Sociotechnical systems theory in the 21st Century: another half-filled glass?

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Is sociotechnical systems theory still relevant?

I have had the pleasure of working with Lisl for nearly forty years and we have a metaphor we use to assess the outcomes of our many efforts to work with organisations. For Lisl the outcome is always a half-empty glass; she is always acutely aware of all the things that did not happen. For me the outcome is a half-filled glass: I'm always surprised that anything changed at all. The metaphor seems particular apt for sociotechnical systems theory at the moment: an approach of enormous potential that has only partly delivered. Can it deliver more in the 21st century?

Both Lisl and I have firm attachments to sociotechnical systems theory. It offers concepts that help in the understanding of how an organisation actually undertakes its work and it offers processes for the design and implementation of new work systems. As we begin the 21st century, sociotechnical systems theory is 50 years old. The Tavistock Institute researchers who created it believed it was a major breakthrough in the design of organisations fit for people to work in. It has had a big impact around the world and has lasted 50 years so it has been far more successful than most organisational theories. But now many people are telling us it is old and out-of-date. Has it outlived its usefulness and should it now be consigned to the history books? On the other hand there are people in the information technology industry who are now beginning to use the term sociotechnical. Is this a sign of a renaissance? Unfortunately, when I look at their use of the term, I find that very few understand its theoretical and practical richness. In this paper I want to consider the concepts and methods in sociotechnical systems theory that are relevant to the world of business today and to suggest some ways in which we might need to reformulate the theory so that it can make a real contribution to the information age. Maybe we can yet top up the glass.

So what do people say about sociotechnical systems theory today? There seem to be three kinds of statement:

- It was a theory about the kind of manufacturing jobs we had 50 years ago and since we don't have those kinds of jobs in the developed world now it is not relevant.
- It was a theory about autonomous work groups, job enrichment and worker democracy and we know all about that now
- Sociotechnical systems are any in which people use ICT as a communication medium. So it can help us understand phenomena like social networking. The

old idea that the organisational context is important is no longer a central issue.

It is certainly true that the first sociotechnical systems studies were undertaken in coal mines and weaving mills and that what they demonstrated was the disruptive influence of new technology on jobs (Trist et al 1963, Rice 1958). It is also the case that the solutions that the early sociotechnical systems designers came up with were to find new forms of organisation that could work with the new technical systems and provide good quality jobs. In most cases the organisation design involved autonomous work groups and one result has been that, in many parts of the world, sociotechnical systems theory became synonymous with autonomous work groups.

It is also true that the sociotechnical systems of interest to the original researchers were work systems in organisations. Many of the significant concepts in the approach are organisational so a sociotechnical approach that is not organisational is a rather different beast. I am following sociotechnical systems developments that do not have an organisational focus with interest but, for me, the real strength of sociotechnical systems theory is as an explanatory framework for organisational life and my comments here will stay within this frame of reference.

In the terms in which they present their comments it is perhaps not surprising that so many people think the approach is dated. What is missing, however, is an appreciation that the approach offers a theoretical framework that has enduring relevance. What is important to me about sociotechnical systems theory is that it provides a way of understanding the complex way in which people at work co-operate and use tools and technology to get their collective work done. It helps us understand how the operational reality of working life achieves the goals of the organisation. It does so by treating the collection of human and technical resources in the organisation as a system producing work and focuses on the interdependencies between the people in their respective work roles and the technical artefacts they use to get the work done. Two properties of this work system seem to me to be all-important. First, if you change one part of the system (say bring in a new technical system) the interdependencies mean there are knock-on effects that may be positive for performance but equally may lead to dysfunction in the overall system. The second point is that the work system is an open system; it is subject to changes in its environment, to the inputs it takes in and to the market for its outputs. A successful system is one that can adapt to the turbulence of the outside world and it is the people in their work roles who do most of the adapting. An important question is whether the technical systems they use are capable of supporting this adaptation; if the technology is not flexible it can become an obstacle to adaptive behaviour.

I find this version of sociotechnical systems theory a very useful framework for analysing how a work organisation functions and for contributing to design processes that will create new sociotechnical systems. I've had the pleasure of using this framework in working with Lisl both to study existing work organisations and to contribute to the design of new ones. Lisl has been an ardent proponent of the use of tracer studies in order to study how work actually gets done. From her early studies of control systems in the manufacture of soap (Klein 2005) to her studies of the impact of electronic patient records on the treatment of patients in hospital wards (Klein 2001), she has demonstrated the value of tracking what happens as the real work

process unfolds – what happens to the soap and what happens to the patient shows the interdependencies in action as the work passes from person to person and different facets of the technology are called into operation. The striking thing about this approach is that it is grounded and real – it reveals how the work is actually done, how people get round problems, whether the technology is helping or hindering, how the work of one person impacts on another etc - and this is often different, more subtle and more variable than the operations manual that prescribes how it is supposed to be done. Working through the process is also a fundamental feature of the way Lisl has contributed to the design of new systems where she has often been trying to get designers to explore the work organisation implications of a new technical system that is being created. In the development of a new factory for Trebor for example, she played the role of a lump of sugar being processed by the new technical system on its way to becoming a mint (Klein and Eason 1991). The designers found this a very useful way of exploring the systems implications at each point in the new process and of questioning what design options were available to deal with the implications.

I believe that these ways of using sociotechnical systems theory for analysis and for design continue to be relevant and are what we need to build on as we apply the theory to the information age.

The organisational implications of information and communication technology

My specialism has been the impact of information and communication technology (ICT) on organisations and the sociotechnical design of work organisations where ICT is the fundamental part of the technical system. Sociotechnical systems theory has been of great value in this work but I have had to rethink some aspects of it to make it relevant to the issues that have emerged. I want to report some of the major conclusions that I, and others, have reached about what happens when organisations adopt major ICT systems before examining what these findings mean for the development of a contemporary version of sociotechnical systems theory.

Many organisations today operate in an increasingly virtual way – their staff may be geographically spread around the world and many of them might be working from home. The organisastions may work in a tightly interdependent way with their suppliers and their customers. They may be part of a closely coupled 'supply chain' and significant parts of what was their business may now be 'outsourced' and might indeed be undertaken in another country. These ways of working are only possible because the work process is mediated by information and communication technology. The technology makes it possible for people to share information across the globe. However, to report this as an exciting brave new world in which the technology makes everything possible, masks the conclusions of countless evaluation studies of what happens when these forms of technology are introduced into organisations.

The majority of ICT implementations are technical systems introduced to update or 'modernise' existing work systems. Quite frequently companies have undertaken a 'business process analysis' and are looking for ways of 're-engineering their business' to make it less expensive, more streamlined etc. They then turn to ICT suppliers for the electronic systems to support the new vision of the business process. It is increasingly the case that IT suppliers offer 'enterprise' systems that incorporate a range of information storage, processing and communication facilities to support the

business functions of organisations. These systems are largely standardised but may be customized to fit the needs of specific companies. Since the technical systems are designed to support the interdependent parts of the business process, any company that implements them finds there are implications for their work organisation and working practices. There have been many evaluation studies that have studied what happens when these kinds of systems are implemented in an organisation. What the figures show is a higher failure rate or a painful and partial adoption of the new technology. What they show in particular is the way the existing sociotechnical systems responds to the new technical system and how new systems behaviour emerges which is often not what was intended. What is striking is the way the existing sociotechnical system, geared as it is to the day-to-day operations it undertakes all the time, treats the new technical system. The researchers who have studied this process do not use sociotechnical systems terminology to explain their findings but other, related, concepts. Pinch and Biker (1987), for example, use the term 'social construction of technology' to discuss the way the technology is interpreted and used in local settings. Similarly, Orlikowski (2000) describes how users have 'a practice lens' through which they determine how they will use technical systems in the work they do. Abdelnour-Nocera (2005) studied the use of an Enterprise Resource Planning (ERP) system in companies in different countries and gives many examples of different patterns of use emerging from the use of the same technical system. One common occurrence is that the existing technical systems continue to be used alongside the new one. Many electronic systems are introduced, for example, in order that there can be 'paperless offices'. What happens, however, is that people find ways of using both electronic and paper resources and 'paperless offices' remain very hard to find. All of these studies point to the active way in which local staff respond to technological implementations by adopting and adapting them to local circumstances.

In my own evaluation studies I too have been struck by the active response of the existing sociotechnical system but I have drawn attention to two contrasting responses. There are many circumstances where the technology is not directly coupled into the way the work is done and users have a choice of whether or not to use it or whether to use some features of the system rather than others. In many cases new systems do not get used or only a small part of the available facilities gets used. In other circumstances it is necessary to use the technology to get the work done and sometimes the way it works does not fit what the user needs to do. I am convinced that a lot of the creative energy of people at work is devoted to finding 'workarounds' in these situations that enable them to keep the work flowing. The one general conclusion is that, faced with having to do the real work, the existing sociotechnical system finds ways of assimilating the new technical system that are often not what the planners had in mind (Eason 1996).

Sociotechnical interventions in the implementation of ICT Systems

It can be argued that the many researchers now working on the organisational implications of ICT systems have developed their own theoretical frameworks for understanding these phenomena and have no need of sociotechnical systems theory. I wish to argue that sociotechnical systems theory has a number of important contributions to make that are missing from the current accounts in this field.

First, in order to account for new and emergent behaviour patterns, these authors often point to a mismatch between the existing work culture and the prescriptive assumptions that underpin the new technology system. A sociotechnical systems perspective can give insights into the reasons for emergent behaviour that have more to do with the reality of the work to be done. By looking at the work process and the many task interdependencies within it, emergent behaviour may be seen as a way of managing the potential knock-on effects of the new system. Medical staff using an electronic patient record may, for example, be happy to use it to store administrative information but wary about using it to record information about their tentative clinical conclusions because they do not know who will subsequently have access to the information. As a result the emergent behaviour is to use the administrative functions of the system and to ignore the clinical ones. This is not about trying to preserve the culture of an existing working practice but about assessing the possible implications of new working practices.

Another important contribution of the sociotechnical framework is the recognition that the work system is an open system. The work process and all the interdependencies within it have to cope as the environment throws up new challenges. One of truisms today is that the fast moving business world needs resilient and adaptive organisations. But too often the findings of these evaluation studies are that the new technical systems are not adaptive; staff dealing with new situations find their technical systems do not help them. Clerks using the phrase 'my computer will not let me do that' is now a common source of irritation to customers. By tracking the way changes in the demands on the system flow through the work process, a sociotechnical systems analysis has the potential to identify where flexibility and adaptation will be needed and this can be fed into the design of both technical and organisational subsystems.

But the major contribution is to the design (or redesign) of sociotechnical systems. Many of the authors who point to the emergence of new behaviours following the implementation of new technology seem to feel that this is an indication that the sociotechnical system is capable of self-organisation and that a new form of work system will emerge. There is no need therefore for the researchers to play an applied role and to intervene in the development of the new working system. It is undoubtedly true that new systems behaviour will result and it is unlikely to be in the form planned by those who commissioned the technical system. However, the emergent behaviour is likely to be a collection of piecemeal adaptations by individuals as they cope with the new situation that confronts them; the results may be beneficial for the work process but they are just as likely to be dysfunctional. The coping behaviour of one person may simply feed through the task interdependencies to make the work of another person more difficult. The results are often piecemeal and covert and may not lead to an effective local sociotechnical system.

Sociotechnical systems theorists have always been interventionists. A fundamental aim of sociotechnical systems design is to integrate the social and technical subsystems. Lisl has always insisted that in most circumstances there will be 'splitting' – those designing the technical system will have little direct contact with those who shape the social system – and intervention is needed to ensure there is integrated design. As a result sociotechnical systems thinkers have devised sociotechnical design processes that seek to design the subsystems together in order to

achieve an integrated system. However, it is rare for ICT systems to be implemented in this 'greenfield' way. It is much more likely that the new technical system will be introduced into an existing sociotechnical systems and design will consist of looking for ways of modifying working practices, the technical facilities and the local work organisation so that the whole system is more effective. So what form of sociotechnical design intervention can be helpful in this setting? We need participative processes in which the stakeholders (designers and users) can work together on the sociotechnical issues of implementing a new ICT system. In her many design contributions Lisl has consistently emphasised the need for some kind of transitional system to be created that can allow new ideas to be explored and developed. In this particular case, because the existing system usually has to stay operational throughout any change process, it can be difficult to create the time or the space for people to do sociotechnical planning. We need time and space in which several things can happen. First, it has to be a space in which the people who might use the new technical system can explore what it might mean to use it in relation to their working practices. Secondly, it is a space in which people can see how, if they changed their behaviour, it would help or hinder other people in the work system. Thirdly, it is a space in which technical staff and users can meet to develop a shared understanding of the overall system that is needed.

There are a number of ways in which time and space can be created for these purposes. An ideal arrangement is to implement a pilot or prototype technical system into part of the organisation. We were able to do this in one of the branches of a national freightforwarding system (Klein and Eason 1991). This provided staff and technical experts with the opportunity to try the system and understand its organisational implications. In this case, the effect was dramatic. The company saw that the system could challenge the entire working practice of its branches and it changed its mind about the kind of system it should implement. Unfortunately, the live running of pilots can be an expensive process and in many cases may not be possible. An alternative is to create sociotechnical scenarios in which case study narratives are developed in which work is carried out by the existing social system but with a vision of the new technical system in place. These scenarios can then be a focus for meetings in which the various stakeholders come together to work through the implications of these visions of potential futures. During her work at Greenwich Hospital, Lisl was struck by the way the staff there had created their own scenario to explore the inter-departmental implications of a new computer based information system. (Klein 2005). They had created a patient called 'Poor Old Henry' who had everything wrong with him and they used his need of many departmental services to explore the use of the new system. We have recently used this kind of approach in another part of the health service to help staff understand the implications of one of the electronic healthcare records applications being implemented as part of the NHS National Programme for Information Technology (NPfIT) (Eason 2005). The key feature of this work is to create a sociotechnical vision of what it would be like to work with the new technology and to help people examine its implications. If this is done before widespread 'roll out' of the new application there are often opportunities to redesign work practices, the technology and the work organisation to create an effective sociotechnical system.

One important message from this work is that it is not just about accepting the technology and looking for alternative forms of work organisation that might be

compatible with the new technical system. In the freightforwarding case, the work led to a search for a more compatible technical system. In the health service cases, the technical system was 'a given' but it offered choices in the way it could be implemented at many levels. When he formulated his principles of sociotechnical systems design Cherns (1976 and 1987) included 'minimal critical specification' by which he meant that designers should leave as much flexibility as possible so that people could do local design to match the system to what they needed in their particular work situation. Current multifunctional electronic systems tend to be a strange mixture of tightly constrained ways of working and lots of opportunities to adopt or ignore functions and to implement them in different ways according to need. There can often, for example, be opportunities to configure a system in different ways for use by a work team so that either everybody has access to everything or people with specific responsibilities are the only ones with access to and the right to change particular parts of the system. Too often these opportunities are not explored by local staff and the system is implemented in standard 'default' forms that the users may then assume are the only ways in which the technical system can be used. Having struggled to get 'minimum technical specification' into design thinking, sociotechnical workers now have to recognise that users may be ill-prepared to make use of the flexibility now available and may have to develop new methods of uncovering the opportunities and helping users to explore them.

Another lesson from the research on the implementation of these systems is that, however much planning precedes implementation, the work system will continue to evolve. This may be because it takes time for staff to gradually explore new ways of using the technology or it may be because the demands on the work system from its environment continue to change. Whatever the cause, there is a need to keep the sociotechnical system under review and we have found that this process can be stimulated by adopting an action research approach, in which data is gathered regularly about how the system is working and this is reviewed by staff who can take action to re-design the system. For example, in the continued evolution of the Zetoc system, an electronic information system that provides universities with bibliographic information about the holdings of the British Library, we undertook three data gathering exercises over a period of three years that were used by design staff and users to re-shape the service (Eason et al 2006)

Lessons for sociotechnical systems theory

In finding ways of using sociotechnical systems theory in relation to the adoption of ICT in organisations, I have found myself giving emphasis to some aspects of the theory and making relatively little use of other aspects.

For many of us who have devoted much of our careers to concerns about the quality of working life, to matters of job design, job satisfaction and worker democracy, it is a matter of sadness that these aspects of importance in sociotechnical systems theory have relatively little contribution to make in most applications of ICT t organisations. There are several reasons. One is that in most of the organisations where these applications are being made, most of the staff already have challenging jobs. They are not looking for job design to increase their job satisfaction; they are less concerned about getting more variety or discretion into their jobs than they are with finding ways of coping with the stress of tight deadlines, rapid change and new demands. They are

looking for technical systems that will help them cope and do not become additional bureaucratic barriers. There is one class of jobs – in call centres – where the need for work on job design and job satisfaction remains important. Call centres have been called white-collar assembly lines because the computer often controls and paces the rate at which staff are allocated calls and good job design is desperately needed in these applications. Another reason why these issues are not prominent in other applications is that, when ICT is implemented, there is usually no intention of making major organisational changes. Rather we are talking about a process by which the new technical system is assimilated into the existing work system and the need for organisational change emerges over time as the assimilated process reveals problems and opportunities.

The aspects of sociotechnical systems theory that have enduring relevance are those that emphasise the reality of the work process and the interdependencies it creates between people and between the social system and the technical artefacts. The theory is particularly helpful in understanding the implications of a new technical system for an existing sociotechnical system.

I have found it increasingly useful to adopt a resource utilisation view of a working sociotechnical system. In this view the current working system is seen as making use of some of the human and technical resources available to it. It has long been obvious that working systems often only make use of some of the potential of the human beings who work in the system but, in relation to ICT, it is now also true that the working system often makes use of only part of the technical resources at its disposal. When a new technical system is implemented it is usually treated by the current working system as an extension of the available technical resources. The outcome of implementation is often that some of the new resources are harnessed in the work that is done and the rest are ignored. The main function of the intervention strategies described above are to make this less of a piecemeal assimilation process by providing the reflective spaces in which local re-design efforts can be made to assess whether there are now better ways of utilising the human and technical resources available to meet the challenges of the work process.

Conclusions

In the 50 years since sociotechnical systems theory was introduced it has evolved in many different ways. It has had a vital role to play in the never ending struggle to integrate the social and technical components of every working system. If it is to remain relevant and be developed further it now has to contribute to a world in which flexible, multifunctional information and communication technologies are being regularly implemented into existing operational work systems. I believe it has a particular value in helping us understand what happens when an ICT system is implemented in this way. Of even greater importance, it also provides us with the tools to help people in these working system engage in local sociotechnical systems design work so that they are able to harness the growing sophistication of the technical resources to their operational ends.

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