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Socio-Theoretic Accounts of IS: The Problem of Agency

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Abstract. A long-standing debate in the IS literature concerns the relationship between technology and organization. Does technology cause effects in organizations, or is it humans that determine how technology is used? Many socio-theoretic accounts of a middle way between the extremes of technological and social determinism have been suggested: in recent years the more convincing explanations have been based on Giddens' structuration theory and, more recently, on actor network theory. The two theories, however, may be seen to adopt rather different, and potentially incompatible, views of agency. Thus, structuration theory sees agency as a uniquely human property, whereas the principle of general symmetry in actor network theory implies that machines may also be actors. This rather fundamental disagreement may be characterized as the problem of agency. At the empirical level the problem of agency can be studied through ERP systems. These systems, though built and implemented by people, are thought to be wide-ranging in

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their effects on organizations, and offer good opportunities for the study of the interplay of human and machine agency. However these empirical stories also reflect the theoretical confusion. This paper argues that neither structuration theory nor actor network theory offers a particularly convincing account of the interaction of humans and machines, and that their different accounts of agency make them hard to integrate in any meaningful way. Comparing the two theories and their use in IS raises many important issues, questions and problems, which need to be solved if the IS discipline is to develop a consistent socio-theoretical vocabulary.

Key words: machine agency, human agency, structuration theory, actor network theory, ERP systems.

1 Introduction

The relationship between technology and organizations has traditionally been understood in terms of technological and social determinism (Markus and Robey 1988). In one tradition, technology causes changes (technology effects) in an organization which is apparently powerless to resist them; in the other, technology is solely portrayed as the product of human intentions, designs and actions. While to some extent these opposing viewpoints may be caricatures of more subtle positions (George and King 1991; Grint and Woolgar 1997), they nevertheless highlight an issue that would seem central to the IS research endeavor, that is the relationship between the technical and social aspects of IS. One way of characterizing this discussion is through the study of agency. Agency, in this context, relates to actions which have outcomes or consequences, in Giddens' terms "the capability to make a difference" (Giddens 1984). Thus an agent is, in its widest meaning "something that produces an effect or change," such as a chemical agent, or when applied to people, "a person who does something or instigates some activity" (Oxford English Dictionary). There is an implied causal relationship between the action and the outcome, which is fundamental to the positivist American MIS tradition, but less so to the Scandinavian tradition. The study of the relationship between organisations and technology involves the study of actions and their effects, the causal relationships between those actions and effects, and the relation of particular consequences to particular agents and their actions—hence agency. In the social determinist account agency lies with humans (having consequences for the technology), whereas in the technological determinist account

agency lies with the technology (producing effects on the humans). Most commentators find these accounts too extreme, and various attempts (e.g., George and King 1991; Markus and Robey 1988; Pinnsonneault and Kraemer 1993) have been made to develop an intermediate position that could admit both forms of agency.

Initial interest (in the community of IS researchers with their theoretical roots in social theory) was focused around Giddens' structuration theory (ST) (Giddens 1984). However for Giddens, agency is synonymous with human action (he also uses the term *social actor* without distinguishing it). Technical artefacts, their enduring materiality notwithstanding, are theorized as *allocative resources*, equivalent to codes and normative sanctions, which influence social systems only when incorporated in processes of structuration (Giddens 1984). IS accounts of structuration theory that try to admit technology effects (for instance, the adaptive structuration theory of DeSanctis and Poole (1994)) somewhat violate Giddens' formulation of agency and structure, either by locating structure inside the technology (Jones 1997), or by allocating agency to technology. More recently actor network theory (ANT) (Latour 1987) has attracted increasing attention. Latour and his colleagues choose not to use the terminology of agency and agents, referring instead to actors and actants. This is in part an effort to distance themselves from the structure/agency debate in social theory (Latour 1999). Though there is some distinction between the two ANT terms ("an actor is an actant endowed with a character" (Akrich and Latour 1994)), the focus has been on treating all the contributors to the formation of a network in the same way. Thus "the term actant is symmetrical, it applies indifferently to both humans and non-humans" (Latour 1991). Here action is defined in the context of one particular type of consequence: a role in a socio-technical network and particularly the historical development of those networks. The coining of the term actant (Latour 1987) was designed to move the theory away from the restrictive association of agency solely with humans, and IS theorists have used ANT widely in order to characterize computer systems as actors, for instance in the infrastructure literature (Ciborra 2000). However, despite, the different conceptual vocabularies of the two theories, and their different emphasis, they share a concern with actions and their consequences which we characterize as the study of agency.

An appropriate empirical way to study agency in organisations is to study the implementation of Enterprise Resource Planning (ERP) systems. These systems are designed, implemented, operated and managed by humans, but are thought to have significant effects on organizations in themselves. In attempting to provide seamless integration of all information flowing through a company (on the basis of industry best-practice processes), ERP systems are seen

as reaching into every aspect of a business, promoting common processes and transforming organization and culture (Davenport 1998; Kumar and Hillegersberg 2000). In particular, these systems are sometimes seen as embodying a technological imperative that enforces a standardized model to which organizations must adapt. Davenport (1998, p. 122) argues that "an enterprise system, by its very nature, imposes its own logic on a company's strategy, organization and culture." Ross and Vitale (2001) report that, in a company they studied "the daily experience of persons actually using the system was that a computer was dictating how they would do things." "We are slaves to the systems," said the company's CEO, "and we have accepted the technological imperative that that implies" (Ross and Vitale 2001), p. 240). Whereas these accounts suggest that it might be sensible to try to theorize an ERP system as an actor in the unfolding development of an organization, many other accounts focus on human agency, particularly that of managers. Here the major determining factors become managerial competences (Kræmmergaard and Rose 2002), change management (Aladwani 2001), the role of the CIO and IT function (Willcocks and Sykes 2000) and the managerial decision making process (Rooney and Bangert 2000; Shakir 2000; Somers and Nelson 2001). The resulting picture of ERP implementation reflects the technological/social determinism dilemma—it can be regarded as primarily a question of human agency, primarily a question of machine agency, or as reflecting the interaction of both forms of agency.

In response to Weber's call to identify the "deep, substantive, generic, prototypical problems that confront our discipline" (Weber 2003, p. iii), we here examine human and machine agency and their interaction in two ways. Firstly we examine the theoretical positions of structuration theory and ANT as adopted by IS researchers in respect to agency. Secondly we look at agency as it plays out in empirical situations in the organizational implementation of ERP systems. Here we briefly review three cases, focusing on the agency aspects. We finally characterize *the problem of agency* and define a number of challenges and issues for researchers working with social theories in IS.

2 Agency and Technology: Structuration Theory and Actor Network Theory

In response to the perceived deficiencies of pure technological and social determinist positions, various attempts have been made to develop intermediate approaches that recognize the contribution of both technological and social factors (Grint and Woolgar 1997; McLoughlin 1999). These include the

schools of thinking known as socio-technical systems (Mumford 1983), social shaping (MacKenzie and Wajcman 1985) and social construction of technology (Bijker et al. 1987). Within the IS literature, however, theoretical attention initially focused (Markus and Robey 1988; Pinnsonneault and Kraemer 1993) on the socio-technical 'web models' of Kling (1982) and structuration theory (Giddens 1984). Structuration theory has tended to predominate in subsequent studies (Jones 2000), and has received a sophisticated exposition relevant to the problem of agency in the work of Barley (Barley 1986; 1990; Barley and Tolbert 1997) and Orlikowski (Orlikowski 2000; Orlikowski 1992; Orlikowski and Robey 1991). More recently a number of IS studies using actor network theory have emerged (McMaster et al. 1999; Monteiro 1998; Vidgen and McMaster 1996; Walsham 1997; Walsham and Sahay 1999), partly in response to Monteiro and Hanseth's call to be more specific about the technology (Monteiro and Hanseth 1996).

Agency is seen in structuration theory as one element of a mutually-constitutive duality with social structure: agency is shaped by structure, while structure is produced, and reproduced, by the actions of humans in social contexts. Giddens argues, however, that agency does not determine the production and reproduction of structure because of unacknowledged conditions and unintended consequences of intentional action. This emphasis on *mutual shaping* can be seen as offering an alternative to technological or social determinism (Markus and Robey 1988; Pozzebon and Pinsonneault 2001). From Giddens' perspective, however, the duality of structure and agency is seen as "a 'virtual order' of transformative relations ... that exists, as time-space presence, only in its instantiations in [reproduced social] practices and as memory traces orienting the conduct of knowledgeable human agents" (Giddens 1984, p. 17). This means that apparently material resources (such as IT) which "might seem to have a 'real existence,' become resources only when incorporated within processes of structuration" (Giddens 1984, p. 33). In terms of a spectrum between social and technological determinism, therefore, structuration theory is very much towards the social end, seeing technology as having no agency of its own. Both agency and structure belong to humans in their social practice, and "technology does nothing, except as implicated in the actions of human beings" (Giddens and Pierson 1998, p. 22).

Notwithstanding this socially oriented conception of agency and structure, a number of attempts have been made to develop structurational analyses of IS that address the *problem of agency*, notably by Barley (1986; 1990) and Orlikowski (1991; 1992; 2000). Thus Barley (1986, p. 78) characterized technology as providing an "occasion for structuring" and described structuration as offering a form of "soft determinism" (Barley, p. 107). Barley (1990, p. 99)

further argued that "technically-driven social change is likely to be rooted in a technology's material constraints," but that these must be transformed into social forces if technology is to have a significant effect on social organization. Orlikowski's early structurational model of the *duality of technology* goes somewhat further in explicitly introducing material technology into the structure/agency duality and suggesting that social rules may be "embedded" in IS during their design (Orlikowski 1992, p. 417). Unfortunately, as Orlikowski (2000, p. 406) later acknowledges, this is "problematic" because it, "ascribes a material existence to structures which Giddens explicitly denies." It could also be argued that her position implies a type of technological agency (the technology has effects or outcomes on the organisation) which is equally foreign to Giddens. Orlikowski later develops a *practice lens* (Orlikowski 2000), whereby technology structures are seen as "virtual, emerging from people's repeated and situated interaction with particular technologies" (orlikowski 2000, p. 407). While this may go some way towards incorporating technology into a more conventional structurational perspective, it focuses on human actions, banishing machine actions to the twilight of human perceptions and interpretations. It does not overcome the criticism of Berg (1998, p. 465) that structurational analysts unduly privilege human agency, causing "technology to vanish from their accounts, appearing only as an occasion for structuring, without any activity or specificity of its own."

In contrast to this diminution of the role of technology, a central tenet of actor network theory is an assumption of *general symmetry* between the technical and social worlds. No *a priori* distinction is made in the treatment of human and non-human actors such as IT (here often referred to generically as *machines*). Rather, the aim is to identify the configuration of the alternative heterogeneous networks of actors (comprising both human and non-human *actants*) and the way in which they influence the development and stabilization of forms of technology. Its appeal for IS researchers wishing to avoid determinism, but also to take technology seriously (Monteiro and Hanseth 1996), may therefore be evident. While the status of material artefacts in actor network theory is somewhat ambiguous (different authors adopting apparently different definitions at different times), Latour's discussion of the agency of key fobs, door closers, and speed bumps (Latour 1991) suggests a concept of agency that is not restricted to human actors. Discussing a French research program to develop an electric vehicle, for example, Callon (1987, p. 90) talked of catalysts that "refused to play their part" and of hydrogen atoms "refusing to be trapped by catalysts," alongside engineers from Renault lobbying against the project. Thus, in actor network theory, agency is not restricted to humans, but is attributed to technologies (machines) and to material objects

more generally. Moreover, the thrust of the theory is to treat human and machine (or material) agency equivalently.

Critics of this position (Collins and Yearley 1992; Shapin 1988) argue that this is little more than an ontological slight of hand, a "hylozoism, an attribution of purpose, will and life to inanimate matter, and of human interests to the nonhuman" (Schaffer 1991, p. 182). Other writers have also questioned whether actor network theory is successful in avoiding any form of determinism (Grint and Woolgar 1997) and whether the equivalence of human and machine agency makes sense in more than semiotic terms (Pickering 1995). What is clear, however, is that, in principle at least, actor network theory seeks to position itself firmly in the middle of the spectrum between technological and social determinism.

IS researchers using ANT analyze technology (computer systems) as material agents or actants. Monteiro (2000, p. 83) claims that large systems like the internet "appear as independent living actors." Hanseth and Braa (2000, p. 140-142) speak of "infrastructures as actors," of the "agency" of SAP, and point out that SAP was a "powerful actor" and an "ally" in "getting the change process moving" in the company they studied. As a more complex infrastructure emerges, SAP becomes "a more independent actor," and "increasingly resistant to control." Another distinctive strategy amongst IS researchers is to clearly set out the principle of symmetry, but then to analyze only the agency of the human actors, whilst ignoring the agency of the non-human actors. Holmstrom and Stadler (2001, p. 201), for instance, assert that "ANT regards humans and non-human as equally endowed with the power to act" and that "technology is an actor because it has been endowed with the ability to act through its position in the network." However, in their analysis of the failure of the Swedish electronic cashcard, they analyze almost exclusively the interests of the human actors: banks, merchants, customers, technology providers and users, effectively ignoring the agency of the technology. Here the technological artefacts are clearly components of the networks described; how (or whether) they *act* is unclear.

Thus, while both structuration and actor network theory may have made valuable contributions to understanding information systems, they offer quite different views on the problem of agency. Each approach has its limitations. In structuration theory, technology's capability to 'make a difference' is unacknowledged. It is relegated to the status of an inert tool employed by human agents. In actor network theory, on the other hand, whilst technology becomes an independent actor in its own right, no distinction is made between the agency of technology and humans. While a consistent theoretical account of the agency of machines and humans, therefore, cannot simply combine the

two theories, it may be that a critical analysis of their insights can enable such an account to be constructed.

The next section examines the problem of agency at the empirical level.

3 ERP Systems in Practice: Reflections on Agency

This section briefly examines three ERP implementations well known to the authors, all of which have been previously published in other contexts. The three sections are designed to illustrate different assumptions about the involvement of human agency and machine agency (here the agency of an ERP system) in the development of the host organisation. However all three cases are described entirely empirically, without reference to any specific theoretical background. In the first illustration the focus is exclusively on human agency, and machine agency is either absent or ignored. In the second, human agency is still predominant, but the agency of the machine is consciously exploited by the humans to bring about changes in the organisation which would have been hard to achieve otherwise. The third illustration, somewhat longer, paints a more complex and nuanced picture: here outcomes in the organisation are the result of the somewhat unpredictable interaction of both forms of agency.

3.1 ERP at OMEGA: A Story of Human Agency

The ERP implementation at OMEGA (the fictionalized name for a Danish production company) was the subject of a five-year longitudinal interpretive study (Kræmmergaard and Rose 2002). The study began in February 1996 (at the time the decision to adopt an ERP-system was taken in the company) and continued until mid 2000, more than three years after the system went live. The company experienced various problems with the transition, some of them serious, and three different project managers came and went at various stages of the project. The research investigated the managerial competences required for the complex interactions involved in successfully integrating an Enterprise Resource Planning system into an organization. The three managers in the story, Erik, Sten and Olav (the names are fictionalized), were talented individuals, with different skills and backgrounds, yet each of them struggled with aspects of the journey. Erik struggled to understand the technical complexity of the SAP, while Sten, familiar with the technical details, struggled to com-

municate with the business environment. Olav, apparently the most successful of the three (but the inheritor of much previous hard work) was the first to admit that he couldn't have managed the earlier phases. The stages of the journey gave them different kinds of problems. One feature of the whole journey was how important personal management competencies were – the everyday business of planning, getting on with people, communicating in ways that can be understood, motivating, inspiring and problem-solving. These could never be ignored or taken for granted without getting into trouble. Technical competences were certainly important, and particularly in the central parts of the journey. However business competencies were also vitally important. These were pivotal in understanding why an ERP system should be chosen, how the ERP system would fit with the organization, and how organizational processes would be changed. These activities characterize the early part of the journey. Business competencies were also important later, for understanding and realizing the potential business benefits.

In this account, ERP implementation is regarded entirely as a question of human agency. Success or failure of the system is assumed by the researchers to be the outcome of the actions of the various managers (dependent on their individual competences) and the decisions they take.

3.2 ERP at Martin: The Manager Exploits the Agency of the Machine

Martin Group is a Danish company specializing in products for the entertainment industry, such as intelligent light shows, speakers and smoke machines for rock concerts. The company found itself in a serious crisis as a consequence of its own success and rapid growth—a fairly common occurrence. In the early phases of the company's establishment and development, the management focused on sales, turnover and income, rather than on organizational processes or standardized production techniques, and this resulted in a diversity of working and reporting practices throughout the company which the investigating researchers characterized as a "state of near anarchy." "The company lacked control throughout its divisions and subsidiaries, and there were many logistical problems. There were no standard procedures, and people more or less invented their own ways of doing things, or followed old habits" (Kræmmergaard et al. 2001, p. 113). As a result of the crisis a new CEO, Kristian (the name is also fictionalized), was appointed in 1998. Part of his strategy for putting the company back on course involved the purchase and implementation of an ERP system. Kristian saw the ERP system as a strategic tool for establishing the missing standardized procedures which would restore

order and managerial overview and control; thus bringing the company 'out of puberty.' The implementation project was from the beginning understood to be both complex and difficult and Kristian insisted that it be completed in one hundred days—judging that the company could not sustain such a substantial effort over a longer period. The Martin Group chose Baan, and elected a *make-to-stock* production model based on the best process models coded into the system, and a big-bang plain vanilla implementation strategy (all the chosen modules in all the company's departments with minimum customization). The system went live (on schedule) in January 1999. The implementation caused many problems in production (the company was unable to make a single delivery in the first 23 days) and the first six months were characterized by system performance difficulties and fire-fighting. However the company gradually settled down again with more standardized processes, better co-ordination with its subsidiaries, and improved reporting to management. As Kristian had predicted, the company slowly overcame its crisis with the help of the ERP system.

At Martin, the CEO is the human agent making the decision to introduce an ERP system, and determining the implementation strategy. Standardization is achieved, but not because the CEO introduces improved common practices. The ERP system doesn't encourage, facilitate, or in some cases allow diversity of working and reporting, especially when it is not customized, and the human actors are forced to some extent to conform to the processes coded into the system. Here the human agent "marshals" (Jones 1999, p. 298) the agency of the machine to achieve his purpose, and the investigating researchers accept that both humans and machines are agents in the development of the company, though machine agency is subservient to that of the human. The ERP system is effectively a powerful tool for organizational development in the hands of the human manager.

3.3 ERP at BCTel: Human and Machine Agency Interweaved

Managers at BCTel (British Columbia Telephone Company—a major Canadian telecoms company) decided to replace legacy systems with an ERP system (SAP) in July 1996, despite anticipating opposition from the TGU (the Telecommunication Workers Union). The case is reported in Truex (2001) and Rose, Jones, and Truex (2003). Management were worried about the looming threat of the millennium bug and the need for better systems interoperability, and SAP was fast becoming the industry standard in Canada. They expected to achieve efficiency savings through headcount reductions. Amongst union

activists, the ERP system acquired the nickname of the 'Armageddon machine'; the machine that would lead to the destruction of the union's interests. However, the union was powerless to stop the implementation, and the system went live in June 1998. The early stages of the implementation (also *plain vanilla big bang*) were characterized by initial confusion and dysfunction, both in terms of poor system performance, but also in terms of disturbance to employees' work practices. It was clear that the effect of the ERP system on work process had not been thought out thoroughly in advance. The system was designed around so-called industry best practices, which poorly matched the established practices at BCTel and there had been only minimal customization. The ERP system therefore came largely to structure the new work practices, with the consequent organizational disruption reflecting the time it took for users to adapt their practices to fit the system. In the absence of on-going customization the computer system was inflexible, forcing the humans (more flexible) to adjust. Managers and staff worked hard (often with many hours of unpaid overtime) to devise workarounds and adjust processes in order to restore service levels to customers. Downsizing (euphemistically called 'surplussing') began in the areas of accounting and finance and later widened to other areas. According to union officials, BCTel managers used the implementation as an opportunity to reduce the influence of the union by 'surplussing' union members. The ERP system next became a major factor in the company's merger with Telus Alberta in June 1999. Managers argued that the merger was feasible because both companies were SAP users. In practice, integrating the two companies proved far from straightforward as their SAP implementations were very different. Telus Alberta had chosen a highly customized (configured) implementation of a limited set of modules whereas BCTel had opted for the *big footprint* approach. Upgrading to SAP v.4.6 proved nearly as difficult as the original implementation and the BCTel version was eventually scrapped. Managers expected little resistance from the demoralized unions, but, after further 'surplussings,' worker attitudes had hardened, and the more militant TGU won the election to represent the workforce in the new company Telus. The resurgent TGU negotiated protective terms for workers, which partially protected them against further management rationalizations.

In the case of BCTel, the researchers describe a pattern of interaction of human and machine agency, which is more complex than the earlier illustrations. At the adoption decision, the focus of agency lay with the managers and the unions. However, they acknowledged the ERP system's power (agency) to dictate work practice, and therefore to cause disruption to established patterns. Hence the fast implementation decision—essentially an attempt to get the mis-

match between SAP practices and BCTel practices over with in one short, sharp shock. Union leaders attributed (ultimate) agency to the machine also, seeing it as the bringer of final destruction to their interest—the Armageddon machine. Although the Armageddon machine characterization was (with hindsight) exaggerated or mistaken, it clearly fed into the union officials' response to SAP. However at the go-live it is the ERP system, as in the Martin case, which is largely prescribing what will happen next. Those using the system must decode, or de-scribe the routines coded into the system, and change their own tasks to accommodate. In the next cycle of the story, managers aimed to marshal ERP agency to achieve the merger with Telus. Since SAP was common to both companies, managers attributed to SAP the power to enable the merger. However conflicting implementations of SAP (reflecting earlier managerial agency) resisted managers' intentions and could not be easily integrated. The researchers characterize managers' and union officials' decisions here as unforeseen consequences of the earlier interaction of human and machine agency. They (the researchers) show that managers and unions exerted agency, but that the SAP system also shaped what happened (particularly at implementation), and organizational outcomes were unpredictable and emergent. The exercise of managers' agency, the union's agency and machine agency was interwoven over time, and outcomes for the organization were dependent upon the interaction of both forms of agency.

4 The Problem of Agency

With these discussions in mind, we are now able to characterize *the problem of agency* with which this paper is concerned. At the level of reference discipline (that is before IS theorists adopt and adapt them), structuration theory and actor network theory offer different and conflicting theorizations of agency. Their originators have different histories and agendas. In structuration theory only humans can be agents, and technology lacks any capacity to act independently in a way which has consequences. In actor network theory both humans and material objects can be agents/actants, and (in principle at least) technological and social actants should be treated symmetrically. Here the machines become equivalent or symmetrical with humans in the formation of networks. In terms of ANT they enroll, translate, delegate, inscribe and so on. However, achieving this involves attributing to machines properties of agency which are often assumed to be the preserve of humans. In ANT the machines achieve a questionable equality with humans which masks their different agency characteristics. ANT also offers an account of the interwoven nature of

human and material agency in the formation of networks, whereas in structuration theory, material objects are resources employed by human agents in the process of structuration.

When these reference theories are taken into the domain of IS and used to explain the agency of actors and computer systems in organizations, different problems result. In structurational accounts of IS which adhere to Giddens' intentions (such as Orlikowski 2000), the enduring materiality and power of the machines, and their consequent capacity to affect future outcomes, is unacknowledged. The machines are, in effect, relegated to the status of props and tools for knowledgeable human agents. Where the information systems are centre stage (in the adaptive structuration theory of DeSanctis and Poole (1994) and, to a lesser extent, the earlier work of Orlikowski) there are difficulties reconciling the accounts with Giddens' intentions.

In actor network accounts of IS, the materiality and constituting nature of computing infrastructures, large software programs and technological artefacts is located more centrally in their role in the formation of networks. However the issue of how exactly machines act, in relation to their human counterparts, is left unresolved, with the implication that there is little difference between human and machine agency.

At the empirical level, accounts of ERP system implementation (such as the three cases used here as illustrations), also display differing assumptions about the nature of human and machine agency, their interaction, and their consequences upon organizations. In our cases the focus was on (case 1) human agency (machine agency non-existent or effectively irrelevant), (case 2) human agency exploiting machine agency, and (case 3) human and machine agency interacting. Though we used the cases primarily in this paper to give an empirical dimension to the theoretical argument, it could be argued that differing agency assumptions are fairly widespread across the ERP literature.

We would suggest, however, that neither the structurational account, nor the ANT account satisfactorily explains the complex, emergent interplay of different forms of agency evident in the cases. Though we focus on two theories which have become central to socio-theoretic thinking in Scandinavia, England and America, the problem of agency reflects a common disagreement and source of confusion across the socio-theoretic IS community.

5 Discussion

In this paper we have articulated the problem of agency. Whereas it is neither our concern to rewrite structuration theory or actor network theory, nor to try

to re-focus the ERP literature, we do suggest that it might be interesting to try to work towards shared theoretical understandings of human and machine agency in IS. These understandings might improve our understanding of typical IS concerns, such as the implementation of large computer systems in organizations. What would the characteristics of such an IS-focused agency theory be?

An IS focused resolution of the problem of agency might acknowledge both the agency of machines and the agency of humans, but also recognize that they are different. In as much as machines can act, and do so increasingly autonomously, and in as much as those actions have intended and unintended consequences, they do possess agency. Many of those actions, but not all, are either intended or at least anticipated by the machine's designers. However, those design decisions may be so far away in time and so difficult to remedy, that the human designers have become irrelevant in the story. If people do not perceive it to be possible to alter the machines they work with, then the machines have become autonomous at least in the sense that they are as they are, and that their design history has become effectively irrelevant. In addition it is impossible for the designers of the machines to foresee, or in many cases even understand, all the sets of conditions they will be used under, or the decisions of the humans who supervise and work with them. Machine agency, however, should not be understood as equivalent to human agency. Many of the components which are central to human agency (such as self awareness, social awareness, interpretation, intentionality and the attribution of agency to others), are not readily available to machines, though rudimentary forms of them can increasingly be programmed. Next we conclude that the exercise of agency, whether machine or human, cannot be understood in isolation from the situational conditions which both make it possible, and frame its subsequent interpretation. Here we concur with Giddens (1984) that social structures, made up of individuals' personal experiences are important to understanding, but admit, with Callon (1987), that material components of existing networks can also form part of the situation in which agency is exercised. The exercise of agency, through its intended and unintended consequences, partially constitutes the set of conditions under which the future exercise of agency is carried out. In this emergent process, machine and human agency can be found inextricably intertwined: a double dance of agency. Humans base their actions on complex interpretations of past actions and present conditions, and on attributions of agency to machines. Those actions are partly planned, partly opportunistic; partly pro-active, partly reactive to conditions; partly successful, partly unsuccessful; part strategic oversight, part bricolage and tinkering. Machines (in this case computer systems)

also play an important (but different) part in the double dance. Machines facilitate and enable some parts of the human exercise of agency, but constrain other parts. Seen more from the standpoint of their own agency, they accommodate some human purposes, but resist others. Humans try to marshal the agency of machines to serve their own purposes, but cannot always anticipate or control the consequences. Outcomes are emergent from the interaction of both forms of agency, not from one alone.

6 Implications, Questions, Challenges, Provocations

In this section we address some issues that might form the basis of future contributions on the subject of the interaction of human and machine agency. We adopt a deliberately provocative tone (in the form of challenges) in order to encourage other researchers to respond.

Challenge 1 (to social theorists in IS). Despite repeated calls for theorists to be more precise in their descriptions of technology (Monteiro and Hanseth 1996; Orlikowski and Iacono 2001) we agree with Kallinikos (2002, p. 287) that social constructionist IS theorists display "paradigm consolidation" in underestimating the influence of technology. It has become a norm to focus on the actions of humans, and a kind of heresy to point to the effects of technology. We challenge social theorists also to be specific about what the technology *does* and invite fellow researchers to use this debate section to propose effective ways of doing this.

Challenge 2 (to those influenced by structuration theory). It has proved to be difficult to reconcile the central tenets of structuration theory with IS understandings of technological structure and technological agency. We should either have these theorizations in place, or we should move on and incorporate some features of structuration theory into better IS theorizations of the interaction of human and machine agency (or structure). However we should stop calling these developments 'structurational' if they violate Giddens' central ideas. Contributors could use these columns to suggest what can usefully be retained of structuration theory and how it can better be integrated with our IT issues.

Challenge 3 (to those influenced by actor network theory). Take symmetry in actor network theory seriously, say how the computer actants act, and what the consequences of these actions are, using the concepts provided by ANT. Focusing on the actions of humans in networks of which computer systems are also components is decidedly asymmetrical and in line with the social con-

structionist "paradigm consolidation" described above. If symmetry is not a satisfactory solution, then theorize the difference between human actors and computer actants in ways which do not undermine the original theory. Suggestions could be made to these columns.

Challenge 4 (to those interested in the problem of agency). Theory about the interaction of human and machine agency (which could also explain the implementation of an ERP system) could distinguish between the two types of agency, identify the relevant structural contexts (as structuration theory partly does) and identify the process of their interaction (as ANT partly does), how outcomes are formed and how these emergently contribute to the formation of new contexts or conditions. Many other theoretical sources may also be relevant. Early formulations could be published in these debate pages.

Challenge 5 (to systems developers influenced by social theory). Computer systems are introduced into a complex labyrinth of social arrangements. On the one hand, systems developers and software engineers are the creators of an efficiently engineered artefact; on the other hand they introduce a new dimension into a social system; one that may impact that set of social arrangements. This technical artefact may become a factor in the emergent development of the organization. Systems developers could also try to use social theories such as ANT and ST to anticipate and manage the impact of their computer systems on the social systems they are designed for. Neither the computer system, nor the organisation can be expected to remain static, and systems developers should account for their artefacts' role as agent in the emergent future of the organisation. Suggestions for practical tools for developers based on these considerations could form part of the discussion in these pages.

Challenge 6 (to social theorists in IS). We have a tendency to move on to the next fashionable reference theory and forget, or re-invent the learning associated with the last one. How do we integrate the many areas of agreement about how humans act in relation to IT and how IT influences human action to build integrative theories which are grounded in the history of social theory, but more focused on our IS concerns and less slavishly dependent on the reference theory?

We look forward to hearing the opinions of other researchers working in these fields.

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