRODUCTION

Information systems (IS) is a combined social and technical area (Lee, 2004) and there are numerous variations within the socio-technical theory field of how to understand the general relationship between the two sides. The aim of this paper is to discuss a number of socio-technical theories and how they can provide perspectives on information systems planning.

This paper focuses on the possible contribution from the broad theory field of social shaping of technology (SST, Mackenzie and Wajcman, 1999). As a background to this we discuss both the general use of socio technical theory in the IS field and the specific background to SST in the philosophy of science field, sociology of scientific knowledge (SSK, Bloor, 1976). Following this background, two current directions of SST, that have caught the attention in the IS field are discussed, social construction of technology (SCOT, Pinch and Bijker, 1984) and the actor network theory (ANT). As result a four-point program for balancing and directing the possible uses of a socio technical perspective is discussed.

2 BACKGROUND: USE OF SOCIO-TECHNICAL THEORY IN THE IS FIELD

The designer's frame of mind determines what is possible to explore in information systems planning processes. The socio-technical perspective argues that it is the focus on technical frames in combination with the lack of social frameworks that lies behind the behavioral problems causing information systems failures (Bostrom and Heinen, 1977a). It should be

imperative for any information systems planning approach to provide balanced sets of frameworks from both perspectives (Bostrom and Heinen, 1977b).

Bostrom and Heinen (1977a) support the idea of a strategic design process that guides the IS development process. Here they refer back to Hedberg (1975) who talk about designing a meta system, a system that guides the design of the computer system. This is a process where the goals of the intended system are formulated and guiding policies are laid out. This should be the responsibility of the organization including the users, thus providing a mechanism for user participation. The goal of this strategic design process should be to include values into the systems design process that are representative of a wider group than that of professional systems analyst and programmers. Making values explicit and evaluating results in terms of these values can be thought of as a part of the strategic function of systems design. These plans should be translated in to technical specification by an administrative function, and operative personnel should in turn realize these specifications as technical solutions. The strategic function that is sought by Hedberg (1975) should be responsible for the initiation of change, requests of design proposals, and monitoring the outcome against the values.

An essential demand on any planning framework for these purposes is that it must be systemic. Frameworks must clarify the interactions and relationships between social and technical aspects. The essential goal is, as pointed out by Bostrom and Heinen (1977a), that the package of changes suggested by the strategic planning process must include both suggestions based on information technology as well as suggestions originating from more people oriented organizational activities.

3 SOCIOLOGY OF SCIENTIFIC KNOWLEDGE (SSK)

From a sociological perspective the problems have been the opposite of the ones in the information systems area: how to incorporate technology in social theories. Technology has been managed indirectly by, for example, financial means and has not been a concern in it self (Sorensen, 2002). Some sociological directions have tried to changes this by incorporating the content of the technology in to the analysis. For example the social shaping of technology (SST, Mackenzie and Wajcman, 1999) explores how a range of social and economic factors, as well as technical considerations, patterns the design and implementation of technology.

The SST approach has its roots in the area of "sociology of scientific knowledge", (SSK) and the strong program of sociology (Bloor 1976). Here the role of sociology in explaining scientific knowledge is discussed. Bloor attacks the view that sociology only can explain why science fails and not why it succeeds. Four basic tenets and values are discussed as basis for the strong program:

- Study of the causes or conditions that bring about beliefs or states of knowledge.
- Impartiality with respect to truth and falsity, rationality or irrationality, success or failure.
- Explanations should be symmetrical; the same type of cause can explain both success and failure.
- The study should be reflexive; the same explanation should apply to sociology as well as science. (Bloor, 1976, p. 5)

The SST approaches can be seen as extensions of the concepts of SSK into the area of technology studies. SSK focus on how social factors contribute to the development of scientific knowledge. Given that two scientists perceive the same natural phenomena and get

the same data, the contexts of the scientists can then be used to explain how they reach different beliefs about the phenomena (Bloor, 1999).

Bloor (1999, p. 90) sums up some of the basic assumptions of SSK. SSK concentrates on the history of scientific theories and focus on decisive moments where the development of a theory as branched of in directions. All studies starts from the perspective of an actor in the situation. SSK approach has sometimes been accused of being idealistic, denying a natural world. However, in centre of the study is an individual who perceives the world and gathers cognitive data through experience. It is what happens with these cognitive data when the person tries to make sense of them, that is in focus. This is done using collectively shared conventions and institutionalized concepts. In this way, nature will always be in the centre, but always filtered, simplified, selectively sampled and interpreted into personal knowledge rooted in a collective tradition. Here is the concept of interpretative flexibility rooted, what something means depends on who you are, how and why the meeting between man and nature occurs.

This does not answer the question of how nature is represented in this line of research. Bloor (1999, p. 92) also discusses this aspect, contending that the sociologist must have a grasp of what the agent is responding to. Bloor says the following:

"It doesn't matter greatly how we specify or describe what the agent experiences as long as we mange, somehow to capture that experience in a way that is sufficiently neutral for our purposes." (Bloor 1999, p. 92)

The description of the phenomena should be neutral amongst the range of likely theoretical alternatives. The aim is to understand how studies of the same object, that gives the same data, gives rise to different understandings. This difference is sought in the frames of understanding and situation that the different investigators reside in. It is what is attributed to things that interesting not the things as such.

4 SOCIAL SHAPING OF TECHNOLOGY (SST)

The problems of the general social studies of technology are the tradition of treating technology as a black box, and just look at the contextual variables. The box should be opened, "to allow the socio-economic patterns embedded in both the content of technologies and the processes of innovation to be exposed and analyzed" (Williams and Edge, 1996, p.866). SST moves beyond both a narrow technological determinism and a simplistic form of social determinism. The social forces affect the choices between options provided by the technology. Social factors stemming from organization, economic, politics and cultural circumstances, pattern the design and implementation of technology (Mackenzie and Wajcman, 1999).

Williams and Edge (1996) presents SST as a research direction or as a "broad church", including a large number of ideas and concepts. There are differences both in details and in more fundamental issues, between different directions. The main SST approach can be summaries as:

- An innovation process, which is moved forward by making (design) decisions.
- A series of choices (made more or less consciously) creates negotiability or flexibility of technology.
- A process that moves towards a point of no return (irreversibility) when the artefact is stabilized and the process ends.

This model breaks with a more traditional linear model of technology innovation and instead suggests an interactive, feedback, spiralling process where technology and social factors interacts. The aim is to understand technology change as a social process, where technical and social interact in a seamless web.

Williams and Edge (1996) also discusses the design perspective, claiming that SST researchers become very knowledgeable in the process of studying technology and should have a lot to contribute in a design process. They could stand together with other actors, technical specialist, in the design process. Williams and Edge also points to the role of the designers of technology, who engaged in "heterogeneous engineering" (William and Edge refer to Law, 1988 for this concept) employing a wide range of knowledge in creating a complex socio-technical system.

The SST approach has been discussed from an information systems perspective (Howcroft, et al., 2004). Howcroft et al. write that "SST conceptualizes the human-technology alloy as unstable and inherently contingent; it is constructed through the interpretive processes of actors and does not therefore embody any definitive capabilities or effects." (Howcroft al. 2004, p. 359). Technology is not viewed as an independent variable; no objective account of it can be established. SST is seen as providing ways of conceptualizing how information technology is integrated into the analysis of human societies. Both the content of technology and the context that frames the technology are examined. Conceptual tools are offered for the analysis and a long range of factors (organizational, political social, economical and cultural) are used for finding patterns in the design and use of information technology. Howcraft et al. chooses to focus on two directions within the SST line of thought as important for the IS area. These are discussed in the coming two sections, first "social construction of technology" and secondly "actor-network theory".

5 SOCIAL CONSTRUCTION OF TECHNOLOGY

The social construction of technology (SCOT, Pinch and Bijker, 1984) provides an integrated approach for the empirical study of technology as an innovation process. Four main concepts are used:

- *Relevant social group*, including organization and institutions as well as informal groups of people. The groups are defined by different understandings of a piece of technology in common for them all. The development of an artefact relies on these understanding, and on how understandings of different groups compete over time.
- *Interpretative flexibility*, referring to the development of interpretations of artefacts of a relevant social group makes
- *Stabilization and closure* refers to how the design process comes to some kind of end. Two ways are discussed by Pinch and Bijker (1984), first when the social groups define the problem as solved by the artefact. Another possibility is a rhetorical ending when the relevant social groups no longer perceive the problem and then the artefact stabilizes. This can be seen as a consensus among the groups; the solutions provided by the artefact satisfy the perceived problems. Alternatively the problems are redefined, ending the current process.
- *Wider context*, relating the process to the wider socio-cultural and political situation of the social groups. This is done in order to understand the background of norms and values that influence the meaning given to an artefact.

This sociology of technology focuses on peoples beliefs about technology. These beliefs guide both the constructions of technology and how the artefact is understood and used once it is constructed. The innovation / development processes are described in networked styled diagrams, where social groups interact around problems and artefacts. The problems are solved by innovative solutions that are implemented. The approach is primarily a heuristic; it aims at bringing out relevant aspects of the process. This leaves a lot of responsibility to the analyst (Bijker and Pinch, 2002), witch could be seen as something positive. The personal involvement of the analyst could work as an antidote against a naïve empirical study of technology. Mainly because this influence is always there and if this is not recognizes, its influence will be immune to critique.

6 ACTION-NETWORK THEORY (ANT)

A central idea in an ANT (action-network theory) analysis is to understand a technology development process as a network of interacting actants. An actant refers both to humans and non-humans (objects, artifacts, for example: anthrax germs, a metro control system etc.). These humans and non-humans are given an equal role in the network; they are treated in a symmetrical way. The ANT moves beyond the traditional sociological perspective of studying the beliefs of people and incorporates artefacts as active components of the study. This makes quite different of the SCOT and the general SST perspective. Latour (2005) says that SCOT is different and on top of that that the SST school is a failure, and just another way of creating names and attaching meaning to things.

First we will present a short summary of some key concepts (based on Howcroft et al., 2004 and Walsham, 1997). ANT aims at describing the development of society into a sustainable whole, or in the ANT vocabulary to describe the development of a seamless network consisting of actants. The actant concept represents a brake with the traditional objective-subjective dimension used to structure most science. It is a suspension of defining nature of things, in an effort to avoid either social or technological determinism. The network is created by actants enrolling new actants into the network. The interest of the actant is translated to the new potential actant making it an ally. The viewpoint of the actant is inscribed into the new actant, which then delegates (stand up and speak) these opinions. This process is seen from a certain actant of in the network, the goal being to stabilize the network in a favourable way for that actant. The goal is to enroll actants and create a state of irreversibility, ie when the network cannot change back again. This creates a frozen state of the network; and it then turns into a black box, a predictable machine. The ANT is used to examine a process that has taken place; it tries to make a detail description of the motivations and actions that leads to an end state. When this frozen state is reach, it is possible to sort out the social from the natural, or as Latour puts it drawing the line between the material infrastructure and the symbolic levels.

In (Latour 1992) a simple example is provided of how to apply the concepts. The aim is to explain how social stability is achieved using artefacts. The story begins from an individual persons perspectives and that person's need of changing his world. The example focuses on a hotel manager who has problems with disappearing room keys. The first step that he takes is to make an utterance by writing a sign that says: "leave the key at the counter". This is the start of an innovation processes aiming at changing the behaviour of a social group of people, i.e. hotel guests. This process includes creating of action programs that gradually changes the current situation towards a new stable state. In the case, a new situation where the guests leave their keys at the hotel reception desk instead of taking them out and forgetting them in

various places. To achieve this the hotel managers do not only resort to social action (asking the guest to return the key when the guest register), he must also use artefacts to put force behinds his intentions. The first program includes writing a sign (an actant); the manager enrolls the sign in his struggle and inscribes a message that delegates the intentions of manager. This is done in an effort to include as many of the guest into the managers network. The example continues with the effect of the message, the collective of guest will react to the sign, some will accept and comply; others will create anti-programs, ignoring the sign. The manager must then create a new action program; add more words (for example, a "please" or explain the dangers with bringing the key from the hotel). If this does not work, other actants could be enrolled, for example, the key is modified, making it heavy to carry around. The new configuration of the network will go through a new process of inclusion or exclusion. If enough of the guests comply the network will stabilize and become a black box. Some guest might still object to the system but as long as the losses incurred by these people are seen as lower than the costs for expanding the network, the manager probably will let the case rest.

In this analysis the actants can be abstract concepts, physical tings, or people. For the analysis it not important what is human or not. The study makes it clear how a new power relationship is created; the manager creates tools for controlling the guests. The network, the focus of the study, consists of human and non-human, forming a chain of actants. Power is a characteristic of this chain and as such it is an explanation why the chain holds together. Latour points out a number of principles for this analysis.

- The analyst should never in advance decide what is important or not, this must be decided from the role that the actant, utterance or object plays in the network.
- Symmetry between the social and technical, the outcome of the innovation process cannot be determined by either the social or the technical. At the same time will the social be change by the technical and symmetrically the other way around.
- The final explanation of a situation lies in the careful description of details. It is important not to try to find the explanation outside of the situation, for example by invoking general social categories.

Howcroft et al. (2004) and Walsham (1997) provide a basic account of ANT relevance for information systems. The limitations of ANT are also discussed in these two papers. Howcroft et al. points to the moral deficits that the ANT seems to have, recommending the use of ANT to be complemented with critical theory. Walsham (1997) concludes that the disputed state of ANT makes it hard to use, but many ideas could be reused as tools in the IS area.

7 DISCUSSION – CENTRAL ISSUES FOR IS PLANNING

The basic message of the socio-technical perspective is to put the two perspectives on the same level, i.e. both the social and the technical. Practical models for the investigation of each of them must be provided in order to make an informed discussion on their interconnections possible. The contradictions and the reciprocal dependences between effective technical system and a durable human social system must be laid out in the open.

The inability of organizations to formulate these policies from a broader socio-technical perspective leaves the designers as the real decision makers and interpreters of the organization. If no one expresses an integrated and explicit framework for the intervention, there is no one that takes a real responsibility for the project. There are differences in the languages that are used; the one used to solve the organizational problem is probably not the

same as used for developing the information technology artefact. Frameworks that make these connections on a strategy/policy level are necessary.

A number of problematic areas can be discussed shortly: strategic planning, the connection between sociological and technical, methods and tools and the critical perspectives. IS researchers (Howcraft et al., 2004) discusses these issues from a research perspective, how these ideas could be moved to a design situation is not investigated. Together these issues form a research agenda for the examination and reformulation of current IS methodologies and maybe the development of new ones.

7.1 Strategic phase in IS Development

The first area concerns the necessity of a clearly identifiable strategic phase of the IS development process. There should be a socio-technical policy formulation process, which should be performed before any decisions on the details of the system. Discussions of technology policies (Sorensen, 2002) provide another input to this perspective, focusing for example on problems of changing the understanding of what the core of a problem really is. The great challenge is the integration of the standard strategic approach in IS planning (for example, Mcfarlan, 1984) with the socio-technical ideas of strategic planning and policy making. In the "Ethics" approach (Mumford, 1983) there are room for a traditional IS strategy, but the problem here is that the socio and technical dimensions are brought together after the two investigations are completed.

7.2 Connecting the Social and the Technical

The second area includes three different views on how social and technical perspectives can be related.

- Social shaping of technology seeks to find a neutral position of technology and then investigate the different choices made of different people around the technology.
- The social construction of technology theory sees technology as a social phenomenon that is defined by interpretation of relevant social groups. These interpretations decide how people perceive technology and subsequently interact with it.
- ANT tries to make a symmetrical analysis where things and people are interacting in a network; a final decision on the objective or subjective nature is postponed in an effort to avoid any pre assumption that might interfere with the analysis.

Any IS methodology with ambitions to deal with socio-technical perspectives should be examined on this issue. For example, the "Ethics" approach (Mumford, 1983) acknowledges the importance of both perspectives, but it seems to be a very pragmatic relationship. "Ethics" suggest a two track process where the two perspectives are investigated separately. The mechanisms for the interaction are some what unclear with an ambition to create a best solution given limitations and possibilities from both sides.

7.3 Methods and Concepts supporting IS Development

The third area concerns the different concepts and methods presented in the various approaches discussed in this paper. The possibilities for use in IS planning processes should be explored, either as stand alone methods or integrating concepts, methods or models into existing IS planning models. The recommendation from Walsham (1997) to use the methods

and tools from the SST area, even if the frameworks in general are under discussion, should be used as a leading star. Some examples have been presented in the sections above, with the SCOT approach and the ANT as the clearest methods with toolboxes. The examples of how these concepts have been used, seems mainly to be examples of descriptive approaches, seeking traditional social science results. The integration into the planning practice for pragmatic reasons seems not very common. A crude way of doing this it might be to ad a SCOT inspired stage to "Ethics", which would deliver an idea of which system to develop. Another way could be to use ANT approach to plan the design and introduction of an information system into an organization. This would result in a number of design change programs intended to enroll people into speaking for the program and using it.

7.4 The Critical Dimension of Information Systems Development

The last area deals with a critical dimension of information systems. This is in line with the value dimension or the lack of it, as identified in the social constructionist view of technology in general. Howcroft et. al. (2004) recommends that a SST approach should be accompanied by the use of critical theory. Walsham says, in his comments on ANT that it is not possible to make moral judgments on the basis of the network alone. Much as been written on critical methods and how they might be used in IS development (Mingers and Gill, 1997), but this are seems rather disconnected to the SST perspectives. Integrating critical theory into more mainstream IS development approaches should be a part of an effort to use SST perspectives.

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