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Black Boxes, Non-Human Stakeholders and the Translation of IT Through Mediation

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Abstract

The adoption of technological determinism or social constructivism (or a dialectical combination of the two) is considered to be problematic due to a lack of symmetry between organizational work and technology. Latour's notion of quasi-objects is introduced to mitigate the limitations of an artificial distinction between object and subject worlds that results from the adoption of a dualistic approach. The idea of a mediated network of technology and organizational context is proposed, in which Information Technology implementations become black boxes as a result of dissemination through space and time. This process requires that allies be enrolled and controlled, which in turn indicates a need for the interests of relevant stakeholders (human and non-human) to be understood. The ideas of quasi-objects and mediated networks are applied to a case study of an automated access control system for a car park. The case study demonstrates the potential impact of (information) technology on organizational work through physical and informating changes in a pluralistic situation.

1. INTRODUCTION

Methods used in support of Information Technology (IT) have a long tradition of separating "what" and "how" issues. For example, in SSADM (Structured Systems Analysis and Design Method) there is a clear distinction, in theory at least, between analysis, which addresses *what* is needed, and design, which is concerned with *how* requirements are to be met (CCTA 1990). In the life-cycle model (Boehm 1976), these stages are then followed by detailed physical design and construction, testing, implementation, and maintenance. However, in practice it is difficult to

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separate the issues of what and how into successive time periods and the two can only be separated with any confidence once a computer system has been built (Budde, et al. 1992); while a computer system is being constructed, what and how issues are co-present. Furthermore, the presence of ongoing maintenance to computer systems suggests a process of continuous (re)building in which what and how issues reach temporary rather than final separation. A soft systems approach, such as SSM (Soft Systems Methodology), avoids the means-ends limitation by widening the debate to include issues associated with "why" and a recognition that although change should be systemically desirable, it must be culturally feasible (Checkland 1981; Checkland and Scholes 1990). In the Information System development process, neither the hard approach typified by structured methods nor soft approaches such as SSM gives a symmetrical weight to the organizational work to be supported and the IT that might be deployed. For example, in SSADM Version 4, specific technologies and platforms that might be used are not addressed until stage 4, Technical System Options. Stages 1, 2, and 3 of SSADM address Investigation of Current Environment, Business System Options, and Requirements Definition respectively. These stages focus on understanding and specifying real world business requirements. With SSM, the exhortation is to think conceptually and to avoid contamination from the real world when constructing human activity system models. SSM conceptual models are then placed in a dialectical relationship with a real-world problem situation.

This paper is concerned with a symmetrical treatment of organizational work and IT and we seek to avoid the limitations of an artificial distinction between technological determinism and social constructivism (Woolgar 1994). To do this, we will draw principally from Latour (1987, 1993). The structure of the paper is as follows. In section two, the notions of mediation, networks, and black boxes are introduced. Section three explores stakeholders and interests. The ideas from sections two and three are then applied to a case study in section four, followed by a discussion of the findings in section five. Section six contains conclusions and thoughts on further research.

2. QUASI-OBJECTS, NETWORKS, AND BLACK BOXES

Information System (IS) development methods that adopt a separation of what and how reflect a dualism that can lead to a separation of analysis and design, organizational work (context) and technology. An ontological distinction that pervades IS development methods is objectivism and subjectivism. When combined with epistemological issues, this distinction leads to a seemingly implacable dualism of scientism and interpretivism. Burrell and Morgan (1979) used the objective/subjective distinction and a radical change/regulation distinction to derive four paradigms. They consider that these paradigms should be closed:

> We firmly believe that each of the paradigms can only establish itself at the level of organizational analysis if it is true to itself. Contrary to the widely held belief that synthesis and mediation between paradigms is what is required, we argue that the real need is for **paradigmatic closure**....the paradigms reflect four alternative realities. They stand as four mutually exclusive ways of seeing the world. [Burrell and Morgan 1979, pp. 397-398, emphasis added]

The four paradigm model has been taken up in IS research, particularly by Hirschheim and Klein (1989). Willmott (1990) has reported on developments that go beyond paradigmatic closure,

highlighting the work of Berger and Luckman (1966) and structuration theory (Giddens 1984). An implication of structuration theory is that the objective and subjective can be seen as a duality, in which structures of signification constrain action while at the same time those very structures can be changed by action. A critique of dualistic thinking is provided by Latour (1993), whose analysis directly addresses the relationship between *object* worlds, such as the technical artefacts of IT, and the *subject* world of society. This analysis is described in overview in the next section.

2.1 Quasi-Objects

Latour argues that one aim of the modernist project is purification: the separation of an objective and given natural world from a socially-constructed subject world. Modernism contains a paradox insofar as it espouses separation of natural and social worlds while relying upon their inseparability for its successes. However, the middle ground is more than a meeting place of natural and social worlds:

> We do not need to attach our explanations to the two pure forms known as the Object or Subject/Society, because these are, on the contrary, partial and purified results of the central practice that is our sole concern. The explanation we seek will indeed obtain Nature and Society, but only as a final outcome, not as a beginning. Nature does revolve, but not around the Subject/Society. It revolves around the collective that produces things and people. The Subject does revolve, but not around Nature. It revolves around the collective out of which people and things are generated. At last the Middle Kingdom is represented. Natures and societies are its satellites. [Latour 1993, p. 79]

With respect to IT, the quest for purification leads us to make artificial distinctions, such as the separation of context from technology, conceptual model from real-world, incremental change from radical change, analysis from design. The tendency is toward purified subject and object worlds that are either kept separate or explored through dialectical movements. However, dialectics is not a solution:

> Linking the two poles of nature and society by as many arrows and feedback loops as one wishes does not relocate the quasi-objects or quasi-subject that I want to take into account. On the contrary, dialectics makes the ignorance of that locus still deeper than in the dualist paradigm since it feigns to overcome it by loops and spirals and other complex acrobatic figures. Dialectics literally beats around the bush....Quasi-objects are much more social, much more fabricated, much more collective than the "hard" parts of nature, but they are in no way the arbitrary receptacles of a full-fledged society. On the other hand they are much more real, nonhuman and objective than those shapeless screens on which society — for unknown reasons — needed to be "projected." [Latour 1993, p.55]

Latour proposes "quasi-objects" and a constitution that retains elements of pre-modernism, modernism, and postmodernism (1993, p. 66). We have paraphrased this constitution and amended it with respect to IS development:

- the non-separability of the common production of Information Technology and organizational work/context;
- the inseparable objectivization of Information Technology and subjectivization of organizational work/context;
- freedom is a capacity for sorting and recombining sociotechnical imbroglios;
- the replacement of the clandestine proliferation of technological/organizational hybrids by their regulated and commonly-agreed-upon production.

The modernist division between nature and society has scientists speaking on behalf of things which cannot speak for themselves (mutes) and sovereigns speaking on behalf of subjects. The scientist represents nature faithfully and the sovereign represents what the subjects would have said if they had all been able to speak at once. In terms of system development there are developers who represent "things," such as software, and users who represent their communities (often known as "key" users). However, there is the possibility of a double betrayal: the developers might be talking about themselves rather than the technology that they represent and the key user might be pursuing his/her own interests rather than those of the user community at large. How can we know whether the developers and user representatives translate or betray? Latour argues that it is our attempt to separate nature and society that is the problem (1993, pp. 142-145). Representing nature and representing society are not two problems of representation but one. The "parliament of things" is a place where technology is present with its representatives (suppliers and developers of IT) who speak in its name; society (users) is present, but with the objects that form its ballast. Latour argues that this view need not lead to a revolution since all that it requires is a ratification of what we have always done, albeit clandestinely.

We now turn to the question of how these technical/organizational hybrids are combined and how black boxes of hard*(ened)* fact emerge.

2.2 Networks and Black Boxes

Rather than posit that science and technology and society are separable, Latour proposes that we are faced by a "gamut of weaker and stronger associations" (1987, p. 259), where to understand what facts and machines are is the same task as understanding who the people are. Adopting this approach, we see IT not as diffusion of technology but as translation carried out through networks. These networks will be shorter or longer, with weaker and stronger associations, possibly containing obligatory passage points (strongholds in the network, such as the law of gravity). IS development is concerned with transforming a "lash-up" (Law 1986) of heterogeneous, disorderly, and unreliable allies into an automaton, which, once it resembles an organized whole, can be considered as a black box. Thus, we can picture a sophisticated word-processor, such as Microsoft's Word for Windows, as a black box that hides many complicated parts and is supported by a complex commercial network of sales, support, marketing, and product development. Whether we are concerned with scientific facts or with technical artefacts:

> The problem of the builder of "fact" is the same as that of the builder of "objects": how to convince others, how to control their behavior, how to gather sufficient resources in one place, how to have the claim or the object spread out in time and space. In both cases, **it is the others who have the power to transform the**

> **claim or the object into a durable whole.** [Latour 1987, p. 131, emphasis added]

Latour outlines a number of strategies for enrolling others in the creation of a black box: to appeal to the other's explicit interests; to get the others to follow our interests; to suggest a short detour (this is particularly strong when their road is blocked); to reshuffle interests and goals by tactics such as inventing new goals, inventing new groups; by becoming indispensable to the others. To build a black box, others have to be enrolled so that the black box is bought and spread across time and space; once enrolled, they need to be kept in line so that what is disseminated remains broadly the same.

In the next section consideration is given to how the motivations of *the others* might be described, providing a basis for an analysis of interests and goals.

3. INTERESTS

The generation of black boxes through networks raises a particular issue: who are the *others* and what are their *interests*. Latour seems to assume that the identification of others and understanding their interests is not especially problematic. Interests are defined as *inter-esse*, lying between actors and their goals. Latour argues that resources will "jump" at the chance to translate claims and technical artefacts that further their goals (1987, p. 109) and that the formation of black boxes is promoted when interests move in the same direction. In our opinion, Latour's view of interests and goals is problematic insofar as it supports a view that goals have an objective existence, act as the motivation for the actions of the others, and thereby impact the formation, strengthening, and weakening of networks. Rather than see goals as determining action, it is perhaps tempting to argue that goals are socially constructed through action. However, all this achieves is the establishment of another binary opposition, goals as objective entities and goals as social constructs, and if it is not appropriate to nature and society then why should it be appropriate to actions and goals?

Viewing goals and actions as outcomes of the mediation of interests accords with the concept of quasi-objects described above: goals and actions are the outcomes of a process of purification rather than goals causing actions or actions creating goals. This view of goals and interests has parallels with structuration theory (Giddens 1984), in which there are three dimensions of structure and interaction: signification/communication, domination/power, and legitimation/sanction, mediated by an interpretative scheme, facility, and norm respectively. Structuration theory has been used by Walsham (1993) to provide a link between the context and content of change with the process of change; considerable attention is given in Walsham's analysis to the interests of those involved. In our opinion, the adoption of a structurational view of interests makes it possible to view actions and goals as co-present, mediated through interests, thereby allowing a symmetrical approach to interests to be taken that parallels the symmetry of technology and organizational work. In such a view, interests represent a mediation between goals (structure) and action by the others. This implies that action is constrained by goals and at the same time can result in changes to goals. The meaningfulness of the goals is mediated through an interpretive scheme that addresses interests. Structuration theory provides a powerful framework for understanding the implementation of IT through the dispensation of power

(control over resources) and the legitimation of action (appeal to norms). In this paper we focus on understanding the goals and the interests of the others, but we are aware that the ways in which interests are pursued in actuality can be understood through further dimensions of structuration theory.

In analyzing the goals and interests of significant others we draw from work on stakeholder analysis, soft systems thinking, and multiple perspectives.

3.1 Stakeholder Identification and Representation

One task for the implementors of IT is to identify in a specific problem situation who the others are. The rich picture is a Soft Systems Methodology (SSM) technique that allows a complex and messy problem situation (Ackoff 1974) to be expressed informally, including relationships and value judgements (Checkland and Scholes 1990; Lewis 1994; Stowell and West 1994). Rich pictures are helpful in gaining a heterogeneous understanding of a situation and can be used to represent human and non-human allies. There is no formal notation for a rich picture, although some diagrammatic conventions, such as crossed swords to indicate conflict and an eyeball to represent a concern, have been used widely. The rich picture has been used to identify the involved parties who have a stake in a problem situation (Vidgen 1994; Wood, et al. 1995) and we propose here that rich pictures can be used to provide a static analysis of actor networks.

Stakeholder analysis is a well-established technique, which in its evolved form states that: "Stakeholders are any individual, group, organization, institution that can affect as well as be affected by an individual's, group's, organization's, or institution's policy or policies" (Mitroff and Linstone 1993, p. 141).

An organization comprises the entire set of relationships it has with itself and its stakeholders (Mitroff and Linstone 1993, p. 142) and, as these relationships change over time, then so the organization changes, becoming in effect a different entity. This view of organization is sympathetic with Vickers' notion of appreciation and a concern with relationship-maintaining and judgement rather than the "poverty-stricken notion of goal-seeking" (Checkland and Casar 1986). However, this is very much a social view of stakeholders and organizations. To bring in non-human allies requires a new definition of *stakeholder*. We propose that:

> ***Stakeholders are any human or non-human organization unit that can affect as well as be affected by a human or non-human organization unit's policy or policies.***

In the above definition, organization unit is used to cater for individuals through institutions and, for example, a computer chip through the interNet. We use the word organization in the tradition of cybernetics where the organization of a system defines the identity of the system (Beer 1981; Maturana and Varela 1980), as well as reminding the analyst of the recursive properties of organization units in a systems approach.

In different situations there might be further non-human stakeholders. For example, in the aerospace industry real-time flight control systems must be able to cope with the low

temperatures associated with high altitudes; in such a case, the weather can be thought of as a stakeholder. As these stakeholders cannot speak for themselves, representatives need to be appointed. In one sense this is no different from the task of identifying representatives of human stakeholder groups, since assumptions need to be made and therefore the analyst is likely to be faced with the same difficulties: is the representative faithful to the interests of the stakeholder group? It is unlikely that it will be possible for each and every member of a stakeholder group to be involved, hence the need to appoint a "sovereign" to represent the interests of the subjects. Similarly there is a need to appoint a representative for the non-human stakeholders. Having identified human and non-human stakeholders/actors, we now consider how interests can be understood in practice.

3.2 Understanding Stakeholder Interests

Habermas' (1972) work on knowledge interests provides a framework for exploring stakeholder interests. These knowledge interests are technical, practical, and emancipatory, and have been described by Dahlbom and Mathiassen (1993) and Flood and Jackson (1991) as follows: the technical interest is concerned with control and labor and can be characterized by the metaphor of the engineer; the practical interest is concerned with interpretation and language (the facilitator); the emancipatory interest is concerned with criticism and power (the emancipator). The multiple perspective approach (Linstone 1989; Mitroff and Linstone 1993) also draws upon the idea of different domains of knowledge. Mitroff and Linstone consider three perspectives: Technical, Organization, and Personal. The Technical perspective is concerned with a scientific world-view, logic, rationality, modeling and analysis, and a claim of objectivity. The Organization perspective is concerned with social entities, politics, and the establishment of shared understandings. The Personal perspective addresses individuals and factors such as power, influence, prestige, learning, values, and experience. In order to understand stakeholder interests we propose that multiple perspectives/different knowledge interests will need to be considered: no single perspective will, by itself, be sufficient in gaining an understanding of complex and messy situations.

A multiple perspective approach is adopted in this paper for the purposes of gaining a rich understanding of interests and concerns. We have defined the following categories: the *Rational* perspective is used to reflect a logical view of interests (which need not be the rationality of science); the *Organizational* perspective is concerned with social and political interests; the *Individual* perspective allows personal concerns, such as status, career progression, job security, to be included. This model is referred to as ROI. The presence of an R perspective does not mean that the O and I perspectives are irrational, nor that the R perspective should necessarily be privileged with respect to the other perspectives.

In the next section, the ideas developed in sections 2 and 3 are applied to a case study of technology implementation.

4. CASE STUDY

The case study concerns the implementation of an innovative car park system, which is both an information system and an access control system. It has been chosen because it involves IT (and thus a data component), physical equipment, and heterogeneous allies. The choice and justification of research method is presented first, followed by the background to the case study.

4.1 Research Method

We are primarily concerned with gaining understanding of a particular problem situation and the assessment of the potential value of using the ideas described in sections 2 and 3 above in the implementation of IT. According to Zmud, Olson and Hauser (1989), case studies may be a highly appropriate medium. Case studies offer a holistic (as opposed to a reductionist) view of the processes involved (Gummesson 1988) and a high level of "richness of worldly realism" (Mason 1989). There are however disadvantages, in that case studies have an inherent predisposition to weak internal and external validity (Zmud Olson and Hauser (1989), or as Mason puts it, a lack of control and a corresponding difficulty in generalizing the results. Gummesson disputes this when he says that it is no longer obvious that a limited number of observations cannot be used for the basis of generalization, any more than it is still obvious that large numbers of observations will lead necessarily to more meaningful generalizations (1988, p.78-79). In a similar vein, Walsham describes an interpretivist (soft) approach to case study in which he argues that generalization from an individual case or cases is not a matter of statistical validity but the "plausibility and cogency of the logical reasoning used in describing the results from the cases, and in drawing conclusions from them" (1993, p. 15). We use the ideas developed in sections 2 and 3 as a way of understanding the case study presented here.

4.2 Background to the Case Study

In 1993, an institute of higher education in the UK purchased a new automatic access control system (AACS) for each of its three main car parking areas. The system has a number of unconventional features including proximity cards, retractable steel bollards, and an "invisible" card reader, which we briefly describe.

Proximity card technology. These are cards which resemble "magic wands" in the sense that they need only be waved around close to the "reader" rather than inserted into a slot in order to operate the system. The cards each contain a unique code which has been allocated to the card holder. When this is presented to the system, a check is made against a database image which is downloaded periodically from a personal computer (PC) to the car park site computer, via modem links, for validation. The system also includes a more conventional "slot," into which a token may be inserted, for casual users or visitors. Tokens may be purchased from vending machines that are located in the entrances of a number of campus buildings. Information held on the database includes car registration and make, owner's name, department and status (e.g., staff, student). Information concerning usage of the system, either collectively for the three sites, from individual sites, or indeed for individual use, can be uploaded and processed as required. The times individuals enter and leave car parks can be monitored, the identities of those (registered

users) who are in the organization at any given time can be ascertained, and many other ways of statistically manipulating such data for management or other purposes is possible. In this respect we can describe the system as an information system that utilizes IT.

Retractable steel telescopic bollards. These are unusual compared with the more conventional "arm" type wooden barrier with which most drivers are familiar. When retracted, these bollards are flush with the ground. Associated with the bollard are three induction loops, embedded in each of the access roads, designed to detect the presence of motor vehicles in the system. These are critical to the safe operation of the system. If a vehicle were unfortunate enough to stall over the bollard, for example, its detection on the loop ensures that the bollard remains retracted.

Hidden card reader. The card reader is housed within a brick structure, and is therefore not visible to the user. There is a metal plate on the brick housing which indicates where the proximity card should be generally waved about, but there is no direct access to the reader, which picks up the code programmed into each card. The system has other unusual features, but those which we have described are most relevant for our purposes, since they are obvious to the car park users, and are therefore of some significance, as we shall see.

4.3 Implementation Problems Arise

Within four weeks of implementing this system, there were four accidents which involved vehicles colliding with the bollards, causing damage to the vehicles. Following the final accident the systems were shut down by the organization's managers and they have remained so since then.

Accident Number 1. The first accident happened during the testing period following installation of the system. The car park capacity variable had been set to ten and, on entering, the tenth car triggered the "car park full" sign, as indeed it should, but it also triggered the bollard to rise despite the fact that a car following was also "in" the system. This resulted in a minor collision. A small software change was all that was necessary to correct this, so that even if the car park is full, if there is a car in the system, then the bollard will not rise.

Accident Number 2. The next accident also occurred during the testing phase. Someone entered the car park through the entry road, but realizing he/she would have to "pay" to leave, made a sharp U-turn and tried to exit through the entry road, not realizing that the bollard, which had been retracted during entry, was now on its way back up. There was a minor collision. The system has now been modified so that even if a car drives the wrong way through the entrance route, when the induction loop detects the vehicle the bollard will retract. This has compromised security to some extent.

Accidents 3 and 4. The next two accidents are more difficult to explain, since both people claim (in separate incidents) to have presented their proximity cards, received a green "go" light, and attempted to leave the car park. As they approached the bollard, it began to rise and they collided with it. They each tell the same story but one difference, which may be significant, is that one happened on the first day that the system became operational, the other approximately four weeks later. It was after the fourth accident that the system was shut down.

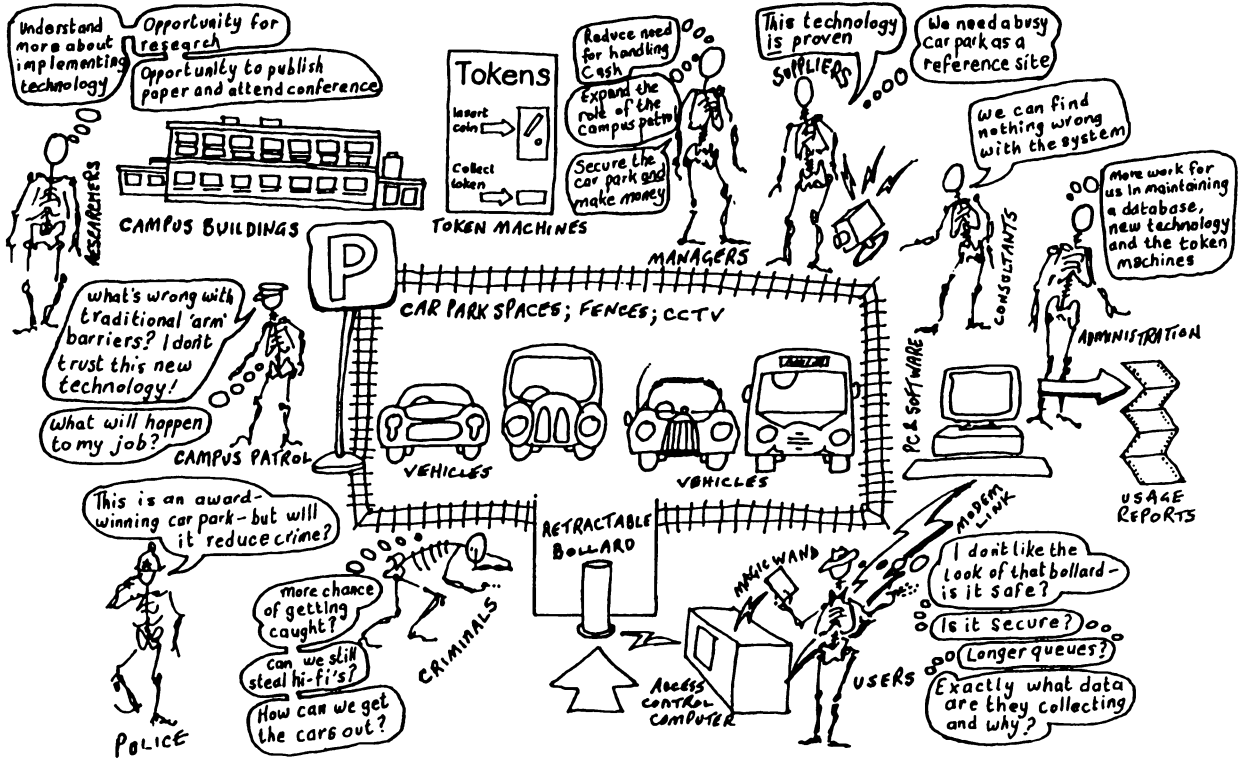

Figure 1. A Rich Picture

After the third accident, the designers looked for every conceivable way to explain how this could have happened. They concluded that the only remote possibility was that there had been some "crosstalk" between the induction loops controlling the exit bollard, where the accident occurred, and the induction loop on the nearby entrance road, over which a car could have been passing at the time. The odds, they say, were enormously against this, but it did seem to offer the only explanation. They adjusted the sensitivity of the loops accordingly, so that such an event is now (it is claimed by the suppliers) impossible.

Following the fourth accident, the system was shut down and the management brought in an independent technical consultancy firm to examine thoroughly the hardware, software and operations of the system. They concluded that the system was sound, safe and in good working order. They furthermore tried to recreate the conditions under which it was claimed the two unexplained accidents occurred, but they were unable to do so.

The AACS was turned off four weeks after it was commissioned for production use. The campus management are now considering what action to take — whether to abandon the technology or to attempt to re-introduce it. At this point, one of the authors was invited to conduct a review of the problems with the implementation of the AACS. As will be seen, despite the adoption of interpretive case study as a research method, we do not consider ourselves to be wholly outside of the problem situation and we have included ourselves as a stakeholder group. Our motivation for this is that, while investigating the politics of the case study organization, we wish to make explicit our identity and surface our beliefs (Knights and Murray 1994, p. 16).

4.4 Investigating the Problem Situation

Figure 1 is a rich picture representation of the situation, as perceived by the current authors. We have placed the car park and AACS at the center of the rich picture, reflecting its role as a way of organizing our thoughts about the situation. In some ways, the more significant issues emerge from the periphery, such as the strained relationship between campus patrol and managers. Using the rich picture, a stakeholder map was developed (Figure 2). This map shows a number of non-human stakeholders: the AACS, vehicles, the physical car park, and the campus. It is not possible for each and every car park user, campus patrol officer, etc. to be involved, hence the need to appoint a "sovereign" to represent the interests of the subjects. Similarly there is a need to appoint a representative for the machines. As the map in Figure 2 contains human and non-human stakeholders, it forms a basis for constituting a "parliament of things" and a symmetrical approach to technology and organizational work.

4.5 Investigating Interests

In Table 1, the interests and goals of the human stakeholders have been analyzed using the ROI approach described above. The symbol ☺ represents a favorable response, 😐 ambivalence, and ☹ resistance.

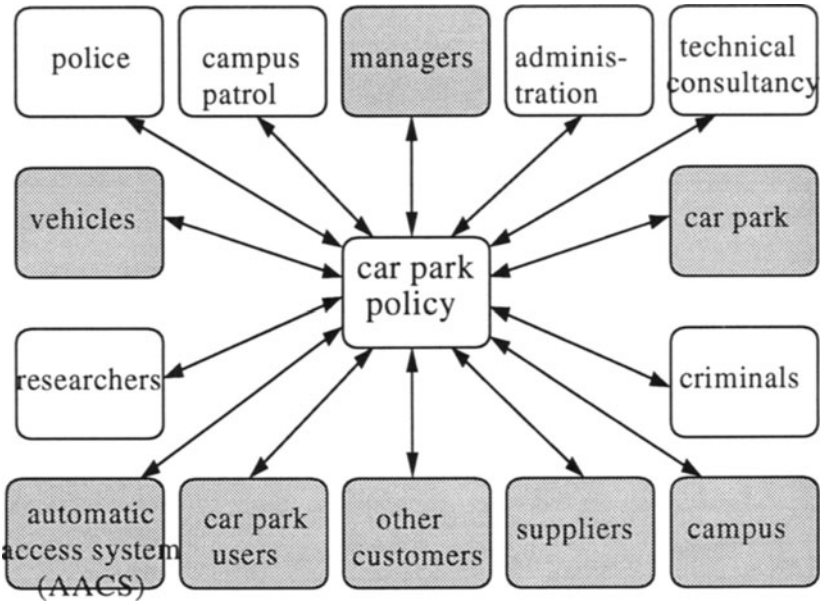

Figure 2: Stakeholder Map

The analysis in Table 1 represents assumptions about the stakeholder's interests goals and does not necessarily reflect the interests of actual stakeholders. For example, the view of "criminals" records the assumptions of the campus management and police officers (as interpreted by the researchers) and as such reflects the biases and prejudices of these parties as much as it does any interests of the criminals themselves. The stakeholder assumptions generated through ROI analysis can be mapped in terms of the degree of importance and certainty and those assumptions that are rated as important and uncertain should be explored further (Mitroff and Linstone 1993, p. 144; Vidgen 1994).

In Table 2, we have attempted to articulate the interests and goals of the non-human allies. We have drawn upon the ideas of systems thinking and catered for the different ways that non-human resources can be combined to form *component* objects with emergent properties. *Interests* have been analyzed in one dimension as we felt uncomfortable about assigning anthropomorphic properties to non-human resources, especially from an individual perspective. Rather, we consider that it is the interests of the *potential representatives* of non-human resources that we should be concerned with. The analysis of interests of technology gives a view of the situation that is complementary to the interests of human stakeholders. One benefit of the technology view is that it can surface human stakeholders that would be otherwise overlooked, such as architects, vehicle manufacturers, and vehicle insurers.

The next section looks at what we have learnt about the car park case study through the application of the ideas described in sections 2 and 3 above.

Table 1: ROI Analysis of Stakeholder Interests and Concerns

	Rational	Organizational	Individual
Managers	• increased security of the car park and the campus ☺	• car park usage statistics become available ☺ • redeployment of car park attendants to campus patrol duties ☺ • increased control over car park related activity through deployment of a reliable ally (AACS) ☺ • exploitation of revenue producing potential of car parking ☺	• career-enhancing - impressive to Institution's senior management and to peers ☺ • career-limiting if the implementation fails ☹
Administrators	• efficient administration of car park authorizations ☹	• significant change in working practice: manual system to computerized ☹ • maintenance of token machines ☹ • analysis of car park activity; administration of car park user database ☹	• fear of new technology ☹ • fears about increases in work load due to new technology ☹
Campus patrol	• increased security of the car park and the campus ☺	• change in role from car park attendants to security patrol ☹ • loss of power through erosion of self-determination ☹	• more time to be spent patrolling the campus and less in a warm hut ☹ • fears about new technology - retractable bollard ☹ • reduction in social contact with car park users ☹ • fears about unemployment through automation of security activity ☹
Car park users	• increased security of vehicle and person ☺		• possibility of monitoring of movements - surveillant properties ☹ • queues to enter and leave car park ☹ • fear of damage to vehicle by retractable bollard L
Suppliers	• a prestigious reference site for a new technology ☺	• important sale for the future of the supplier ☺	• kudos derived by salesperson ☺
Police	• a reduction in car-related crime reported ☺	• high-profile system with gold award ☺ • improved knowledge of what works in car park security ☺	• increased respect - if it works ☺
Researchers	• an opportunity to conduct research ☺	• an opportunity to publish papers and attend conferences ☺	• understand more about IT implementation issues ☺ • enhance careers through publication ☺
Criminals	• a more secure car park ☹	• vandal-proof system makes retaliation difficult ☹ • the Institution appears to be getting serious about car-related crime ☹	• higher risk of being caught ☹ • new opportunities to impress peers ☺
Other customers	• demonstration of AACS technology working effectively in a large car park ☺	• reduction in "post-purchase dissonance" ☺ • survival of supplier ☺	• successful implementation confirms "rightness" of choice and adds to job security ☺
Technical consultancy	• ascertain the technical correctness of the AACS ☹	• income from customer and potential of more AACS assignments ☺	• recognition of role of "expert" ☺

Table 2. Analysis of Non-Human Stakeholder Interests and Goals

	Components	Interests	Potential representatives
AACS	• retractable bollard • hidden card reader • induction loops • IT support - database of users, usage data • data communications • token dispensers • cash • magic wands	• to be used and maintained in accordance with manufacturers instructions • to be used for a fit purpose • security of cash proffered for tokens	• suppliers • technical consultancy • police
Vehicle	• bodywork • parts (e.g., wheels) • accessories (e.g., hi-fi) • contents (e.g., personal possessions of driver)	• to be kept in a secure situation whilst not in use (in part and in whole)	• users • vehicle manufacturers, repairers • police • insurers
Car park and campus	• location of buildings • location of car park • CCTV • car park perimeter fences • car park capacity • access roads to car park	• efficient use of car park space • efficient use of campus space • sufficient space between vehicles	• managers • architects/surveyors • public liability insurers

5. DISCUSSION

5.1 AACS: Success or Failure?

In one way the installation of this automatic access system (AACS) must be counted unequivocally a failure since the network associations were not strong enough for the AACS to be maintained as a black box in this organizational context. The campus management may have believed that it was buying a black box technology, but in the situation described in the case study the technology unraveled: the AACS is no longer a black box since its component parts have become painfully visible as different parties question whether there is a fault in the software, the induction loops, the way the car park users interact with the AACS, and so on. Should the AACS technology remain unraveled at this site and become so at further sites, then it would be reasonable to expect that, at some point, the technology will be abandoned in its entirety. Although the suppliers and other stakeholders are putting considerable effort into strengthening the associations that they believe will make the AACS successful, such an effort is constrained by time and available resources. Uniform products do not necessarily behave uniformly in different contexts and considerable and sustained effort might be needed to maintain the network of associations.

From a relativist stance, one might argue that the degree of success or failure depends upon the perception of a stakeholder (Markus 1983); for the criminal, the implementation of the AACS might be considered a "success." Although the quasi-object view allows one to make more

definite judgements about success/failure, it provides little scope for debating value judgements about "good" and "bad." To make value judgements, one must consider the interests of the stakeholders and the norms that they draw upon (norms are a mediator between structures of legitimation and sanction in structuration theory). Implementation success/failure from a quasi-object perspective depends upon the ability to create and sustain black boxes; from an interest perspective, success is assessed with reference to norms. These views are not separate and exclusive and we believe that both are needed since, although it is difficult to deny the "success" of a particular black box, for example motor cars and atomic bombs, we can (and must) investigate the norms that have been drawn upon to create and sustain the network that gave rise to the black box.

5.2 AACS: The Same Technology or Different?

The AACS technology is in one sense unchanged as a result of the implementation: it still contains basically the same programs and physical components as it did before installation in this car park. In another, arguably more interesting sense, the technology has changed significantly through being *translated.* The suppliers of the AACS wish to disseminate the AACS through time and space by enrolling others. We can conceptualize that their aim is to spread the AACS through lengthening the network, while at the same time exercising control over the form of the AACS, that is over the translations that occur. In this case, the AACS has been translated in such a way that its progress through time and space has been slowed and now runs a risk of being halted altogether. There are inter-relationships between the number of people to be convinced, the angle at which claims clash with other claims, the hardening of facts, and the number of allies that have to be fetched. The failure to implement the AACS in the situation described by the case study has resulted in new claims, a hardening of facts that weaken the network, and claims that now meet at a wider angle. The AACS has been translated and, from a quasi-object point of view, is certainly not the same technology now as the AACS that the campus management bought originally.

5.3 Automation: An Unmanned Car Park?

One aim of the installation of the AACS was to allow the car park to operate unmanned. Successful implementation would have resulted in a car park that was more heavily manned than when there was a manual system. Black boxes are accompanied by many more people, as becomes evident when it fails and the allies become readily visible: the supplier (including sub-contractors who supply specialist components), campus management, campus patrol, car park users. Accordingly, there are more people involved in an unmanned car park than in a manned one, implying that there will be more associations to manage. The implication for IT is that it is erroneous to assume that automation involves fewer people; this is only true in a superficial sense, since the automation is supported by longer and more complex networks of human and non-human allies.

5.4 Automating and Informating

The AACS in becoming a black box takes on the properties of an automaton. In a manual system it would be possible, in theory, for human attendants to record the vehicle registration, time of entry, and time of departure of each and every car. The introduction of the AACS makes it possible to automate the collection of this data through a non-human car park attendant that has a more direct interest in collecting such data. The primary task of the AACS is to control entry and exit and to record these transactions; its interest is direct, whereas human attendants might be tired, uninterested, bored and disenchanted with the (often) wet weather. Even if a human attendant can collect this data, it will still need to be converted to a machine-readable form for the purposes of statistical analysis, reports and enquiries.

A successful implementation of the AACS results in the automation of the process and the AACS itself becoming an automaton with black box properties. Zuboff recognizes that there is a duality of IT — "its capacity to automate and to informate" (1988, p.390). Zuboff argues that automating is a necessary but not sufficient condition for informating and that, although IT development can proceed without consideration of the informating potential of IT, informating will still occur, but as an unintended consequence. The AACS has yet to be implemented successfully and it is therefore not possible to comment on the informating implications of the new technology. We can speculate that, for example, the availability of data that shows the time people arrive and leave could be used to analyze individual and departmental working patterns of staff and students. If the technology was extended to include movements of people around the campus, then rather more complete records of activity could be maintained. Knights and Murray argue that Zuboff gives insufficient attention to power and politics. They argue that Zuboff adopts a determinist approach in which IT is viewed as inherently progressive, leading to "less hierarchical and unequal, yet more dynamic and innovative, organizations capable of continuous learning and adaptability" (1994, p. 9). Analysis of the car park suggests that there might well be informating aspects of automation, but that these affects might not necessarily be beneficial and need to be considered in the context of power.

5.5 Impact on Organizational Work

From the perspective of the campus management, the introduction of the AACS should allow management at a distance. The creation of distance from the center has been recognized as a theme in total quality management, with accounting data being used to overcome the distance created by delegation (Munro 1995). The data capture facilities of the AACS allow the campus management to distance the car parking operations while at the same time gaining more control through the enrollment of a reliable ally — the AACS. For the campus patrol officers, the impact is not just a limited change to duties; they are being asked to transform their role from car park attendants into campus patrol officers who will work to increase and maintain the security of the campus. The campus patrol representative on the AACS implementation committee was not sufficiently strong to voice the concerns of his group, which allowed the campus management to push through the implementation of new technology in the car park. In this instance, the interests of an important stakeholder group were not represented faithfully, contributing to the failure of the implementation. Other stakeholders are also impacted. Car park users see car parking as a means to an end: it is something one does to get to work, to get to a meeting. While car parking

is working, it is a black box that is *ready-to-hand* (Winograd and Flores 1986). A *breaking down*, such as the retractable bollard damaging a car or long queues to enter or leave the car park, results in the car park becoming *present-at-hand.* A successful implementation for car park users will result in a car park that is once again ready-to-hand, that is a black box. Such stakeholders are subject to second-order effects insofar as they will only come to reflect upon the technology in the event of a break-down, whereas campus patrol officers, for example, are affected directly by changes to their working practices brought about by the introduction of the AACS and will reflect actively upon the implications of the changes.

6. CONCLUSIONS AND FUTURE DIRECTION

We have argued, following Latour (1987, 1993), that a dualism of object/nature and subject/society is an artificial distinction which results in either social construction or technological determinism being privileged. A quasi-object approach focuses attention on a collective that produces things and people and a process of mediation. This view can be contrasted with the socio-technical approach (Emery and Trist 1969; Mumford and Weir 1979; Eason 1988) to Information Technology implementation in which it is assumed that object and subject worlds are different and separable and the aim is to bring together the worlds of organizational work and Information Technology. If we follow Latour's arguments, then we need to start from the premise that technical and social systems are inseparable and that any perceived separateness is a temporary outcome of purification rather than a starting point. Similarly, the assumption of separability can be found in the literature concerned with combining "hard" and "soft" approaches to information system development, as in the "grafting and embedding" distinction described by Miles (1988). However, the grafting of an interpretivist method, such as Soft Systems Methodology (SSM) (Checkland 1981; Checkland and Scholes 1990), onto a deterministic method for building computer systems is beset by practical difficulties of making the paradigmatic shift from an organizational context orientation to a technology orientation. Embedding hard methods in a soft framework has the practical advantage of privileging the soft perspective over the hard, but depends upon a dialectical relationship for its success. A quasi-object approach needs to keep subjects and objects together such that paradigm shifts that result from the artificial separation of context and technology are ameliorated. One area for future research is symmetrical information system development methods that is, methods that are based upon a duality of organizational work and Information Technology. In one sense, we are arguing that IS development methods should reflect the practice of IS development, where practice is characterized by the clandestine proliferation of technological/organizational hybrids. The theoretical basis of IS development methods needs then to be concerned more with the regulation of the production of hybrids and less with paradigms and paradigmatic incommensurability. Although considerable work is needed to explore the implications for IS development methods, a small contribution in this area is the inclusion of human and non-human stakeholders on a stakeholder map.

Through the creation and strengthening of network associations, claims and technologies, such as Information Technology, become black boxes, that is, they become hard*ened* facts. For an Information Technology implementation to take on the properties of a black box and to be disseminated through space and time, allies (human and non-human) need to be enrolled and their interests taken into account. We described how multiple perspectives can be used to gain a richer

understanding of a problem situation. The case study also contained a description of a sequence of accidents that appeared to lead to the shutting down of the AACS. A simplistic explanation of the case study is to see the accidents as causing the system to be shut down — a series of technology-related failures that inexorably lead to an implementation failure. An alternative explanation is to see the accidents as resources that can be enrolled to legitimate actions. The campus management were experiencing difficulties with the changes to the working practice of the campus patrol officers brought about by the introduction of new technology and could enroll the accidents in order to legitimate the decision to suspend the operation of the AACS. The campus patrol officers were unhappy about the changes in working practices and the way the changes were being introduced and could also use the accidents to further their interests. Although the supplier denied that the technology malfunctioned in accidents 3 and 4, they could not bring enough weight to bear on the situation to gain control of the interpretation placed on the accidents. The ways in which power is exercised to influence the meaning attributed to events needs to be considered and would go some way to countering the critique of Knights and Murray, who have commented upon the failure of actor network theorists to analyze power.

There would appear to be parallels between the work of Latour on quasi-objects and networks and the structuration theory of Giddens. By viewing goals and actions as outcomes mediated by interests, we have sought to avoid assuming that interests and goals have a real-world existence or that goals and interests are purely social constructs. Using the ideas of Latour and Giddens in concert is a fertile area for research and will be developed in the next stage of the car park research, in which we will be using action research (Susman 1983; Checkland 1991) in a bid to assist the re-implementation of the AACS. Elsewhere we have suggested the use of a communication strategy drawing upon marketing concepts and techniques for the support of Information Technology implementation (McMaster and Vidgen 1995); this is one means of enrolling others in the creation of a black box and will be adopted for the re-implementation project. The use of marketing concepts and techniques is a practical response to Latour's analysis of strategies for enrolling others in the creation of a black box (see section 2.2 above).

We are not comfortable with technological determinism as a basis for IS research; neither are we comfortable with social constructivism. Furthermore, we do not see a solution in dialectics, preferring to consider organizational context and technology as inseparable. In our opinion, the distinctive nature and strength of IS research is the potential to treat context and technology symmetrically, thus differentiating IS research from context-oriented disciplines, such as management, and technology facing disciplines, such as computer science.

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