2003

Information Systems Strategy and Configural Technologies: Cases froom the UK Public Sector

Keith S. Horton
Napier University, k.horton@napier.ac.uk

Information Systems Strategy and Configurational Technologies: Cases from The UK Public Sector

Keith S. Horton
School of Computing, Napier University
Edinburgh EH10 5DT, UK
Tel: +44(0)131-455-2700, Fax: +44(0)131-455-2727
k.horton@napier.ac.uk

Abstract

This paper draws upon symbolic interactionism in order to assess and discuss the findings from a longitudinal, single sector, case-based analysis of information system strategy (ISS) formation within two public sector institutions - institutions that are often characterised as bureaucratic in form, and culture. Each case acquired sought large, complex applications off-the-shelf that required customisation. These are discussed as configurational technologies. The research has been informed by differences in perspective about the nature of ISS formation as reported in the literature - with discussions of ISS often portrayed in bi-polar terms; e.g. ISS as either planned or emergent. Literature suggests that the greater the sectoral stability, and the more oriented towards bureaucracy the institutional form, the more likely ISS planning will be formal - as opposed to emergent or evolutionary for example. First, an argument is presented against the logic of bi-polarity that is evident in many debates about ISS. Second, a case is made for the use of interactionist thinking as a means of better understanding the political processes that shape ISS formation. From symbolic interactionism, we utilise concepts of social worlds, trajectories, and boundary objects. Findings from the empirical study are presented, from which the discussion focuses upon the social shaping of trajectories, and the politics of configuration as constituents of the complex practice of ISS formation.

Keywords

Information system strategy, formation, politics, symbolic interactionism

1. Introduction

This paper reports upon research looking at information systems strategy (ISS) formation in institutional settings that can be described as highly bureaucratic, with rigid hierarchies, and the potential for autocratic behaviour – the UK Police Service - where the environment is relatively stable. It is argued that ISS may be more appropriately understood social shaping through interaction, where information technology, and organisation based practice are mutually constitutive (Mackenzie & Wajcman, 1999). It is neither information, nor technology, nor organisational context, nor people alone that determine 'an outcome' - instead, we believe that it is through the mutual interaction of these areas, which are inseparable, that futures are shaped.

2. An Interactionist Perspective

ISS is distinguished from general business strategy through being specifically concerned with strategy related interactions and interpretations surrounding information technologies - strategy as practice (Jarzabowski, 2003). Views that take for granted the existence of a 'strategy process' that has universal recognition, and acceptance within an organisational setting are to the detriment of focussing upon the social practices surrounding the development and application of technology strategy (Coombs et al, 1992). Studies arguing that ISS formation comprises activity that is embedded within the wider social discourses that take place as part of organisational life (Salmela *et al*., 2000) have become more numerous. Nonetheless, research suggests that bureaucratic, or even autocratic, contexts may be more likely to exhibit formal ISS planning (e.g. Peters, Heng, & Vet, 2002).

This paper draws symbolic interactionism, which is valuable in aiding both exploration, and subsequent reporting, of the uncertainty and unpredictability inherent in technological change - of which ISS formation is an important aspect. Symbolic interactionism, from an organisational perspective, is concerned with the way in which meanings are constructed and reconstructed through workplace interactions between people, in specific contexts. This means that it is not purely focussed upon human interaction, but rather, the interactions between people in situated practice, where technology is present and where technological possibilities are shaped. Three premises underpin this view of interactionism (Blumer, 1969; Gopal & Prasad, 2000). Firstly, that actions are based upon meanings that people have derived from the situation. Secondly, that the meanings associated with social and non-social objects or symbols arise through interactions between people, and finally, that these meanings may be reconstructed as people continually interpret and reinterpret the developing situation. This interpretive flexibility, which surrounds the application and usage of information technologies in organisations (Williams & Edge, 1996), undermines the credibility of realist approaches to ISS which assume unitary, and consensual viewpoints amongst people at work.

In the light of this, three concepts are used to shape the discussion: social worlds, trajectories, and boundary objects (see for example, Garrety & Badham, 2000). 'Social worlds' acknowledges the multiple meanings surrounding technologies-in-use as well as technologies-under-consideration. Looking at roles is one means of distinguishing between groups of people who share certain sets of meanings, access to/use of artefacts, and areas of activity (Gopal & Prasad, 2000). 'Roles' reflect "the socially defined expectations of behaviour for individuals in particular social positions", and providing, "individuals with a complex set of identities, which become the source for individual interpretations of social situations "(ibid. p.514). Examples of ways in which 'roles' may be differentiated include: hierarchy, status, expertise, interest, affiliation, and association.

The concept of trajectories can be subject to misinterpretation. It does not (in our usage) imply inevitability of outcome. Nor does it infer that the presence of specific factors will determine an inevitable outcome, or that a particular path of activity will continue in a foreseeable manner. Instead, the concept draws our attention to the evolution of phenomenon *over time*, and to the interactions contributing to the shaping of the phenomenon. In ISS formation, related activity may incorporate planning, use of analytic frameworks, and even software - all of which may be considered as trajectory schemes (Garrety & Badham, 2000). Such schemes "may shape the trajectory, but they do not *constitute its totality*... It is the interrelationships between schemes and the contingencies that occur along the way that constitutes the politics of the project" (ibid. p.106, original emphasis). This draws attention to the interactions shaping phenomena over time.

Finally, the concept of boundary objects refers to "anything that can be indicated, anything that is pointed to or referred to" (Blumer, 1967, p10). Typically, these can be categorised into physical (artefacts, people), social (work-groupings, experts), and abstract objects (theory, power relations). However, objectification must not become the focus of the exercise, as this would be to the detriment of understanding socio-technical interactions and multiple meanings.

3. Empirical Study - Context & Method

The authoritarian top-down structure of UK Police Forces has been categorised as highly bureaucratic (Loveday, 1993), which is why they were chosen as a venue for investigating ISS formation. Interpretive in-depth case studies are recognised methods for conducting IS research (Darke et al, 1998), with the longitudinal, cross-case comparative analysis covering the period 1994 to 1998. Data collection involved a number of methods, principally: fifty four in-depth semi-structured interviews of 2 hours duration on average, numerous on, and off-site informal conversation, participation, collection of documentation produced by the people involved, and collation and analysis of secondary materials produced outside of the direct areas of study. Key themes were developed having abstracted a range of issues from data coded with the aid of a software tool – NUD*IST.

We are acutely aware of the sectoral distinctiveness of the cases. However, the intention is not to develop generalisations to other contexts, but instead to focus upon developing analytic propositions to a wider body of theory (Walsham, 1995). The anonymity of each Police Force has been preserved, as has that of the interactors.

3.1 Case A

This police force was responsible for policing a city and a large area of surrounding countryside. Prior to 1993, the IT infrastructure was generally poor, having been starved of development following the installation of a command and control system in 1983. Staff in the Force had access to the few national IT systems that existed, but otherwise were dependent upon stand-alone PC based systems.

At the end of May 1993 a new Deputy Chief Constable arrived, and ordered the IT Department to prepare a specification to acquire a range of IT applications with a view to transforming the IT capability of the Force. The aim was to acquire off the shelf applications as far as was possible in order to reduce delay in implementation, and cost, as far as possible.

At a meeting in mid-1993, the new Deputy Chief Constable referred to the need to have a strategy for IS in the Force. The development of an operational requirement for a new system was seen by those involved as just that, the development of an IS strategy. An operational requirement was drawn up by a group consisting of two mid-ranking officers and the Computer Manager. This group were in continual contact with the deputy Chief Constable, both through formal fortnightly meetings, but also through informal discussion on a sometimes daily basis. This informal communication took place more frequently between the Deputy Chief Constable, an Inspector and the computer manager; it was these three people who were perceived to be the main people responsible for developing the IS requirements. The operational requirement was a three page document, and set out the current situation in the Force together with what was required in broad terms. As one person involved in this process commented, *'we deliberately left it open so that when we are in the phase of the project where we are ready to look at what personnel system, we can then say 'right, what is*

the best that is round just now', and not say 'well four years ago we signed up to get that and really it has been overtaken .. so we tried to keep our options as flexible as we possibly can .. not without heartache because the industry has found it difficult, they want to speak about deliverables and signing off parts of the contract".

This operational requirement was couched in broad terms, and did not give detailed requirements beyond the required application titles. The rationale behind this was expressed as follows: "*give the expert the problem and let him come up with the solution, don't give the expert the solution because you will get what you asked for*".

A supplier, who was an international IT vendor, was chosen following a competitive tendering process. All except one of the software applications to be adopted were already in existence, although each would require some customisation for the Force. The one application that was bespoke, a command and control system, was delayed when a senior police officer decided after the contract had been signed to standardise the Force on Windows NT, rather than continue to use Unix - which had been the intended operating environment. The supplier contracted to provide 'best of breed systems', a term which provided the Police team with an area for debate. During 1995 and 1996, as applications came to be considered, the Police team demanded best of breed systems at that point in time, and not what was best of breed when the contract was signed in February 1994.

A project management board was set up in 1994 to oversee the project, and this met every six months for three years. The meetings were not documented in anyway, and were regarded as 'rubber stamping' exercises by those involved. The project formed the basis for IS development in the Force between 1994 and 1998. An acronym for the system was devised, but a view expressed by many staff was of it as, "*the Deputy's IT project*". Most of those closely involved were of the view that the project was the strategy, and vice versa. Among other senior Officers opinion varied; namely that there was not a written ISS as such, just a shopping list of applications, progress towards which had in their view been determined and driven by the deputy Chief Constable. However, as one of the Officers involved in developing the operational requirement commented, in 1996, when considering ISS, "*it's all in our heads, we don't have time to sit down and write a strategy*". In 1998, another member of that group observed that, "*we don't have as such a strategy document that we can hand out, we are working to the philosophy of strategy rather than to the word of it..... So .. the documentation, there isn't a lot of it, we tend to be working by 'hmmm that sounds a good idea let's try it and see'*".

3.2 Case B

The second case study, Force B, also covers a city, together with a large area of countryside, which includes several large towns. The technological infrastructure in 1993 was seen as a significant factor in spurring the development of ISS, in that the lease for the mainframe based system was due to expire in 1995 after some 15 years of usage. The people with influence over ISS in 1993 comprised a small group of police officers within the IS Department, and a civilian IS Manager (who had no authority initially within the hierarchy). The executive level were perceived as disinterested in IS, with no champion for IS.

The common view of those spoken with was that the concept of IS strategy only came to be considered by Police Forces in the early 1990s following the publication of a series of Home Office circulars and Audit Commission papers on strategy and IT. These factors, together with inspection visits by the Inspectorate, were said to have ‘concentrated the mind’ of many senior staff.

In 1993, the IS Manager suggested that they should consider developing an ISS for the next few years. As one of the Officers in the Department noted, "*we never had a strategy that has been documented and stated in the past, it evolved through a series of separate developments and it is only now that we are trying to pull them together*".

In the IS department, ISS development was seen as a response to the ending of the mainframe lease in April 1995. Viewed in combination, these factors were said to have highlighted to the senior staff in the IS department that they needed to develop an ISS. Other senior officers, outside of the IS department, seemed unaware of the lease expiry, or were dismissive of it as a stimulant to ISS. A common view expressed was that the existing systems were in a mess, and that it was about time that something was done about them. The following comments from a senior officer reflect the views expressed by many others, "*you only have to look at the hotchpotch of different computer systems that we've got, that we've built up over the years to realise that this is how to build up an information gathering system when you hadn't really thought about what you want to achieve in the first place. I mean, it's a dogs breakfast*".

In 1994 a project board was set up to monitor the ISS. Some senior police officers, generally those with operational responsibilities, viewed this as a necessary device to monitor the project given the poor track record in delivering IT projects in the past. Some of those officers with greater responsibility for IT viewed the project board as signifying a lack of trust in their ability to deliver. A viewpoint more widely shared was that such procedures were necessary to satisfy the expectations of external agencies, such as the Inspectorate and the Audit Commission. In 1994, it was generally agreed that for an IS development to be accepted, there must be a strong emphasis upon assisting operational officers. The most senior officer on the project board summed up what he was seeking, "*you build up your IT strategy by saying 'what is the bloody strategy of the Police Force, what actually are we here for', We're here, I think, to lock up bad people, look after good people, and keep order on the street. We do that by getting the maximum resources employed at the sharp end by keeping paperwork and bureaucracy to a minimum, by using civilians at every possible post we have and by denying Police officers every excuse you can find to come in out the rain and that sort of thing. You then develop your IT strategy around that philosophy*".

At this point, members of the project board envisaged ISS as a five year plan, although as was noted, "*I would think that every year you would want to stop and reassess your .. not change direction but perhaps the course, because perhaps what someone asks for now is not technically feasible but in two years time it may well be, so you've got to have the flexibility in the strategy to deal with that*".

By 1995, most people were reassured that the documented ISS had been thoroughly thought through, and that it reflected trends in industry. The executive level officers reassured themselves of this by engaging a nationally known firm of IT consultants to provide a review on the work undertaken. Following this, a request for expressions of interest in supplying the required applications was then sent out. Following submissions from 12 companies, a shortlist of three possible suppliers was drawn up by the IS manager and several senior police officers. Following a short series of meetings between members of the Project Board and the shortlisted companies during May and June 1995, a firm was appointed as the lead supplier. In September 1995, a contract was signed for the delivery of ten applications and a new data network. The budget for hardware and software was £3.3 million, with a further £500,000 being allocated for the network. The applications were not bespoke, but did require customisation.

1996 and 1997 were spent working with the suppliers in developing the new applications and preparing for implementation. The attention give to other areas of IS were minimal, and the

IS manager found it increasingly difficult to gain acceptance for the view that IS development needed to be monitored on an ongoing basis. In the view of senior managers, once a contract had been signed with the supplier, it was a question of sitting back and waiting for the systems to arrive. During this time, periodic updates were submitted to the Project Board by the IS manager, although the meetings were seen as uneventful and unproductive.

Between the May 1996 and July 1998, five software applications were implemented in the Force as part of the ISS, these being crime recording, crime reporting, criminal intelligence, personnel, and command & control. In addition to a new wide area network, approximately 700 personal computers were installed. Progress in implementing ISS was perceived to be good, although the envisaged timescale had slipped due to the diversion of resources into planning for a large-scale, and unforeseen event taking place in the Force area.

4. Discussion

First, we consider the trajectory of what we terms ISS, and the way in which the shaping of this area of practice was subject to a wide range of interactions. Second, we discuss the politics of configurations; the ways in which people work to get technologies to 'fit' their organisational settings can be conceived as configuring of technology with institution specific structures, methods, requirements (Williams, 1997).

4.1 The Shaping of Trajectories

Each case ended up with new information technologies in place - an array of artefacts and software embedded within social and work practices that was unique to each case situation. Both cases had bought software that consisted largely of pre-existing applications that required customisation, becoming complex configurational technologies (Williams, 1997) that reflected the socially specific context. The interactors with whom we spoke variously referred to the trajectories in terms of either information technology strategy, or information system strategy. However, the point of concentrating upon the notion of trajectory is that it focussed attention on 'strategic' initiatives not so much as new areas of activity, but rather as continuations of practices surrounding IT within each of the cases. The idea of trajectory therefore encouraged consideration of the antecedents of the initiative in focus, as well as at the socially situated nature of the practice.

In both cases, the symbolism of earlier IT 'disasters' from the 1970's and 1980's, still resonated strongly with staff and could be seen as primary boundary objects. As a senior officer discussing earlier IT initiatives, in Case A, commented that, "*it was an absolute disaster and did not work .... I'm just glad it wasn't me*". In both cases, these 'disasters' acts as boundary objects, with espoused meanings partially shared and partially divergent amongst groups. The divergence was evidenced through additional meanings that different groupings discussed. For example, in all three cases, operational (uniform patrol/detective) officers tended to discuss the earlier technology 'disasters' as representing what happens when non-operational police officers are put in charge of such areas. As a senior officer, this time in Case B, reflected, "*I mean I remember how we got to be the way we are and it was all to do with money being available, money being available quickly .. 'we've got to spend that money, let's get something on board here' ... pressures from persuasive personalities within the organisation can result in them having some sort of stand alone computer system which doesn't merge in with the strategy that we're operating on*". Alternatively, non-operational police officers who were involved with IT in each case tended to view the earlier 'disasters' as

reflecting what happens when there was no clear strategy, implicitly justifying their own contributions to the ongoing IT initiatives.

In each of the cases, 'the IT strategy', or 'the IS strategy' were terms discussed by almost all those spoken with, and the ideas captured by such terms could be seen to act as primary boundary objects in each case. These boundary objects seemed to provide the impetus for the sustaining of the trajectory - the terms, and the meanings that they symbolised, provided some identity for the trajectory, whilst the associated socially located practices constituted the shaping of each case study's trajectory. The trajectory of practices in each of the cases differed in terms of the formality of the 'strategy' practices. According to a senior officer in case A, "*it's all in our heads, we don't have time to sit down and write a strategy*".

In contrast to this, in Case B, developed considerable IT strategy documentation through a lengthy series of formal planning, and project management meetings - with these formalised practices constituting readily identifiable trajectory schemes, shaping the trajectory. However, it was not that these more formal trajectory schemes were not so much lacking in case A, but rather that they each had a different form of trajectory schemes in place. In case A, there existed very small groups of people (at first, four people, and from 1995, three) who were perceived, by themselves and 'outsiders' to each grouping, as being at the centre of the IT initiatives. These small groupings met frequently (sometimes on a daily basis), but informally - and in each cases, these series of informal meetings constituted trajectory schemes just as much as the more formal practices in Case B. Though both sets of practices were influential aspects of the social practices shaping the trajectories of the respective IT initiatives, irrespective of the degree of formality. This accords with the findings of other researchers who have noted the significance of formal and informal political practices in ISS formation (Sillince & Mouakket, 1997).

As a final observation in this area, it is worth noting that these trajectory schemes also acted as boundary objects for the interaction between each case and external institutions tasked with auditing and inspection. Staff in Case B were quite open that the use of formal planning meetings and project management methods was a means of ensuring favourable comment when audited/inspected. Similarly, staff in case A bemoaned the fact that they were repeatedly criticised for the lack of such formality, irrespective, in their view, of the success of less formal practices. Staff in case A adopted more formal practices, in 1997, but as one senior member of staff commented, "*we were supposed to be looking at following PRINCE, but it is very much in name only, we're certainly not doing all the documentation. .... We don't have any methodology really, we just have to get on with it*". It would be easy to dismiss such attempts to incorporate formality as a facade, or mock bureaucracy (Gouldner, 1954). However, the meanings derived from activities of external bodies seemed influential, and reinforced the view that interaction cannot be isolated from the wider sphere of public sector activity.

4.2 Strategic Practice and the Politics of Configuration

ISS formation in these cases reflected aspects of configuring technical artefacts with social processes, work related structures, and requirements (amongst other things). This configuring depended upon interactions, with power relations and political practices being inseparable from the institutional life within which such activity occurred (Knights & Murray, 1994; Sillince & Mouakket, 1997; Garrety & Badham, 2000). Our discussion of interaction in this section has been informed by focussing upon the nature of, and interaction between roles and boundary objects. We have chosen this as an area of concentration because of the potential for variance in interpretation surrounding boundary objects.

Several significant roles were identified across the cases that were closely associated with the respective major IT initiatives, these being primary boundary objects. We also identified secondary boundary objects within the trajectory of the initiatives. For example, in each case, specifications of requirements, and eventually contracts were issued. In case B there was a detailed specification of requirements, something seen as important by the civilian IT manager overseeing this area of activity. Cases A had a much briefer, and more general specifications of requirements. One outcome of this, was that a contract was agreed with the supplier that offered considerable scope for interpretation as to exactly what would be delivered. This lack of specificity was of considerable concern to those less directly involved with the IT initiatives, who perceived this as a position of weakness for the Force, but strength for the supplier.

In each case there existed project Boards that were nominally supposed to oversee the major IT initiatives. In terms of the interactions associated with both primary and secondary boundary objects, there were three aspects of roles that we noted as significant. These were, position in the hierarchy, perceived level of interest in IT, and perceived level of expertise in IT. The mix of these three elements differentiated a number of roles that appeared to be influential. As expected in a quasi-militaristic hierarchy, rank mattered. Cases A had very senior officers who were perceived to be both interested, and IT 'experts' by other police officers. As one senior officer observed regarding the chief officer, "*... and I have to say that many of us were quite shocked by some of his radical views on matters particularly in association with technology, and the fact that he conversed as someone with knowledge, which we'd never been used to, because we'd only been used to talking to people outside*". This individual provided a strong impetus in driving the IT strategy. IT strategy was not documented, and staff expressed reservations about what would happen if the individual left the organisation. Staff were appointed project boards by the Chief officer driving the process. Not only did this provide opportunities for inclusion, but in case A in particular, several senior officers expressed the view that these project boards had been constituted in such a way as to exclude them from airing their views. Many senior staff commented adversely upon the apparent lack of strategic thinking about what was required, exasperated by the limited opportunities for senior staff to comment upon IT developments. In terms of power relations, this could be seen as exercising power through limiting participation as much as through managing decision making (Lukes, 1974; Hardy, 1996). These areas of practice constituted aspects of the configuring of the social and the technical. The political dimensions of interaction ensured that in case A, what transpired (i.e. the trajectory) reflected the direct input of a small minority of staff, with the drive of a senior stakeholder maintaining the impetus for IT developments. The outcome was a perception of technology being imposed. In case B, practice had greater formality, and was less obviously driven by any one individual, although the outcome was of technology being widely anticipated.

5. Conclusion

Whilst each of the cases ended up with 'new' systems in place, the practice surrounding the trajectory of each differed. Complex technology needs are rarely satisfied by off-the-shelf packaged solutions, but instead are particular configurations of technologies which reflect the socially and historically situated nature of the proposed usage (Fleck, 1993). Echoing Voss (1988), ISS formation in these cases constituted part of the configuring process, during the course of which people shape, and are shaped by, technologies that they endeavour to fit with their context. Findings do not appear to support the view that particular types of ISS formation (e.g. formal, emergent, etc.) can easily be associated with this particular form of

organisation. The trajectory of ISS formation can be considered a part of the configuring of the social and the technical in context. It was through focussing upon interactions that the complexity of practices surrounding that we term ISS formation were made more evident, and in particular the political complexity and variances in perspective. Following Smirisch and Stubbart (1985) we can see this as contributing to 'organisation making', that is, a part of the ongoing, everyday social practice that forms an important part of what we come to know as ISS formation in an organisational setting.

References

Blumer H (1967) *Symbolic Interactionism: Perspective and Method*. Berkley, CA: Univ. of California Press.

Coombs R., Knights D., Wilmott C. (1992) Culture, Control and Competition: Towards a Conceptual Framework for the Study of Information Technology in Organisations; O*rganisation Studies*.13, 1, 51-72.

Darke P, Shanks G, Broadbent M (1998) Successfully completing case study research: combining rigour, relevance and pragmatism; *Information Systems Journal*; vol.8, pg. 257-272.

Fleck J (1993) Configurations: crystallizing contingency. *International Journal of Human Factors in Manufacturing*. 3, 1, 15-36.

Garrety K, Badham R (2000) The Politics of Socio-technical Intervention: An Interactionist View. *Technology Analysis & Strategic Management*; 12, 1, 103-118.

Gouldner A (1954) *Patterns of Industrial Bureaucracy*; London: Routledge.

Hardy, C (1996) Understanding Power: Bringing about Strategic Change. *British Journal of Management*; 7, Special Issue, pg..S3-S16.

Jarzabowski P (2003) Strategic Practices: An Actitity Theory Perspective on Continuity and Change. *Journal of Management Studies*, 40, 1, 23-55.

Knights D; Murray F (1994) *Managers Divided: Organisation Politics and Information Technology Management*; Chichester: Wiley.

Loveday B (1993) Management and Accountability in Public Services: A Police Case Study; in: *Isaac-Henry, K., Painter C; Barnes, D.; Management in the Public Sector: Challenges and Change; Chapman & Hall, London.*

Lukes S (1974) *Power: A Radical Perspective.* London: Macmillan

Mackenzie D, Wajcman J (1999) Introductory Essay: The Social Shaping of Technology. In: Mackenzie D, Wajcman J (Eds.) *The Social Shaping of Technology*. Buckingham: Open University Press. 3-28.

Peters SCA, Heng MSH, Vet R (2002) Formation of the information systems strategy in a global financial services company. *Information and Organ*isation, 12, 19-38.

Salmela H, Lederer AL and Reponen T (2000) Information systems planning in a turbulent environment. *European Journal of Information Systems* 9(1), 3-15.

Sillince J.A.A., Mouakket S (1997) Varieties of Political Process During Systems Development; *Information Systems Research*; 8, 4, 368-397.

Smircich L., Stubbart C (1985) Strategic Management in an Enacted World; *Academy of Management Review*, vol.4, 724-736.

Voss CA (1988) Implementation: A Key Issue in Manufacturing Technology: the need for a field study. *Research policy*, 17, 2, 55-63.

Walsham, G. (1995) Interpretive Case Studies in IS Research; Nature and Method; *European Journal of Information Systems*; 4, 74-81.

Williams R, Edge D (1996) The Social Shaping of Technology. *Research Policy*; 25, 856-899.

Williams R (1997) The Social Shaping of Information and Communication Technologies. In: Kunicek H, Dutton W, Williams R (eds.) *The Social Shaping of Information Superhighways: European and American Roads to the Information Society.* Frankfurt: Campus. Pp.299-338.