Techno-social systems in organizations

Main Description

The introduction of new electronic tools or alterations to existing ones can easily founder on user reluctance unless due consideration is given to how the technology fits into users' lives and meets their needs. This is a commonplace for technology developers yet all too often at the point of implementation, such factors are forced into second place by the glamour of the new. This paper discusses such a history in an industrial setting and describes how a team of engineers and social scientists applied a systems model to explaining the relevant cultural factors behind user reluctance in this case. The model describes the techno-social system in terms of dynamic tensions between the technology itself, the organisation of work in various settings within the company and the values, such as decisiveness, held by workers and promoted by the company. The model uncovered often unspoken and unacknowledged aspects of the nature of users' problems using a systems discourse that engineers and technicians found it easy to relate to.

Short Description

This paper describes a project to facilitate the implementation of a new online management system in a large mining and construction organisation.

Keywords

Organizational Culture
Organizational Change
Socio-technic Systems

Organisation as Subject

Construction Industry
Mining Industry

Place as Subject

Australia

Introduction

This paper arises out of a three-year ethnographic study of a large mining and construction firm in Australia, funded by the Australian Research Council in association with the host company. That project has the title *Incorporating Design Management Culture within the Total Project Management Process: A Socio-technical Approach* and is concerned mainly to describe the cultural consequences of changing work practices within large one-off projects in this sector. The purpose of this paper is to explore the uses of the label 'socio-technical'. While it is used in a number of ways, it is generally a reminder that technology is always developed and used within social systems and figures prominently in discussions of the management of technology (Liker et al 1999). The culture we are studying is populated overwhelmingly by people who have technical training in engineering or some related field, and a world view to match. This paper discusses how this technical focus influences some of the social dimensions of the industry. Although our account is drawn from a wealth of data generated through participant observation across several projects, we will take the current introduction of a new computer system as an example. As Dominique Vinck (2003) has noted, there is a tendency for the material realities of technology to disappear behind discussions of actors and their interactions. While no-one, least of all the engineers themselves, would deny the role of social processes in their work, they persist in acting as though the material reality of technology (in which we would include managerial technology) is the generator rather than the product of those social processes. We therefore want to make that perception our starting point and go on to ask what effect it has on the kinds of professional and organisational cultures, and ultimately on the artefacts, that engineers produce.

We do not want to suggest that technology is determining of social process, but we do want to depict the way technology (as work-in-progress, always under discussion) enters into varying relationships with organisational structures and motivating values to produce cultures that are fluid yet coherent. The mining and construction industries are particularly interesting places to pursue such issues. They share some aspects of the research/innovation settings of many social studies of science and technology (Bucciarelli 1994, Kunda 1992, Traweek 1988, Vaughan 1996) in that each project is to at least some extent a new and unique solution to a particular problem. But this is the production end of business and, in Australia, a significant part of the economy. This brings its own sharp constraints. On the other hand, these industries are unlike manufacturing where engineering designers develop prototypes and factories then use standardised procedures to repeat the design. In mining and construction every project is a different and unique combination of established procedures, structural constraints and new legal, social and environmental conditions and thus requires innovation as found in research settings within usually tight financial parameters. What is of interest to us is how individuals negotiate satisfactory outcomes in such situations. The present paper describes a project to redevelop an online management system for

the capture and dissemination of information in a company that deals in mining, large civil infrastructure, building and process engineering, referred to here simply as the company. It has arisen from a larger ethnographic research project which is examining the emergence of new professional roles for engineers in these settings. We take this to be a cultural question and agree with Edgar Schein (1996:229) when he says that "concepts for understanding culture in organizations have value only when they … are definable enough to generate further study." Part of our work has accordingly been to posit a useful set of concepts for understanding culture and it is this model we use to discuss the case in hand.

The Heuristic Model

Discussions of culture in professional and organisational settings often focus on the symbolic and ideational aspects of practice (Smircich 1983), a tendency that contributes to sometimes static renderings of the cultures concerned as merely a matter of unspoken ground rules for practice. It also militates against the greater definition and applicability Schein is calling for. In line with more modern thinking in anthropology (Knauft 1996), the parent discipline for the culture concept, we think it appropriate to conceive of culture as the product of negotiations between values and beliefs, organisational structures and the technology that is so important to our informants. This model is represented diagrammatically in Figure 1. The arrows are not intended to represent any necessary flow between the three nodes, but merely that each node can both affect and be affected by each of the other nodes. While in the social sciences we are used to concentrating on the ways in which technology is brought into being by particular organisational processes and embodies identifiable sets of values and worldviews, our engineering subjects are much more likely to focus on the ways in which technology affects processes and serves (largely unexamined) values. As the present case study illustrates, this has consequences for the decisions they make about managing people and processes.

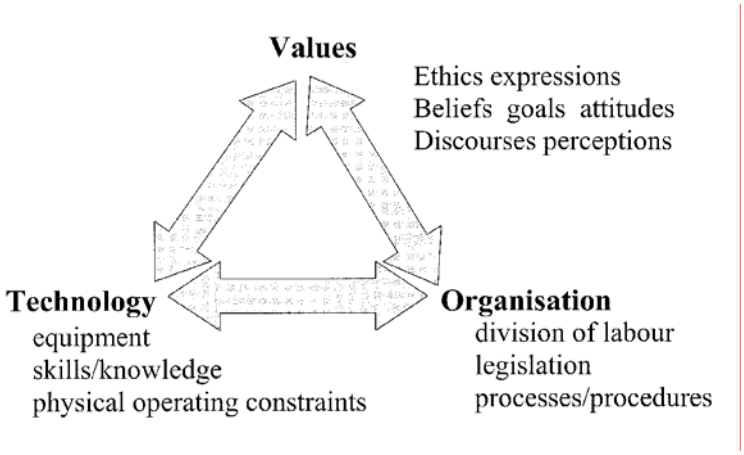

Figure 1:
The heuristic model.

The node labelled Organisation represents all of the structural constraints particular to the situation. This ranges from large-scale issues such as various legal responsibilities and types of contract to the internal organization of the firm and the division of labour within particular offices. The Values node incorporates all of the symbolic dimensions including ethics, corporate myths and sets of beliefs about the nature of the world (or how it should be) taken as axiomatic. Finally, the Technology node does not just include hardware, although we emphasised material reality earlier. In its most general application it means any tool for accomplishing the work, dealing with structural constraints and maintaining values. Although the engineers we have worked with privilege certain types of hardware and techniques for its use, much of the relevant technology is managerial, addressed to achieving right behaviour and successful business outcomes. An example of technology in this sense is the company-wide safety training system which all employees must undergo and which is ever present in on-site posters laying out its principles and various paper-based reporting systems.

After a relatively long period of struggle trying to explain this vision of the local culture to the participants we realised that it was preconceptions about culture that were causing some confusion. Insofar as most engineers were familiar with or interested in the notion of culture at all they tended to understand it as something symbolic and almost by definition not something they could or should concern themselves with. We were having trouble getting them to listen to our discussion of culture because it was a term that did not have any referent for them. We realised we needed a bridging paradigm (Toussaint 2004), some way of conceptualising and describing the issues that would be meaningful to both social scientists and engineers. We found our bridge in the engineers' concept of systems and systems analysis.

This concept can mean different things in different engineering settings, from a narrow concern with, for instance, electrical and electronic control systems, to an

iterative problem-solving process characterised as analysis-synthesis-evaluation. It is a mode of thinking that sees systems in functional terms, analysing them into sub-systems and components but understanding these as working together for a common purpose. Human actors and their influence on the system are studied as psychological or biological components of the larger system (often called Human Factors) and there is a tendency to conceive of systems as relatively closed. Figure 2, which seeks to render the complex interrelation of design and construction within a project, is a case in point. The work of the project is admitted in such an analysis to be subject to environmental, market and other external influences but the workings of such factors remain underdetermined and they themselves are depicted as closed loops.

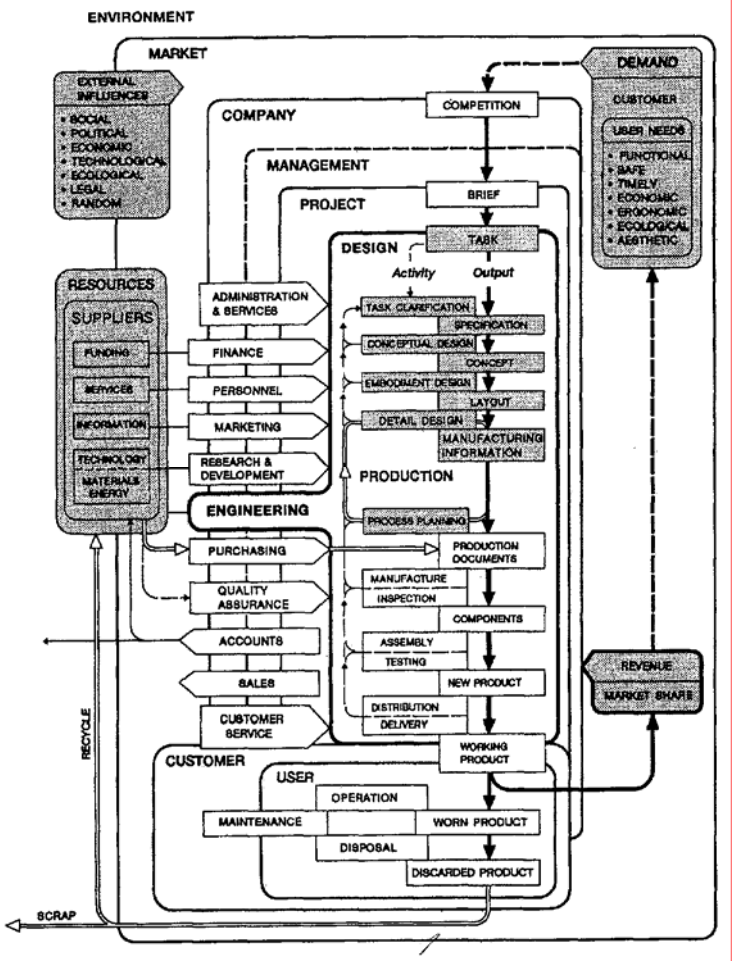

Figure 2:
An engineering systems view of large- scale projects (from Hales 1993)

Nevertheless, such a technical, functionalist understanding, which exemplifies well the techno-social orientation of engineering as a profession, has features which help us integrate ‘culture’ talk into the discussion. One such feature is the

iterative nature of the systems approach. This let us draw on engineers' understanding that their own flow charts and similar representations of process were always simplifications of a real situation that had feedback loops, false starts and changes of direction. This helped us to capture the fluid nature of the interplay between technology, values and organization in ways that engineers could respect. We may not have been being specific about the nature, amount and direction of influence of one feature on another, but they could begin to see that this was similar to moments in their own understanding of processes.

The simple use of the word 'system' rather than 'culture' was also helpful in establishing that we were talking about something they could understand and might have an interest in. The technical and not the social needs to be foregrounded because engineers (and, I would suggest, quite often corporate management too) work in techno-social systems. If understanding the social is a large part of the management of technology it must be presented within a technical frame of reference to get the engagement of these groups.

New organisational constraints, old values

Engineers are often seen, and often like to see themselves, as conservative characters. They rely heavily on what has worked before and are said to be intolerant of ambiguity (Downey and Lucena 1997). This is perhaps especially true of the construction industry. And yet, the world is changing around them and putting more pressure on them as a profession and on the businesses they work in. Around the world, universities and colleges are being called on to pay more attention to the so-called soft skills of communication, teamwork, ethics and social and environmental responsibility and companies such as this one are expected to pay attention to issues such as environmental responsibility and social impact in ways that did not obtain in earlier generations. (IEAUST 1997, Jolly and Radcliffe 2000). In Australia, governments and other clients on large-scale projects are increasingly seeking to devolve risks of all kinds onto contractors, meaning that constructors are now likely to have a thirty-year responsibility for the performance of the infrastructure they build. This requires new ways of doing engineering, including the evolution of new roles and the adaptation of technology to serve new ends and procedures. For those with the techno-social mindset, the obvious way to manage such rapid and far-reaching change is through technological interventions which, by specifying standards and procedures can be guides to action and guarantees of best practice. Yet our case study illustrates that new technology is likely to embody old goals and values and old organisational features; all the more so when such things are not given much attention..

History

The company began life many years ago as a family concern building roads and tunnels and involved in excavation and mining, and its initial success during the

1930s and 1940s was attributed to reliance on the most up-to-date machinery. Although this success required considerable entrepreneurship, it was based on 'hard dollar' construction in hard times and in some ways it set the pattern of values and processes that persist today, when the company is a multi-billion dollar part of a multinational conglomerate. The company is still proud of maintaining its own fleet of heavy machinery for many purposes rather than relying on leasing as required and company engineers themselves will joke about their love for "big yellow things". This is not surprising in a profession for whom big machinery has iconic status, in Australia at least. Likewise company engineers pride themselves on accomplishing big projects "on the smell of an oily rag", on time and under budget. Time and budget are of course the only drivers when the company is small and goes from one relatively straight-forward medium-scale hard dollar job to another, having to finish one job before the next can really begin. In the early decades the company was coterminous with the project and there was considerable pressure to get jobs finished as soon as possible, with no entangling responsibilities past handover date This was the legal and contractual environment of the time.

Although the industrial environment has changed greatly since then this history is not irrelevant today, not least because it underpins contemporary notions of success and is reflected in career and reward structures. Although the profession as a whole is being called on to pay more attention to sustainability, social and environmental impacts and although this industrial sector is operating under new legislative and contract requirements, reward structures still reflect the old 'hard dollar' days. It is commonly understood that the most senior managerial positions will only go to those with substantial experience of managing projects. In the past project managers' bonuses were paid at project completion (that is completion of construction) and reflected the savings the PM generated for the company. However, the real profit on the job is not calculable until all responsibilities associated with the project are discharged, which may be some time after project completion when any claims have been settled. There is evidence to suggest that there were cases of a correlation between high savings at project completion (and hence high financial and status rewards for the PM), and later losses. In the last few years much closer scrutiny of projects has decreased any such possibility but some senior managers feel that the pattern of project completion rewards is still part of company culture. However this may be it is however still the case that an engineer who has specialised in something 'marginal' such as environmental engineering or design management will need to move out of these fields and gain experience in old-style project management in order to progress within the company. The system is 'techno-social' in that the emphasis on narrowly technical achievement and the associated reward structures produces a culture where social and relational jobs such as community relations or design management become problematic. The persistence of old values and procedures like this also affects the attempts to introduce new management technology in 2005.

Growth and diversification

The company ceased to be a family concern some time ago. Over the last twenty years or so, since being taken over by a multinational the company has diversified into new directions, such as process engineering, and has pursued larger and more complex projects. As a result at 2nd July 2004, 51% of the professional workforce were between the ages of 20 and 40, and 42% had been employed by the company for two years or less. In the Building division staff turnover for 2003 was in excess of 50%. These figures are not just the result of rapid growth. A contributing factor is the fact that projects are organised as separate and autonomous entities, sometimes even as separate companies. This of course is in response to environmental factors such as cyclical turns in the economy and the reassignment of risk allocation and other contractual changes referred to above. While some staff move around the company from project to project, a large number of staff on any particular project are likely to have come to the company at the start of the project (sometimes from direct competitors) and will leave at the end of the project. This of course is a pattern that obtains across the sector and is not confined to this company. There are two features of this situation which are significant for the present study.

The first is the high degree of autonomy allowed to each project, whether it be the construction of a dam, freeway or process plant or the extraction of coal from a particular mine. In part this is the result of external factors such as the increased use of alliance contracts, joint ventures or similar partnering arrangements involving several companies and/or the client. In such circumstances considerable care is taken in specifying working and reporting procedures to suit all parties since sensitive information has to be shared with partners. Sometimes the flow of information back to the parent company (or sections of it) has to be blocked in order to facilitate this sharing and to ensure probity and related legal requirements are met. Since the parent company's financial success and reputation relies on the success of every individually managed project, a certain tension is likely to arise between the company's established ways of doing things (including decisions about what exactly is worthy of being done) and the requirements of each project.

Another challenge to the cohesion of the company comes from the fact that there are large numbers of employees circulating through the company who have learnt their practices and values in a diversity of places and who cannot therefore be assumed to value the company's habitual ways of doing things the way longer term employees do. Such employees come with their own ways of using technologies (some of which they bring with them), of organising their work and that of those they are responsible for, and their own value sets about what is important to do. Not only are they prone to diverge from local practice, they are unlikely to be very much interested in adhering to it more than is strictly necessary, since they are likely to leave the company at the completion of a project. This matches patterns of increased employment mobility noted across the industrialised world and said to be associated with an increase in loyalty to colleagues and a decrease in loyalty to any single company (Giddens 1990, Sennett 1998).

Naturally the company has developed policies and procedures over the years for everything from how to apply for annual leave to the procurement of major plant. There are also documents capturing past best practice. Until eight years ago, these policies and procedures were embodied in four fat ring binders full of documents on letterhead paper. We will refer to this here as the Management System (MS). When it was decided to digitise the system these documents were scanned and loaded to the company intranet. Some of them were provided in a choice of either Word or HTML form, but they were basically the same documents as had been used previously in hard copy. The company sees this management system as "provid[ing] its employees with the procedures and guidelines for the effective implementation and management of its operations." Interestingly, only "most of these procedures will be required to be followed", which might be taken to indicate some ambiguity in the status of the system for daily operations. In 2004 it was decided to undertake a review of the system to see how well it currently worked and how well it might improve business efficiencies and profitability. In the next section we will describe how the autonomy and mobility identified above and a particular understanding of the nature of corporate culture affected the early stages of the development of a new MS.

The New Management System

Early in 2004 an external consultant was hired to:

- Determine how the MS currently supports [company] business and risk management strategies.
- Review systems from other organizations.
- Identify how the MS can improve business efficiencies and profitability.
- Make recommendations on improving the current system or creating a new system.

The comparison with other organizations was undertaken not just as a matter of seeking best practice but also because the company was of the opinion that the existence of the system inspired confidence in clients and helped attract quality prospective employees. The consultant confirmed that this was the case but noted that "some people within the organization do not share this same view". Employees reported a range of difficulties with using the system including lack of clarity about what was mandatory and what was not, and the lack of clear links between compliance and performance. The consultant further identified that compliance with the centralised system was compromised by the high value placed on autonomy of both projects and of individuals. These were all identified as cultural issues but it was assumed in the report's recommendations that the culture could be changed by managerial fiat. For instance, despite reporting that staff loyalty was primarily to the project and that entrepreneurial behaviour was encouraged, the report noted that "Project staff need a clear understanding of project performance expectations and the way in which good performance contributes to [the] organization", as though all staff would automatically identify

with the goals and values of the organization as a whole. In fact, of course, culture is what you get as people with different backgrounds (values, habits, strategies) and different goals compete and collaborate over common outcomes. While clear guidelines and expectations would probably be taken account of in many interactions if they existed, that is no guarantee that they would override individual considerations of what is best for the project or of what might be most useful to an individual who needs a successful project to launch themselves into the next job inside or outside of the company. Here the company's desire for an effective level of standardisation was at odds with the organization of rewards described above, which encourages autonomy and project focus rather than company focus. Such reward structures are to be expected in a company, industry and profession which tend to value immediate and tangible accomplishment. Once again, we take this as evidence that the system is techno-social rather than socio-technical.

Despite a rather limited view of the nature and importance of culture, the consultant's final recommendations were heavily weighted towards organisational rather than technological change. A staged approach was recommended starting with defining mandatory requirements and linking them to performance, then increasing staff skills through training and exposure, followed by greater integration of the MS in project set up and monitoring. Interestingly, our informants tell us that the set-up phase is exactly when they are most likely to use the system for the retrieval of the necessary forms and procedures. The fourth suggested stage was improving the ease of use of the MS by updating content and "in the medium term" upgrading the technology base. The first three of these recommendations could have been met without change to the electronic system. In fact they are being addressed through its redevelopment. This is not just a case of technology driving social and organisational change (Agre 1995, Dunn and Kingsford 1999) but a further exemplification of the way in which the system is techno-social rather than socio-technical. In such a setting, given the prevailing values and modes of organization, using technology to bring about changes to the way projects are managed is the most likely route to success.

Introducing Cultural Considerations

In keeping with the project-based organization of the company, the development of a new MS was made into a project of its own with dedicated staff and a project control group made up of senior managers and a range of specialists.. The development team itself was almost entirely IT specialists and systems engineers until the appointment of a technical writer to polish up the team's communications. We were aware that previous technological innovations had been stymied or limited by the very strong value put on autonomy. For instance an accounting system (here called PVT) that would have allowed daily records from each project to be centrally stored and entered into monthly reports automatically was delayed by project managers' allegiance to programs they had used for many years (such as spreadsheets run on the project site) and their

reluctance to lose some degree of control over the reports. That system's rollout had been limited and considerably delayed by such attitudes and is still not as universal in the company as originally planned. We were interested in having more attention paid of such cultural realities, but we had to avoid using the kind of language about culture that the consultant's report had used, since it clearly fell on deaf ears.

Our solution was to talk to the MS developers about the way the new technology entered into systemic relationships with organisational features of the company and the professions involved, as well as the individual and professional values in play in decision-making and technology use and acceptance. They immediately agreed that we could add some value to the project but inevitably understood the issues to be different from our perceptions of them. For instance, the MS project manager was of the opinion that people thought they didn't use the system when in fact they were influenced by it unawares through working with people who were using it or under-reported their actual use and so he was entirely open to our suggestion that we map information flows within projects. We had made this suggestion in expectation of being able to demonstrate the relative isolation of projects from the main system and the reliance on personal knowledge and contacts, data which we now have. We were also asked to do some "experiments" on young graduate engineers to demonstrate the exact nature of the problems such a group (relatively inexperienced engineers unfamiliar with company processes (as most new graduate employees who are looking for knowledge would also be)) might have with using the system. To our mind, this had been demonstrated quite well in the commissioned study that initiated the MS Project but it was felt that it would be beneficial to see whether people from outside the company had the same difficulties as employees. In the end we performed three such experiments, mapped information flow through network analysis and asked participants to answer a values survey that probed their views on autonomy, collaboration and so on. Such quasi-technical approaches to qualitative description have made sense to the engineers and managers, in some cases gaining acceptance for our investigation in ways requests for participant observation had not, even if the social scientists still find the ethnographic evidence the most persuasive.

Change and techno-social systems

Discussions of socio-technical systems commonly focus on how the technology is created as much by the interactions between actors as by the manipulation of material reality. As Vinck (2003) has pointed out, there can sometimes be an implication in such studies that any mention of the strength and power of technology is mistaken. Like him, we think that a culturally-based, ethnographically derived understanding has to take account of "the way in which technicians, specifiers, and users bring to light recognized and shared performances" (Vinck 2003, 215), and in this case that means taking account of the fact that for our subjects technology is not only self-evidently powerful, it is

far more powerful than any other explanation we can offer. Any attempt to enforce a given workplace culture or direction of change that comes only from above (Cacioppe 1998, Roberts 1996, Simpendorfer 1996) runs the risk of disregarding the important role that the individual's values play in workplace culture and the way those values revolve around and are embodied in technology. This can be seen in the company's own behaviour. The company's response to changes in the organisational environment was largely worked through and embodied in a technological development – the new management system. When we approached them with the proposition that our kind of systems approach (a term they understood in their own technical sense) had something to offer they agreed to consider some of the social aspects of the implementation, but they demonstrated a preference for fairly technical investigations and numerical analyses such as the density of information networks. The question is to what extent this technological focus, seen at all levels of operation has the power to impede the company's ability to respond effectively to its changed operating conditions.

In a changing operating environment that tends to fragmentation, the company must maintain its coherence and this is likely to require changes in its management practices. It is likely that some kind of new management tool will be necessary if those changes come about, if only because in a techno-social system a thing is not real until it is embodied in a tool or process. To some extent the company recognizes the need to assess and promote user acceptance (Davis 1993, Davis, Bagozzi and Warshaw 1989). But until the links are understood between the values motivating various actors, including the company, and the habits of organization that militate against the change, little progress can be made. Where workers are still rewarded on the basis of performance measured against deadlines and construction budgets, and promotion is to be had by completion rates rather than completeness and integration, how much effort will be put into knowledge capture? Similarly, where projects are allowed to run as semi-independent entities because they are more profitable that way, why should they spend time on a set of head office directives? And the force of these questions is amplified by the fact that there is now much more fluidity in the workforce than there has ever been. No company can any longer expect employees' loyalty in the modern mobile workplce. . However these questions are finally answered we may be sure that because the actors are overwhelmingly engineers, which is to say inhabitants of a techno-social universe, the solution will be importantly technological. But it will not be able to ignore values and organization if it is to be effective.

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