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Strengths and Weaknesses of Constructivistic Studies of Technology

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Research Papers from the Department of Social Sciences, Roskilde University, Denmark.

Working paper series

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Abstract

The constructivistic approach becomes more and more applied in technology studies. In this article the Social Construction of Technology (SCOT) approach will be examined. The utilization of this approach on a concrete case story reveals strengths as well as weaknesses in the approach. The article presents the key concepts of the approach and discusses strengths and weaknesses as well.

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Introduction

In this article I describe how a constructivistic approach can be applied on a study of the development of a certain technology. The point of departure is the study: "Videotex in the Melting Pot". The aim of this study was to try out the constructivistic approach on the development of online service (or videotex) in Denmark.[1] Anyway, it is not the concrete case I describe in this article, but the theoretical reflections the study have provided. I will only refer to the case of online services when it is necessary to enlighten the theoretical discussion.

Maybe I am one of those people Langdon Winner had in mind when he so scornfully wrote about the SCOT (Social Construction of Technology) approach:

"It offers clear, step-by-step guidance for doing case studies of technological innovation. One can present this method to graduate students, especially those less imaginative graduate students who need a rigid conceptual framework to get started, and expect them to come up with empirical studies of how particular technologies are "socially constructed"." (Winner, 1993, p. 366)

Anyway, I did not find the approach that simple to utilize, and I imagine that my study went a little further than just to conclude that online services are socially constructed. At least my study has resulted in some theoretical reflections which I think other people might find interesting.

At first (in section 2) I give a short presentation of constructivistic theories in the field of technology studies. In section 3 I present the key concepts in the SCOT-approach, and in section 4 I discuss the strengths and weaknesses of this approach. Finally, in section 5 I shortly draw up the conclusions.

A Short Presentation of Constructivistic Theories

Within the last two decades, the constructivistic way of thinking has spread from one scientific discipline to another. In the beginning of the 1980s it spread to the theoretical field of Science and Technology Studies. A wide range of scientists was inspired by experience of the Sociology of Knowledge Studies made in previous years. They realized that scientific facts are constructed in a social context.

The discussions among researchers of technology departed from the question whether this meant that technology became socially constructed, too. At that time this was a rather radical assumption because it was a departure from two fundamental assumptions about how technology develops:

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[1] In the beginning videotex was an approved name, but after a couple of failours (in the US the two biggest services closed down within two weeks in March 1986) people in the US started to call it online services. In Denmark we never really got another name for videotex. Therefore, I will continue to use this name.

1. The technological determinism which viewed technology as something already existing. It just has to be discovered by humans – like for instance the laws of physics. When it is finally discovered it will become a driving force in the development of the rest of the society.

2. The conception that it is the geniuses, and them alone, who discover the technologies which is why they are made heroes of technology.

If one accepts that technology is socially constructed this approach opens new ways of viewing the development of technologies. With this approach it becomes clear that there are no right or wrong technologies. The distinction between true and false and success and failure is dissolved. How technology is shaped, and whether or not it is applicable depends on the actors who are actually involved in the concrete process. Technology is not a given fact in itself. It will be shaped differently depending on the actors involved. If other actors had participated in the process a given technology would have looked different. In other words, it is necessary to turn our point of view from the machines to human beings.

This approach also implies that a given technology is never finished when it leaves the laboratory or the drawing board of the engineer. The succeeding actors, the manufacturers, the distributors, the users etc., all influence the shape and use of technology. Users will some time use the technology in ways never thought of by the designers. When applying this approach, the understanding of technological development is shifted from a technical-natural science paradigm to a sociological-social science paradigm.

Many have already been bidding in on a theory of the construction of technology. There is a big difference in how radical they are in their understanding of constructivism. Some call themselves "soft constructivists" (i.e. Smith & Marx, 1994), while others are more inspired by post modern thinking and thus break with the more traditional way of thinking (i.e. Callon, 1987 or Latour 1993). There are also big differences in what the approach is called. Some call it "The Social Shaping of Technology" (i.e. MacKenzie & Wajcman) while others call it "Social Construction of Technology" (i.e. Pinch & Bijker, 1987). Then there are those who have a feministic angle to the approach (i.e. Haraway, 1981 and Cockburn & Ormrod, 1993).

In broad outline it can be said that the development of a theory of the construction of technology has taken three different directions:

1. The system approach that analyses large technological systems. It is to a great extent a historical tradition which lays the foundation to this branch of the approach. The driving force in this area has been the historian Thomas Hughes (Hughes, 1987).

2. The Actor-Network theory, as it has developed from the French tradition, which is strongly influenced by the anthropologist Bruno Latour and the sociologist Michel Callon (Latour, 1987 and 1993 and Callon, 1987).

3. The SCOT theory (Social Construction of Technology), which at first was described by the British physicist and sociologist Trevor Pinch and the Dutch

engineer Wiebe Bijker (Pinch & Bijker, 1987) and later on further developed by Bijker (Bijker, 1995).

In the study of videotex in the melting pot I have chosen the SCOT-approach as a point of departure. This choice is due to Wiebe Bijker being the one who most unambiguous treats development of technology. I could also have chosen to take Latour's approach as a point of departure, but where Latour treats the development of both scientific facts and technological artifacts, Bijker concentrates on the development of technological artifacts.

There are many differences in the two approaches. As mentioned earlier the Actor-Network theory is to a large extent inspired by Post Modernism and thus far more radical in its constructivism than the SCOT theory. In this way, the Actor-Network theory explains everything with the actions of the actors, whereas the SCOT approach maintains the existence of structures in society limiting the behaviour of the actors. The two approaches have developed different theoretical concepts which cannot be transferred from one approach to another. There are, however, also many similarities stemming from a common urge to develop a theory explaining how technology and society interact.

The SCOT Approach

From a general point of view, a SCOT analysis is split up in two phases. If you regard the technology in question as a thing, the first phase in the analysis consists of breaking this thing into many different parts and study each part carefully. This phase Bijker calls the sociological deconstruction of the technology. In the second part of the analysis it is analysed how all the small parts are merged into one coherent artifact. Bijker calls this phase the social construction of the technology. The phases and the belonging concepts can be illustrated in the diagram below:

Phases in the analysis	Concepts
Sociological deconstruction	Relevant social groups Technological frame – inclusion Interpretative flexibility
Social construction of technology	Stabilization Closure

First Phase: Sociological Deconstruction of the Technology

Relevant Social Groups
The first step in a SCOT analysis is to map the actors or relevant social groups involved in the development of the technology in question. Pinch & Bijker (1987) describe the concept as follows:

"The use of the concept of a relevant social group is quite straightforward. The phrase is used to denote institutions and organizations (such as the military or some specific industrial company), as well as organized or unorganized groups of individuals. The key requirement is that all members of a certain social group share the same set of meanings, attached to a specific artifact. In deciding which social groups are relevant, we must first ask whether the artifact has any meaning at all for the member of the social group under investigation." (Pinch & Bijker, 1987, p. 30)

It is like this not a part of the concepts that members of a relevant social group have to have a certain normative attitude to the technology in question. If the members share the same set of meanings about the artifact you can call it a relevant social group whatever they have a positive or a negative attitude to the artifact. That means that the concept also covers e.g. grassroot movements who is against the use of a specific technology.

About the mapping Bijker (1992) describes that it is a good idea to begin with the individual actors. Some actors act as spokesmen for a relevant social group others do not. In Bijkers understanding of the concept actors are individuals while a relevant social group is a collective entity sharing the same set of meanings about a specific artifact, but a relevant social group is still an actor category.

A relevant social group can change in the course of time if the members begin to have different perceptions of the use of the artifact, e.g. all the users can share the same perception of the artifact at one point of time and in this way belong to the same relevant social group. At another time some of the users can have changed their perception and it will then be necessary to split the relevant social group into two groups, e.g. a group of private users and a group of professional users.

In the mapping of the relevant social groups it becomes obvious that there are many more actors involved in the development of a specific artifact than we usually think of as technological developers. The story about the development of online service in Denmark reveals relevant social groups like a governmental commission, critical media scholars, representatives of consumer organizations, staff in private companies and public authorities who delivered the information and of course technicians and management in the telephone company.

Technological Frame
The second step in the analysis consists of a description of the interpretation of the technology by different relevant social groups. Through a process where the actors interact with each other they build up a common interpretation of the technology. Theoretically this is described by the concept technological frame:

"The concept "technological frame" is intended to apply to the interactions between various actors. Thus, it is not an individual's characteristic, nor the characteristic of systems or institutions; frames are located *between* actors, not *in* actors or *above* actors... The interactionist nature of this concept is needed to account for the emergence and disappearance of technological frames. A

technological frame is built up when interaction "around" an artifact starts and continues." (Bijker, 1990, p. 123)

In other words it is the interaction among the actors which determines whether they are grouped in a relevant social group. If the result of the interaction is that the actors share the same interpretation of the artifact then a technological frame will be built. If the actors do not share the same interpretation no technological frame will be built no relevant group will be established, and there will be no future interaction. Bijker has made this tentative list of elements of a technological frame (Bijker, 1995, p. 125):

TENTATIVE LIST OF ELEMENTS OF A TECHNOLOGICAL FRAME

Goals
Key problems
Problem-solving strategies
Requirements to be met by problem solutions
Current theories
Tacit knowledge
Testing procedures
Design methods and criteria
Users´ practice
Perceived substitution function
Exemplary artifacts

Inclusion
The concept of a technological frame is very important, because it is through this that Bijker wants to catch the social dynamics between the actors. When a technological frame is built it will structure the interaction between the members of a relevant social group, but it will never do it completely, because the actors will have different degrees of inclusion in the technological frame.

> "A technological frame structures the interaction between members of a social group. But it will never do so completely: first because different actors will have different degrees of *inclusion* in the frame – actors with a high inclusion interacting more in terms of that technological frame and actors with a low inclusion to a lesser extent; and secondly because all actors will, in principal, be members of more than one technological frame..." (Bijker, 1990. p. 124)

Inclusion is not an either-or concept, because actors can have different degrees of inclusion. This is important when we want to describe the dynamic character of the development of artifacts. The degree of an actors inclusion is not constant, it will change on behalf of concrete events. Actors will typically be members of different social groups and have different degrees of inclusion in the different technological frames. This tension among actors with different inclusion in a technological frame is an important source for technological change. Actors with a low inclusion in one technological frame can import features from another technological frame in which they have a higher inclusion.

Interpretation Flexibility

The third step of the analysis consists of showing the interpretation flexibility by using the different technological frames. The concept describes that different actors or relevant social groups can interpret the artifact in different ways.

> "... technological artifacts are culturally constructed and interpreted... By this we mean not only that there is flexibility in how people think of or interpret artifacts, but also that there is flexibility in how artifacts are *designed*. There is not just one possible way or one best way of designing an artifact." (Pinch & Bijker, 1987 p. 40)

Second Phase: The Social Construction of Technology

The next phase in the SCOT analysis consists of an analysis of the social construction of the technology. The SCOT approach regards technological development as a process where the involved relevant social groups gradually agree in a common interpretation of the artifact. The result of these processes is a gradually stop of the flexible interpretation so that one of the former variants of the artifacts is becoming the dominant one. Bijker describes this process by the two concepts:

Stabilization and Closure
These concepts are described as follows:

> "This becoming dominant of an artifact is the effect of two combined processes – closure and stabilization. They are actually two aspects of the same process... The concept of "closure" relates to the interpretative flexibility argument, and is analogous to the discussion of closure of scientific controversies in recent social studies of science. The concept of "stabilization" is grounded on a critical evaluation of the naive "invention-as-an-act-of-genius" approach to the study of technology and draws upon work in linguistics and recent laboratory studies in the sociology of science. Stabilization can most easily be introduced by analysing the *intra-group* development of artifacts, while closure is primarily relevant to an *inter-group* analysis." (Bijker, 1990, p. 93-94)

> "Closure, in the analysis of technology, means that the interpretative flexibility of an artifact diminishes. Consensus among the different relevant social groups about the dominant meaning of an artifact emerges and the "pluralism of artifacts" decreases..... It is important to recognize that the process of closure is almost irreversible – almost, but not completely." (Bijker, 1990. p. 95-96)

The processes take place as controversies between the relevant social groups. Every time a controversy is closed, and consensus among the different relevant groups is reached, the technology becomes a little more stable. The controversies can be closed in many ways. Bijker describes three different configurations that give different ways of closure:

1. A situation where there is no single dominant group and the process is about to build a common technological frame.

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2. A situation where one single relevant group dominates.

3. A situation where there are two or more entrenched groups with competing divergent technological frames.

Depending on the situation there will be different ways in which the controversies will be handled and closed.

Sociotechnical Ensemble
Bijker ends up with the concept of sociotechnical ensemble. By this concept Bijker wants to describe a new way to understand the interaction of technology and society. On behalf of his case studies he shows that the development of a certain artifact consists of both technical and social features. Bijker argues that we cannot separate these features from one another, both technical and social features are necessary to describe the construction of technology. Bijker defines sociotechnical ensembles in this way:

> "The technical is socially constructed, and the social is technically constructed. All stable ensembles are bound together as much by the technical as by the social. Social classes, occupational groups, firms, professions, machines - all are held in place by intimate social and technical links... Instead of technical artifacts, the unit of analysis is from now on "sociotechnical ensemble". Each time "machine" is written as shorthand for "sociotechnical ensemble", we should, in principle, be able to sketch the (socially) constructed character of that machine. Each time "social institution" is written as shorthand for "sociotechnical ensemble", we should be able to spell out the technical relations which go into making that institution into a stable set-up. Society is not determined by technology, nor is technology determined by society. Both emerge as two sides of the sociotechnical coin, during the construction processes of artifacts, facts and relevant social groups." (Bijker, 1995, p. 273-274)

Discussion of Strengths and Weaknesses of the Approach

By using these theoretical concepts in an analysis of the development of videotex in Denmark I am convinced that we here have an important tool for the theoretical understanding of technological change. Bijkers central concepts: Relevant social groups, technological frame, interpretative flexibility and stabilisation and closure are all fine tools in an analysis of a concrete case. It becomes another way of thinking to think actors (and social groups of actors) instead of technique and this way of thinking leads to new understandings. Just like the concept of sociotechnical ensembles describes a new way of understanding the coherence of technology and society.

Not everybody agrees in this rather positive assessment of the SCOT approach. One of the fundamental critiques of the approach is a question of whether we can call this approach a theory or not. It is clear that SCOT is not a theory in the traditional understanding of theory as generalized knowledge that explains certain coherences. Thus the critique describes SCOT as a narrative. But due to Bijker the difference between a narrative and a theory is that the narrative does

not have any links with other narrative. Bijkers own case stories have several links that serves like flags you can carry on from one story to another. These links or flags are the theoretical concepts and because there is coherence between these concepts you can regard SCOT a theory.

In the following section I discuss SCOT as a theory and describe the weakness of the approach I found when I used it in the analyses of the development of videotex in Denmark.

Relationship between Actors and Structures of Society

One of the main points of the SCOT theory is that the traditional distinction between the micro and the macro level of society is dissolved. This happens as a consequence of following the development through the involved actors. The macro level is thus described through the actors' actions and attitudes to the technology, i.e. the technological frame they build around technology. This point has caused quite a few theoretical discussions of the relationship between the actors and the structures of society (e.g. Winner, 1993).

In one case I have found it necessary to draw some structural societal changes from the concrete story of online service and treat them exclusively, namely in the case of the development within the telesector in Denmark. Here it was impossible to incorporate the structural changes at the macro level in the description of the creation of the technological frames. Although the technological frame is a very comprehensive concept, I found it impossible to incorporate it in the story in a satisfactory way. I found it necessary to treat these macro structures as separate subjects.

If I had chosen to follow the SCOT model consistently, I had been forced to incorporate these changes as an explanation of why the political actors in the story changed course and got a different interpretation of the role of the tele-phone companies in the development of online service. Such causal explanations of why the actors interpreted the technology the way they did, would – on the other hand – be contrary to the intentions of the SCOT approach. The point here is to *describe how* the actors interpret the technology, not to *explain why* they interpret it the way they do.

It is a problem in the theory that if one solely follows the actors some of the societal macro structures are excluded from the analysis. The danger of not incorporating the societal macro structures is that you become blind to structures like for instance class, gender and race. You cannot for example explain why all secretaries are women by solely following the actors, in this case you have to know about the sexual division of labour. If we solely look to the knowledge gained from the actors, we run the risk of ending as pure empiricists, unable to discern the general societal structure. In order to avoid this situation, we must incorporate the generalized knowledge that we after all possess about society and its institutions.

If the theory is applied as pure empiricism it also raises some methodical problems. First, the danger of getting overwhelmed by the amount of facts because the researcher is unable to determine what is important and what is

inferior. Secondly, that the researcher becomes unable to reflect on his/her own role. The researcher may see himself as a machine which only registers the facts told by the actors. This is quite the opposite of the constructivist principles, but may nevertheless become the result if the theory does not include some methods for incorporating such reflections.

I do not, on the other hand, see it as a violation of the basic preconditions of the theory to give an individual description of these structures in certain cases. Bijker (1995) has explained that the researcher must describe the "backdrop" for the play, enacted by the actors. To me there is no doubt about the importance of bringing in these societal structures; the question is how to do it in a prober way. Thus the conclusion of this discussion at this point must be that the theory itself does not prevent the societal structures to be brought into the analysis, but it is up to the researcher to bring them in.

Power Relations

Many places (e.g. Hansen, 1995) the SCOT theory is criticized for being blind to societal power relations. The theory does not attribute greater importance to one group than to others. It therefore does not imply that different actors can possess different power. According to the theory, the researcher must examine the technology interpretations of all the actors despite their different power.

Bijker has taken up this critique in his latest book (Bijker, 1995). Here he points out that even though there is a big tradition of discussing the power perspective in many different scientific disciplines there are not many who discusses power in relation to technological change. Bijker himself chooses to take a point of departure in Giddens' definition of power: "the transformative capacity to harness the agency of others to comply with one's ends" (Bijker, 1995, p. 262). Through this definition power is understood as a social relation. Others understand power as a resource, but Bijker argues that it seems natural to combine the constructivistic analysis of technological change with an interactive concept of power. Anyway, this is not sufficient. Bijker argues further that it is necessary to be able to sort out the institutionalized aspects of power. It is necessary to conceptualize power in a way where we can combine a perspective of action and a perspective of structure. After this Bijker describes to kinds of power:

> "Giddens uses "domination" and "transformative capacity" as respectively the structure and action sides of his power coin. I will employ the terms "semiotic power" and "micropolitics of power" to forge a more direct link with my conceptual framework... Power thus is the apparent order of taken-for-granted categories of existence, as they are fixed and represented in technological frames. This semiotic power forms the structural side of my power coin. The micropolitics of power describes the other side - how a variety of practices transforms and structures the action of actors, thereby constitution a particular form of power... It will be clear that semiotic power and micropolitical power are inextricably linked: micropolitics result in a specific semiotic structure, while the semiotic power in turn influences the micropolitics structures." (Op.cit. p. 263)

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After these arguments Bijker combines the concept of power and the concept of technological frame. When a technological frame is established by stabilization and closure the interpretation of the technology is getting fixed. This fixation of interpretation represents power. At the same time a technological frame is constructed of the interaction among actors and determining the actions of the actors. Bijker writes:

> "Artifacts are elements of a technological frame: they thus form part of the vocabulary in which interactions develop; they provide some of the resources on which actors draw for these interactions and for the transformative action by which they seek to harness the agency of other actors, and finally they constitute an important part of the capabilities of actors. Often these capabilities take the form of routines." (Op.cit. p. 265)

In the development of online service there were actors involved who appear in an organized shape, like for instance the telephone companies and the politicians. Other actors appear as single individuals, and the individual actors may not even be aware that the researcher includes them in social groups with others (as e.g. the users of an online service). It is clear that in these examples the decisive power position for making decisions about the design of technology lies with the organized actors. They have the semiotic power to fix certain interpretations of the artifact. In the story of online service the users' interpretation of the technology has only been incorporated when the organized actors needed to know what they thought about it.

The latest rewriting Bijker has made of the question about power and technological change is one step on the road, but I do not think the problem is finally solved. Without doubt the SCOT approach can be inspired by other theories of power. It would for example be evident to examine whether SCOT can use Foucault's concepts of power (which is built on relations among actors too) for a further development of the discussion.

Democratizing the Development of Technology

The discussion about the power relations raises a new question: Is it possible to use the SCOT approach in a democratizing of the development of technology? Usually, it is especially the weak organized, less powerful actors who do not get any real influence on the development. As a rule, the future consumers or the citizens in general lack the power to get involved in the design process of technology.

This is not only a theoretical question, it is very much a practical one as well. There is far too many examples of companies which spend a lot of resources in developing a product which the consumers then refuse to buy, with substantial losses for the company as a consequence. To see it as a question of making sufficiently valid market research beforehand is, however, simplifying matters too much. To avoid such situations, the future users must be involved much earlier in the design process. The SCOT approach makes us aware of the fact that also the weak actors have a role to play in the development of technology. However, if this role is to consist in more than a mere choice of whether you want to buy

the technology or not, these actors must be involved at a much earlier stage in the design process.

This critique actually raises two questions: What methods must the developers use in order to involve the users in the development? How can the researchers register the users' attitude towards technology if the developers do not involve the users? The immediate theoretical answer is that if the actors have no attitude regarding technology and therefore do not see any problems there, then they are not actors in relation to this technology. Maybe the developers can buy an attitude towards technology from future consumers (for instance when they pay some "users" to act as test persons in the company's own laboratory). However, a researcher cannot force people to have an attitude towards technology if they actually do not care.

As the theory does not in advance ascribe greater importance to some relevant social groups than to others, there is nothing in it to condition the exclusion of some groups either. The responsibility for tracing all the actors is thus left with the researcher. To single out some groups as irrelevant is a political project and the researcher should abstain from it under all circumstances. If we as researchers refuse to participate in the exclusion of some groups in advance, but lack the representation of the weak groups in the development process, we all of a sudden find ourselves facing the problem of our own participation in the democratization of the technological development.

This problem may have several answers. Without entering into details, I can immediately mention some methods of which we have experience here in Denmark. The Danish Board of Technology was set up with the aim of involving the broad public in assessments of different technologies. For this purpose the Danish Board of Technology has developed both consensus conferences and scenario workshops (Andersen, 1995). At the consensus conferences the weak groups are represented by laymen, who assess the technology in question on behalf of some experts descriptions. At scenario workshops laymen are involved in the workshop to the same extent as experts, politicians, and administrators.

In Denmark (as well as in the other Nordic countries) we have a tradition for setting up social experiments. In these experiments you let the users test the technology themselves and you show responsiveness to ideas for using the technology in other ways than originally intended (Cronberg et al., 1991). Finally, we have a tradition for action research in Scandinavia, in which the employees, as part of a research and development project, are directly involved in the technological development at their own workplace (Clausen et al., 1992). A number of investigations is still needed to show how good or democratic these methods are, and it is in itself a long discussion which I shall not enter into here, but I want to point out that the SCOT approach has contributed to bringing this question into focus.

A Relativistic Slide

A deconstruction of a given case reflects in itself a relativistic way of thinking: you take nothing for granted, all the elements of the story can be turned over and over again and be related to their surroundings. But in every story, the

researcher comes to a point where she must take things for granted, and this often happens when discussing some basic societal structures or institutions. Otherwise relativism may become a slide where you end up being unable to make any statements at all. In the story of the development of the bicycle, the narrator must take the road for granted. In the story of the development of online service I have also taken many things for granted. To explain everything that is taken for granted will be too complicated, but it is essential to do that at some point, as one might otherwise suspect that the narrator tries to sneak a particular normative concept of reality into the story.

On the other hand, the relativistic way of thinking helps the researcher reflect about things that is usually taken for granted. As part of my study of videotex in Denmark I went on a study trip to the USA to see the development of the same kind of technology, but in another cultural context. One of the things I realized was that I took for granted that the Danish telephone company would be the best actor to create an electronic infrastructure in Denmark. My point of departure was that the best solution would be to get one coherent, standardized, nation-wide electronic highway, and of course this was a task for the public authorities. By comparing the development of videotex in Denmark with the development of online services in the US I found out that I was so deeply rooted in the Danish social democratic way of understanding society that I just took it for granted that this way to do it would be the best way. However, the development in the US showed me that it did not need to be in that way.

Possibilities for Making Generalizations

Using the SCOT theory it is up to the researcher's own intuition both to find the right actors and to group them into relevant social groups. Add to this that it is also up to the researchers own intuition to choose the essential controversies to be analysed and to map out the most important elements in the different technological frames. This means that the same development, at least in principle, can be quite differently described by another researcher. Maybe another researcher will attach importance to other actors or group them differently. Or another researcher may choose other controversies as essential to the analysis. Here it becomes clear that it is impossible to make generalizations form a case study analysed with the SCOT approach.

As researcher you often meet the demand from the authorities that your studies have to create generalized knowledge which the politicians can use for their policy making. The politicians are not interested in concrete experience from certain enterprises. Neither the SCOT approach nor most of the other social sciences is able to fulfil that demand. It is simply not possible to make predictions about the future and use it for making policy on behalf of a case study no matter what approach is used. The SCOT approach points to the fact that in the next case it might be other actors involved, or maybe there will be other circumstances, other legal problems and so forth. In all cases the result of the next case will be impossible to predict, but we can use the SCOT approach to gather knowledge about the processes behind the construction of an artifact, and then make a policy that has an impact on these processes in the direction wanted.

Processes in the Social Construction

The last subject I discuss in this section is the processes of construction. As already mentioned Bijker uses the concepts of stabilization and closure to describe the processes that diminish the interpretative flexibility and at the end get the relevant social groups to reach a consensus about the artifact. It is essential to the SCOT approach to describe these processes. There is no doubt that the concepts are important to understand technological change, but they need a clearer description than the one they get in Bijkers texts.

Also other people have tried to describe what happens in these processes. Latour (1987) describes the process with the concept: *translation* of motives or interests. Feenberg (1992) develops the concept: *re-appropriation* which describes how users invent new forms of applications of an artifact. Hård (1993) argues that instead of seeing the artifact as a result of a process that ends up with a consensus among the different relevant social groups we should maybe regard it as a result of a long series of conflicts among the groups.

Just like the discussion of power relations it also would be helpful at this point to the further development of the theory to get inspiration from other theoretical approaches. Bijkers explanation of these very important concepts is not sufficient.

Conclusion

After carrying out an analysis of the development of videotex and online services based on the SCOT approach I must conclude that Bijkers work has brought us an important step further in the discussion of how we understand technological change and how we theoretically can understand the coherence between technology and society.

However, I do not see the theory as fully developed. The SCOT approach is very empirically based, and as I have argued in this article I think that the theory would be further improved if it incorporates some other theory's descriptions of the specific dynamics between the actors. Pursuant to the work with the specific analysis of the development of videotex in Denmark I have the definite impression that the SCOT approach would become more applicable if it could incorporate the more exact descriptions of the dynamics between the actors implied by the Actor-Network approach.

I also think that the critique that the theory lacks room for incorporating the macro structures and the power structures of society is important, and that the theory will have the opportunity to a further development at these points. The constructivistic approach to technology studies will probably develop in many different directions as actors involved in other scientific paradigms begin to draw features from these paradigms into the constructivistic approaches.

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