Social Constructivism and Technology

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Abstract

The "work outwards" approaches adopt a "Social constructivism" position in relation to the definition of technology. That is, as we noted in the Introduction, what technology is and what it can do are seen entirely as a "cultural product. In order to understand "te- chnology" we have to "open the black box" and "get inside" to follow actors as they engage in the making of "technology." (Latour 1987:13). The social constructivist per- spective is meant, therefore, as a strong antidote to technological determinism, one that is claimed to be a far more effective analytical "care all" than has been applied by the perspectives considered in earlier chapters. However, as we will see in the chapter, the effectiveness of constructivism in ridding analysis of technology of determinist tendencies is matter of considerable internal debate amongst the various strands which constitute this approach. Some constructivist "care-alls", it turns out, claim greater efficacy than others.

The social construction of science and technology

The implications for the "management" of change are fundamental. The essential task is either to achieve greater creativity in formal strategic planning, or to abandon the idea of rational economic decisions altogether and instead focus attention upon analysing and managing the conflict and politics inside and outside the organization. But which way is the practice to jump? The current vogue for more behavioral solutions may be tempting, but are they likely to achieve strategic change in the long time? The answer from the available empirical evidence would seem to indicate that solutions based. The origins of the constructivist approach to technology lie significantly, although not exclusively, in developments in the 1970s and 1980s in the sociology of scientific knowledge (SSK). These developments sought to move beyond previous empirical appr-oaches to the study of science, which focused on institutional arrangements and the norms, careers and rewards of professional scientists, to focus on scientific knowledge itself (Pinch and Bijker 1987:18). A particular objective here was to show how such know- ledge, rather than being a superior version of "truth" and a better "way of knowing" was in fact, in epistemological terms, no different to other knowledge systems. In other words it could be understood and explained as a social construct, that is, expla- nations for the genesis, acceptance, and rejection of knowledge claims are sought in the domain of the social world rather than the natural world" (Pinch and Bijker 1987: 18).

This approach was referred to by its proponents as the "strong program" in that it took as its starting point the view that the investigator or analyst should adopt an impartial position with regard to the truth or falsity of the beliefs embodied in any knowl- edge system. In other words, such beliefs should be "explained symmetrically" (Pinch and Bijker 1987, citing Bloor 1973). Studies that adopted this approach typically involved detailed "anthropological" and ethnographic research of scientific activity. This revealed how then process of scientific development could be seen as comprising key points at which ambiguities are present in the development of a scientific knowledge base – for example, when a controversy exists between competing theories seeking to explain an empirically observed phenomenon (see e.g. Collins and Pinch 1982).

The resolution of these ambiguities has a significant impact on the future development of the area of scien- tific knowledge concerned and much broader implications in terms of the understanding of science by decision-makers and the public at large (Collins and Pinch 1995). Explaining why one interpretation wins out over others through the establishing of its plausibility by its proponents within the scientific community, and ultimately beyond it, is a key objective of SSK.

Since the early 1980s attention has been turned by some of the SSK community to the social construction of technological knowledge embodied in individual arte facts and systems (Edge 1995). The defining characteristics of this "turn to technology" (Woolgar 1991a) have been described by three of its principal early exponents as a:

- Move from considering the individual inventor as the key explanatory concept in technological innovation.
- rejection of "technological determinism" (in particular liner/rationalistic models of the process of technological development), and
- regarding the social and the technical as a "seamless web" where no clear distinct- ions between the technical, social, economic and political elements of technology- cal development are made (Bijker *et al*. 1987:3).

For the social constructivist, the idea that it is essential capacity "within" a techn-ology which, in the end, accounts for the way we organize ourselves, our work and other life experiences is the defining characteristic of technological determinist thought (Grint and Woolgar 1997:2). In contrast, from the constructivist or "anti-essentialist" position the capacities embodied in technological arte facts are seen as the product of social ante-cedents involved in their production. As such, technology can be regarded as" congealed social relations: or" society made durable" (Latour: 1991). It follows that, seen as a social and cultural product, technology and technical systems are open to social analysis, "not just in their usage but especially with respect to their design and "technical" content (Bijker *et al*. 1987:4).

What marks constructivist approaches out from those considered so far, therefore, is their recasting of the relationship between technology and the social "as a network rather than as parallel but separate systems"(Grint and Woolgar 1997:19) or as Bijker and Law out it, "technologies are not purely technological.....they are heterogenous" and as such "embody trade-offs and compromises" in the form of "social, political, psychologi-cal, economic, and professional commitments, skills, prejudices, possibilities, and constr- aints"(Bijker and Law 1992: 10). Where and when the line between the technical and the social is drawn, therefore, is contingent.

The two principal approaches normally identified in the literature as constituting the nine examples of this "turn to technology" within SSK are: the social construction of technology or "SCOT" approach and actor-network theory (ANT). These will now be co-nsidered in turn.1.

The social construction of technology

Pinch and Bijker (1987, also Bijker 1995a, 1995b) have applied the principles of SSK to the development of what they term the social construction of technology (SCOT) approach. In this they argue that technological developed is not a longer process with only on possible outcome but rather a "closure" process during which the form of an arte- fact or system becomes "stabilised" as consensus emerges among key social groups with a stake in the design. As such the development of technology can be regarded a multidir- ectional process where a range of alternative design options exist and are gradually elimi- nated as a consensus is established by relevant social groups over what the "technology" is, what it can and cannot do and so forth. It is only through "retrospective distortion that a quasi-linear development emerges" (Pinch and Bijker 1987: 28).

The analytical starting point for SCOT is the concept of *interpretative flexibility* carried over from SSK. Just as different truth claims in science exist during scient- ific development, differing perspectives on what a technology is and can and cannot do also exist during the process of technological development. Thus, "relevant social groups" will articulate different definitions, identifications, etc. of a technology, their meanings in effect giving rise to quite different arte facts or systems in the sense that there is no "one best way" to design an arte fact (Pinch and Bijker 1987: 40). Further, just as in SSK, different definitions of technology, what constitutes a successful or unsuccessful design and so on, have to be treated by the analyst symmetricaly. That is, competing claims by relevant social groups regarding technology are to be regar- ded as equally valid. The final form of a technology does not, therefore, reflect its te- chnical superiority, but rather the social processes which establish consensus around the belief that it it *is* superior.

Alternatively, to put it another way, that a technology "works" is the result of the establishments of consensus on what a properly "working" techno- logy is rather than a reflection of any inherent technical characteristics or capabilities of the final arte fact or system.

Relevant social groups are comprised of those who share a particular set of unde- rstandings and meanings concerning the development of a given technology. These groups may include designers, employers, consumers, protesters and so on. Each gro- up will be identifiable through the different views they have with regard to the most appropriate design of the arte fact, or even whether it is a desirable technology at all. They will thus each perceive different problems and potential solutions to them.

The different goals, values, and tools for action that groups possess are derived from *technological frame.* That is, their shared assumptions, knowledge and expecta- tions or underlying belief systems in relation to the technology. These enable "thinki- ng and action" but at the same time, by setting certain parameters as to it, also constrain action (Bijker 19995a: 190). As the frame develops, such constraints become more pronounced. Thus, at the start of a process of technological development a variety of technical, social, legal and moral solutions are likely to be articulated as possible ways of resolving a range of perceived problems. This in turn gives rise to a range of views as to the most appropriate design of a technology. The thought and action of relevant social groups is thus more enabled than constrained members of particular groups, will be able to establish the legitimacy of their interpretations as to the most appropriate way to construct problems and derive solutions which inform the design of the artefact. Hence, as a technological frame becomes established it acts more to constrain thinking and action.
Once relevant social group have been identified and the interpretative flexibility of a technology demonstrated, the next analytical task for the SCOT approach is to demonstrate how closure occurs. This can take place in two ways (Pinch and Bijker 1987: 44-5). First, through "rhetorical closure" where competing designs are eliminat- ed because one is seen by a relevant social group as a better solution to their percei- ved problem (for example consensus may be reached through acceptance by social groups of an argument concerning the superiority of a particular design).

Second, through "problem redifinition" where the utility of a design is demons- trated by redefining the problem itself (for example a design which is presented as a solution to one problem without a consensus emerging may be stabilised by the devi- ce of simply presenting it as a solution to another problem which generates acceptance amongst a broader constituency of social groups).

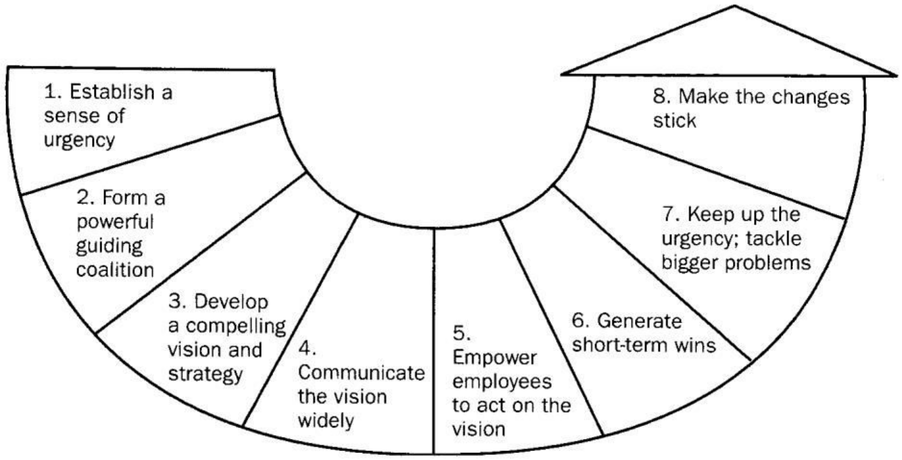
In sum, SCOT seeks to open the "black box" of technology by showing how tec- hnological artefacts can be viewed as both culturally constructed and interpreted, not just in terms of how they are viewed by different groups, but more fundamentally in terms of the actual design of technology and technological systems. This is accompl- ished by revealing how "technical decisions" are a matter of meaning, established th- rougout a social process of interpretation and negotiating (Pinch and Bijker 1987: 40).

Leading a Major Change

When leading a major change project, it is important for leaders to recognize that the change process goes through stages, each stage is important, and each may require a significant amount of time. Leaders are responsible for guiding employees and the organization through the change process.
Exhibit 1.1 presents an eight-stage model of planned change. To successfully implement change, leaders pay careful attention to each stage. Skipping stages or making critical mistakes at any stage can cause the change process to fail.

At stage 1, leaders *establish a sense of urgency that* change is really needed. Crises or threats will thaw resistance to change. Consider the situation at Volkswagen, Europe's largest automaker. Already stumbling as a result of weak sales, high costs, and an overcapacity of more than a million cars a year, Volkswagen spiraled into crisis after accusations that executives solicited bribes, siphoned money into fake companies, and arranged visits to prostitutes using company funds. Wolfgang Bernhard, who was brought in to lead a transformation, is getting support for many of his efforts because employees know the organization has serious problems and might not survive without change. In many cases, though, there is no obvious crisis and leaders have though, to make others aware of the need for change. Leaders carefully scan the external and internal environment—looking at competitive conditions; market position; social, technological conditions; and demographic trends; profit and loss; operations; and other factors. After identifying potential crises or problems, they find ways to communi- cate the information broadly and dramatically.

Exhibit 1.1: the eight stages Model of Planned Organizational Change



Source: John P. Kotter, *Leading Change* (Boston: Harvard Business School Press 1996), p. 21.

Stage 2 involves *establishing a coalition* with enough power to guide the change process and then developing a sense of teamwork among the group. For the change, process to succeed there must be a shared commitment to the need and possibilities for organizational transformation. Middle management change will seek top leader support in the coalition. It is also essential also essential that lower-level executives become involved. Mechanisms such as off-site retreats can get people together and help them develop a shared assessment of problems and how to approach them. At Master Brand Industries, transformation began with an off-site meeting of some 75 key managers who examined the need for change and discussed ways to remake Master Brand into a team-based organization.

Stage 3 requires *developing a vision and strategy.* Leaders are responsible for formulating and articulating a compelling vision that will guide the change effort, then developing the strategies for achieving that vision. A "picture" of a highly desirable future motivates people to change. A new CEO at Yellow Freight System had a vision of transforming the traditional trucking company into a service company that could quickly respond to customers' changing needs.

Bill Zollars' vision involved using a sophisticated, integrated information system and redesigning jobs so that employees had more autonomy, enabling Yellow Freight to offer one-stop shopping for a range of services and allowing customers get deliveries exactly when they wanted them.

In stage, 4 leaders use every means possible to widely *communicate the vision and strategy.* At this stage, the coalition of change agents should set an example by modeling the new behaviors needed from employees. They must communicate about the change at least 10 times more than they must think necessary. Transformation is impossible unless a majority of people in the organization are involved and willing to help, often to the point of making personal sacrifices. At Yellow Freight, Bill Zollars regularly visited terminals across the country to communicate the new direction. "Repetition is important, especi- ally when you're trying to change the way a company thinks about itself," Zollars advises. "You're trying to create new behaviors."

Stage 5 involves *empowering employees throughout the organization to act on the vision.* This means getting rid of obstacles to change, which may require revising systems, structures, or procedures that hinder or undermine the change effort. People are empowered with knowledge, resources, and discretion to make things happen. A primary purpose of investing in information technology at Yellow Freight was to give employees on the front lines the information they needed to solve customer problems quickly. The management system was also changed to give people freedom to make many decisions themselves without waiting for a supervisor to review the problem.

At stage, 6 leaders *generate short-term wins.* Leaders plan for visible performance improvements, enable them to happen, and celebrate employees who were involved in the improvements. Major change takes time, and a transformation effort loses momentum if there are no short-term accomplishments that employees can recognize and celebrate.

For example, Philip Diehl of the U.S. Mint wanted to transform the clumsy, slow-moving government bureaucracy into a fast, energetic organization that was passionate about serving custom- ers, particularly coin collectors. Diehl publicly set an early goal of processing 95 percent of orders within six weeks. Even though that sounds agonizingly slow in today's fast-paced business world, it was a tremendous improvement for the Mint. Achieving the goal energized employees and kept the transformation efforts moving. A highly visible and successful short-term accomplishment boots the credibility of the change process and renews the commitment and enthusiasm of employees.

Stage 7 *keeps up the urgency,* building on the credibility and momentum achieved by short-term wins to *tackle bigger problems.* Successful change leaders don't simply declare victory after small wins and become complacent. They use courage and perse- verance to give people the energy and power to take on issues that are more difficult. This often involves changing systems, structures, and policies; hiring and promoting people who can implement the vision; and making sure employees have the time, resources, and autho- rity they need to pursue the vision. Leaders at one company striving to improve collabor- ation, for example, found employees' energy flagging after they had achieved a short-term win that improved on-time and complete shipment from 50 percent to 99 percent. They decided to invest significant time and money in reconfiguring the plant to increase interaction of production and office personnel, thereby creating a feeling of community that reinforced and continued the change effort in a highly visible way.

Stage 8 is where leaders *make the changes stick.* The transformation isn't over until the changes have well-established roots. Leaders instill new values, attitudes, and behaviors so that employees view the changes not as something new but as a normal and integral part of how the organization operates. They use many of the ideas we discussed in Chapter 14 for changing organizational culture, such as tapping into people's emotions, telling vivid stories about the new organization and why it is successful, selecting and socializing employees to fit the desired culture, and acting on the espoused values so that people know what leaders care about and reward. Leaders celebrate and promote people who act according to the new values. This stage also requires developing a means to ensure leadership development and succession so that the new values and behaviors are carried forward to the next generation of leadership. Stage in the change process gene- rally overlap, but each is important for successful change to occur. When dealing with a major change effort, leaders can use the eight-stage change process to provide a strong foundation for success.

The Creative Organization

Leaders can build an environment that encourages creativity and helps the organization be more innovative. Five elements of innovative organizations are listed in the left column of Ex- hibit 1.2, and each is described below. These elements correspond to the characteristics of creative individuals, listed in the right column of the exhibit.

Alignment

For creative acts that benefit the organization to occur consistently, the intere- sts and actions of everyone should be aligned with the organization's purpose, vision, and goals. Leaders make clear what the company stands for, consistently promote the vision, and clarify specific goals. Leaders make clear what the company stands for, con-sistently promote the vision, and clarify specific goals. In addition, they make a commitment of time, energy, and resources to activities that focus people on innovation. Many organizations set up separate creative departme- nts or venture teams. One increasingly popular approach is the **idea incubator,** which is being used at companies such as Boeing, Ziff-Davis, and UPS. An idea incubator provides a safe harbor where ideas from people throughout the organization can be developed without interference from company bureaucracy or politics.

Creativity

The generation of ideas those are both novel and useful for improving effice- ncy and effectiveness of the organization.

Creative Values

Most people have a natural desire to explore and create, which leads them to want to initiate creative activity on their own. Unfortunately, this desire is sometimes squelched early in life by classroom teachers who insist on strict adherence to the rules. Leaders can unleash deep-seated employee motivation for crea- tivity and innovation.

Exhibit 1.2: Characteristics of innovative Organizations and Creative People

The Innovative Organization	The Creative Individual
Alignment Focused approach	Commitment
Creative Persistence Energy	Values Interdependence
Unofficial activity Nonconformity Curiosity	Self-confidence
Diverse stimuli Conceptual fluency Enjoys variety	Open-mindedness
Within-company Communication Loves people	Social competence Emotionally expressive

Source: Based on Alan G. Robinson and Sam Stern, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Fran-cisco: Berrett-Koehler, 1997); Rosabeth Moss Kanter, "The Middle Manager as Innovator," *Harvard Business Review,* (July-Aug-ust 1982), pp. 104-105: and James Brian Quinn, "Managing Innovation: Controlled Chaos," *Harvard Business Review,* (May-Ju-ne 1985), pp. 73-84.

Leaders encourage an entrepreneurial spirit by instilling values of risk-taking and explor- ation and providing the structures and systems that encourage people to explore new ideas. This **corporate entrepreneurship** can produce a higher-than-average number of innovations. One im- portant outcome is to facilitate idea champions. **Idea champions** are people who passionately be- lieve in an idea and fight to overcome natural resistance and convince others of its value. Change does not happen by itself. Personal energy and effort are needed to successfully promote a new idea. Champions make sure valuable ideas get accepted and carried forward for implementation.

Unofficial Activity

Employees need to be able to experiment and dream outside of their regular job description. Leaders can give people free time for activities that are not officially sanctioned. One study of creativity found that in almost every case the essence of the creative act came during the "unofficial" time period. Dream time is what makes it possible for companies to go where they never expected. The best-known example is 3M's Post-it Notes, one of the five most popular 3M products and one that resulted from an engineer's free-time experiments with another worker's "failure"—not-very-sticky glue. 3M lets employees spend 15 percent of their time on any project of their own choosing, without management approval. Managers at Google also keep creativity alive by letting people spend 20 percent of their time—one day each week—working on any project, they choose, even if the project doesn't tie in with the company's central mission.

Diverse Stimuli

It is impossible to know in advance what stimulus will lead any particular person to come up with a creative idea. The seeds of the idea for Post-it Notes were planted when an engineer's bookmarks kept falling out of his church hymnal. Leaders can help provide the sparks that set off creative ideas. Companies such as Hallmark, Nortel Networks' Broad Band, and Bell Laboratories/ Lucent Technologies bring in outside speakers on diverse to-pics to open people up to different ideas. Advertising agency Leo Burnett holds a regular "Inspire Me" day, when one team takes the rest of the department out to do something totally unrelated to advertising. One team took the group to a Mexican wrestling match, where team members showed up in costumes and masks like some of the more ardent wrestling fans. One idea that grew out of the experience was a new slogan for The Score, a sports network: "The Score: Home for the Hardcore." Leaders can also provide employees with diverse stimuli by rotating people into different jobs, allowing them time off to participate in volunteer activities, and giving them opportunities to mix with people different from themselves. Organizations can give people opportunities to work with customers, suppliers, and others outside the industry.

Internal Communication

Creativity flourishes when there is frequent contact with inter- disciplinary networks of people at all levels of the organization. Without adequate internal communication and coordination, ideas from creative departments or idea champions can't be impleme- nted. Leaders foster an environment that encourages people to communicate across boundaries. For example, at appliance maker Electrolux, CEO Hans Straberg introduced a new approach to product development that has designers, engineers, marketers, and production people working side-by-side to come up with hot new products such as the pronto cordless stick vacuum, which gained a 50 percent market share in Europe within two years. "We never used to create new products together," says engineer Giuseppe Frucco. "The designers would come up with something and then tell us to build it." The new cooperative approach enhances creativity and saves both time and money at Electrolux by avoiding the technical glitches that crop up as a new design moves through the development process.

Leaders can use the characteristics of innovative organizations to ignite creativity in specific departments or the entire organization. Consider how leaders at Samsung Electronics have applied these ideas to encourage creativity and get designers and engineers to come up with innovative products rather than crank out cheap imitations. By encouraging entrepreneurship, allowing for unofficial activity, providing employees with diverse stimuli, and encouraging internal communication and collaboration, leaders have transformed Samsung Electronics into a hotbed of creativity and innovation.

Many organizations that want to encourage innovation also strive to hire people who display the characteristics of creative individuals, as listed in the right hand column of Exhibit 1.2. Creative people are often known for open-mindedness, curiosity, independence, self-confidence, persistence, and a focused approach to problem-solving. Clearly, these characteristics are stronger in some people than in others. However, recent research on creativity suggests that everyone has roughly equal creative potential. The problem is that many people don't use that pot-ential. Leaders can help both individuals and organizations be more creative.

Actor-network theory

In common with other constructivist approaches, therefore, ANT (Actor-network theory) is concerned with the heterogenous nature of the socio-technical world and in particular the manner in which new socio-technical configurations come to be built or assembled and, in some instances, disassmbled. However, unlike other constructi- vists approaches it asks us to make the challenging counter-intuitive assumption that "technology" and other material as well as natural phenomena, are capable of inte- rnational astion in the same way as human agents. The key to our understanding is thus, not just the role played by human actors, but also non-human actors as they create complex heterogeneous webs of juxtaposed technical, social and natural elements. The method here is similar then to SSK and SCOT in that what is proposed is a detailed antropological and ethnographic approach to the empirical study of scientists, engineers and other "actants" as they engage in the building of the "actor-networks" which constitute the "black box" of "technology" (see Latour 1987).

For actor-network theory, innovation is understood as a process of changing net- works of social and technical relations – identities, expectations, beliefs, values, mac- hines, material resources, etc. In this perspective technology is a form of congealed social relations which "just happens to take a material form" (Woolgar 1997). The formation of new socio-technical relationships involves the alignment of an initially diverse set of actors and interests into new relationships and networks. This process can be understood in terms of the following steps or elements the outcome of which comprises a stabilised set of relationships between both human (organizational, eco- nomics, political, legal, etc.) and non-human (technical, material, natural, etc.) eleme- nts.

- *Translation*: actor-networks are the consequence of an alignment of otherwise diverse interests. Alignment is dependent upon the enrolment of different act- ors into network. This is accomplished through a process of translation whe- re the interests of actors change to accord with those prescribed by key acto- res (individuals, groups, organizations, technology) that are seeking to bring about innovation.
- *Problematization:* these key actors seek to construct scenarios which demons- trate to potential members of the network that their interests – for examp- le the way they construct problems and define their solution – are best se- rved by enrolment into the network.
- *Displacements*: once actor have been enrolled through the problematisati- on process a range of entities are mobilised to ensure stabilisation of the network.

Stabilisation is threatened by:

- *Juxtaposition:* actors are members of juxtaposed actor networks and me- mbership of other networks may be a stronger influence in the definition interests and perceived "problems" and "solutions".
- *Simplification:* enrolment in a network is thus dependent upon an actor's willingness to accept the simplification of their interests in the process of enrolment to new networks.

The role of "machinations" is given particular emphasis by Latour (1987: 108-32; see also Callon 1986). He suggests we view innovation as a rhetorical controversy where- by the resolution of arguments occurs when the "claims" of a "contender" are accepted by other actors who as a result are enrolled into the network. This might be the result of:

- a successful attempt to cater for others' interests in developing the innova- tion (e.g. the need of a finance house to make a profit);
- the convincing of others that innovation is a means they can use to achive ends which they could not achieve by existing means (e.g. the innovation provides a means of improving real time data for management);
- the invention of a new group that needs the innovation (e.g. an untapped market of workers who would rather telecommute than commute);
- persuading the enrolled group that their interests are driving the innovation (e.g. suggesting to the customer that their needs define the product "every- thing we do is driven by you") such that the distinction between "enroller" and "enrolled" is blurred; and
- Making sure that accounts of successful innovation attribute that success to the contender and not the enrolled groups (e.g. Microsoft's success is due to the entrepreneurial genius of its founder rather than the fortuitous acquisitioins of technologies developed by other organizations).

This highlights a key aspect of the building of an actor-network: the control of enrolled actors to ensure that their behavior remains consistent with that required to su- stain the network. Intriguingly, and unfortunately most difficult to grasp, "keeping interested groups in line", as Latour puts it, frequently involves the enrolment into the network of a non-human element. This is needed to address weaknesses in the existing network which are a source of dissent – for example, a design problem which threatens support by some actors for a project might be resolved by the adoption of a new techno- logy, system or component.

In so doing this enrols new ad non-human actors into the network. Of course, these non-human factors may pose new problems as they interact with other actors in the network, new components may not work well with existing ones and so on. This under- lines the shifting, unpredictable nature of alliances between human and non-human actors and network builders have to decide which actors they need to keep within the network and which they can jettison in order to achieve their goals – them- selves shifting as the web alliances and enrolments of other shifting interests takes place.

The element which ultimately ties the network together and allows it to stabilized is building of a "machine", the product as already stated of the "machinations" which gave rise to it, but which, on being built, assumes an autonomy closer to our common se- nse understanding of what an arte fact is. Again, to put it simply, a "black box" with its lid firmly closed. In this sense, the machine becomes an "obligatory passage point" which holds the human and non-human elements of a network together. If successful, the mach- ine "concentrates in itself the largest number of hardest associations.....that is why we call such black boxes "hard facts", or "highly sophisticated machines" (Latour 1987: 139).

Having said this, its proponents argue that the ANT approaches are frequently missused and misrepresented precisely because of misunderstandings over the meaning and use of the terms"actor, and "network". In particular by focusing on networks as either technical or social phenomena these entities are erroneusly reduced to distinctive and pregiven social and technological categories (Latour 1996; also Callon 1991).

The social construction of "ISTs"

The constructivist perspective was initially developed through empirical studies which, although broad and diverse to say the least in their technological focus, in the main were not concerned with contemporary developments in information and computing technology.

However, in recent years there have been numerous individual studies of ICTs and several major research programmes which have sought to apply and develop a constructivist perspective (see e.g. Setnan 1991; Woolger 1992; Bloomfield *et al*. 1992; Brigham and Corbett 1997: Orlikowski and Cash 1994). How then might this sometimes challenging approach be applied to enhance our understanding of the relationship betw- een contemporary technological developments in ICTs and organization? Can, for instan- ce, allowing computers, software, optical fibres, digital switching mechanisms, syberspa- ce and all of the other non-human entities which are captured by the "fiction" of the generic acronym ICT really cast new light, as proponents of ANT would claim, on the interaction of "technology" so constructed and organization?

One immediate issue is the continuing relevance of talking of the effects of social construction of arte facts such as computer hardware and software, telecommunications systems and so *on per se*. Rather, the "seamless web" metaphor invites us to discontinue drawing such a priori disctinctions between the "technical" and the "social". Bijker has recently suggested the use of the term "socio-technical ensemble" to reflect the basic constructivist premise that "the technical is socially constructed and the social is techni- cally constructed" (Bijker 1995b: 273). It follows, therefore, that when we talk of "ISTs" from a constructivist perspective we are really referring to a complex heterogenius web or network of socio-technical relationships or as Misa puts it, "Properly understood, "technology" is a shorthand term for the elaborate socio-technical networks that span society" (Misa 1994: 141). In short, we are no longer talking simply about technical arte facts or systems as if they were outside of or immune to the social.

With this refocusing in mind, Jackson and Van der Weilen (1998) provide one example of an attempt to provide a constructivist perspective on the evidently socio-technical phenomenon of tele working and virtual organization. They suggest that much literature on this topic has treated these ideas as an "objective phenomenon" which is "out there" in the "real world". At the same time, the field is hampered by problems of defining precisely what telework and virtual organization actually are, and ther's also a tendency to collapse these ideas into a purely technological representation. The lack of conceptual clarity that flows from the inevitably variable, and sometimes clarity determi- nistic, answers which are given to such questions means problems of gauging the extent of and predicting trends in teleworking are legion (a common observation is that there are actually more people researching this problem than there are actual teleworkers!).

Brigham and Corbett use ANT to develop a similar analysis of the emergence and development of electronic mail (e-mail) in an organizational setting. Rather than frame this issue in terms of a study of the "effects" of e-mail on organizational structures, pro- cesses or inter-and intra-communications, the adoption of an ANT perspective draws attention to the "dynamic dimensions of organizational and individual power" through which "attempts to constitute, renegotiate and/or extend a view about what is technologi- cal and what is social" take place (Brigham and Corbett 1997: 25). There is, in other words, little point in talking about the "impacts" of a technology when what the techno- logy is, what it can do, and so forth are themselves matters of social choice and negotiat- ion. It follows, that the conclusions reached about the consequences of the use of e-mail reflect, not fixed and inherent technical features of such systems, but rather "an emergent property of the interaction between e-mail and its organizational context" (Brigham and Corbett 1997: 26). Thus, Brigham and Corbett suggest the nature of this interaction can be understood in terms of how individual and collective actors engage in micro-political activities to "articulate conceptions of the natural and social words" and then "impose these on others", the success of which "generates ordering effects "such as" devices, agents and organizations" (Brigham and Corbett 1997: 27).

A preliminary assessment of constructivist approaches to technology

We will leave a full assessment of the constructivist perspective until the end of the following chapter. However, for the moment we can note a number of points of contrast and comparison with respect to the two perspectives so far considered. First, they both draw on a variety of metaphors –"black box" "seamless webs", "networks" – to help us think about the way in which technology is socially constructed and that the relati- onship between the "technical" and the "social" is a contingent one. As such, the constru- ctivist perspective can provide a means by which the multiple actors, agendas, interacti- ons and complicated web of relationships involved in "making technology" might be more adequately understood. In this respect SCOT and ANT share much common since they are both concerned with the way in which what we take to be "technology" comes to be stabilised (see Westrum 1987; Law 1987: 112-13).

In Latour's terms the "Janus-faced" nature of technology is recognised (Latour 1987: 4). That is, on the one hand, discourse around technology provides a language which describes "ready made" and autonomous machines with definitive capabilities and characteristics inherent in the arte fact or system itself and which promotes a liner view of innovation as a process where "science invents and technology applies":. On the other is the language, normally hidden and inaccessible to non-technologists, of "technology in the making". In contrast, for ANT the focus is on entrepreneurial political activity in enrolling human and non-human actors into actor-networks. The key process is one of changing meaning through discourse where rhetorical devices are deployed to effect translations of interest which ultimately yield a set of meanings that we take in common sense terms as "the machine".

Networks, for ANT as we have already noted, are not then to be seen as exclusi- vely social phenomena, or for that matter as exclusive technical (Latour 1996). It follo- ws that whether social factors exercise the key influence over the formation of a network is contingent and can only be established by empirical means. Thus:

Other factors – natural, economic, or technical – may be more obdurate than the social and may resist the best efforts of the system builder to reshape them. Other factors may, therefore, explain better the shape of arte facts in question and, indeed, the social structure that results......*the stability and form of arte facts should be seen as a function of the interaction of heterogeneous elements as these are shaped and assimilated into a network.*
(Law 1987: 113, original emphasis).

Hence, ANT sees networks as being built through a struggle with hostile or indiff- erent elements which ecompass social, economic, technological and natural elements. The resultant associations, though relatively stable and durable can be dissociated by superior forces, for example natural phenomena. .

At this point we need to note a major criticism of both SCOT and ANT from wit- hin the constructivist perspective. Both approaches make use of the "black box" metaphor. Whilst the notion that the "box" can be opened and what is inside subject to social analysis is a useful antidote to the tendency to take technology as a "hiven" in the approaches considered in earlier chapters, it also carries with it other connotations which some critics within the constructivist perspective see as far less helpful. For example, Grint and Woolgar (1997) admit that notions of "closure", "network-building" and "tra- nslation of interests" associated with the metaphor are fruitful ways of showing that there is "no one best way" to design a technological arte fact of system, "let alone a way dete- rmined by the technology itself". However they also convey the idea that once "techno- logy is designed, its capacities and effects become embedded in material form" – a black box. The point is that once constituted the technological black box appears *then* to be capable of having "effects" insofar as it "offers considerably more resistance to human attempts to use it for purposes other than those prefigured by the designer" (Grint and Woolgar 1997: 20).

It is thus the agreement of these critics that a more "thorough going" application of constructivism is needed. This day suggests would take the view that neither attitudes towards, nor control structures over, not the form, effects or use of technologies is dete- rmined: they are all elements in a negotiated order (Grant and Woolgar 1997: 20).

Conclusion

In this chapter, we have seen how social constructivists have attacked the idea that the form of technologies is necessarily fixed and derived from an immutable technical logic. They invite us to "open" the hitherto closed lid of the "technology black box" in a far more fundamental way than that proposed by the order perspectives so far considered. Just as organizational sociologists stress the role of choices in, and the negotiated nature of, the organizational outcomes of technological change, the social constructivist perspective uses the "black box" metaphor to point to the socially conti- ngent form of technology itself. Critically, this analysis extends not just to the context of the design and development of technology but to its "technical" content. We have also noted, however, that doubts have been expressed over the extent to which SCOT and ANT as primary examples of this approach do in fact avoid technological determinism. To explore this critique further we need to examine another metaphor which seeks to help us understand the interaction of technology and organization – "technology as text".

Notes

1**.** Historians of technology have also contributed to the development of the social constructivist approach. For example, Thomas P. Hughes (1983, 1987) has developed the "technological systems theory" to explain the growth and expansion of large-scale techn- ological systems. The late-nineteenth century provides a number of examples of such sys- tems, for instance electric light and power transmission systems, whilst notable early-tventith century systems might include the system of mass production in industrial assa- mbley. Developments in the Internet and global systems of computer-based telecommun- ications would constitute a contemporary examples. As with other constructivities Hugh-es is a man that no a priori distinction can be draw between the "technical" and the "social" elements of such systems. He similarly evokes the metaphor of the "seamless web" and suggests we view such "technological systems" as comprising both physical arte facts and a range of social, political, organizational and legal elements and even the natural resources upon which such systems might draw to function. Moreover, "technolo- gical systems" can be seen as highly malleable in the sense that they are both socially shaped and are themselves "socially shaping" (Hughes 1987: 51). Hughes draws attention to both "patterns of evolution" and the role of a range of entrerpreneurial actors or "syst- em builders" in shaping their form.

2. I am grateful to the DMS lunch time crew for yet another intellectual insight: may the discussions continue to range for and wide in my absence.

3. Law himself shows how the durable and robust association of network elements that enabled exploration of the African coast Portuguese explores could on occasion be readi- ly disassociated the superior forces of nature (1987: 117-18) whilist on others, following the enrolment of new allies in the form of superior ship design, in navigation and weap- onry, prove a superior form of "heterogenus engineering" able to disassociate the hostile natural and social forces encountered in extending trade into the Indian Ocean (1987: 127-9).

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