



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Beyond The ERP Implementation Study: A New Approach To The Study Of Packaged Information Systems: The Biography Of Artifacts Framework

Citation for published version:

Pollock, N & Williams, R 2009, 'Beyond The ERP Implementation Study: A New Approach To The Study Of Packaged Information Systems: The Biography Of Artifacts Framework', Paper presented at ICIS 2009, United Kingdom, 1/01/10.

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Publisher's PDF, also known as Version of record

Publisher Rights Statement:

© Pollock, N., & Williams, R. (2009). Beyond The ERP Implementation Study: A New Approach To The Study Of Packaged Information Systems: The Biography Of Artifacts Framework. Paper presented at ICIS 2009, United Kingdom.

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



BEYOND THE ERP IMPLEMENTATION STUDY: A NEW APPROACH TO THE STUDY OF PACKAGED INFORMATION SYSTEMS: THE BIOGRAPHY OF ARTIFACTS FRAMEWORK

Completed Research Paper

Robin Williams

University of Edinburgh
ISSTI
Old Surgeons' Hall
High School Yards
University of Edinburgh
Edinburgh UK
Robin.Williams@ed.ac.uk

Neil Pollock

University of Edinburgh
School of Business
George Square
Edinburgh, UK
Neil.Pollock@ed.ac.uk

Abstract

Scholarship addressing the social and organizational issues surrounding enterprise resource planning (ERP) systems is blossoming. However, many of these studies produce unhelpful readings of the characteristics of ERP and its implications for organizations. The typical 'ERP implementation case study' has been given undue emphasis within Information Systems (IS) research. Often influenced by constructivist frameworks and qualitative methodologies, including Actor Network Theory and ethnography, these approaches encourages actor-centered analysis and rich local pictures of the immediate response by organizations to these systems. However we are skeptical that the most useful way to study ERP is solely at the place where the user encounters it. One implication is that important influences from other levels and timeframes are missed from analysis. We propose an alternative research approach - the emerging 'Biography of Artifacts Framework' - that takes seriously the multiple locations and different timeframes in which ERP systems operate and evolve.

Keywords: ERP, strategic ethnography, implementation, actor network theory, multi-level, biography

Introduction

Scholarship addressing the more fine grained implications of enterprise resource planning (ERP) solutions for organizations appears to be blossoming. There are now entire journal issues and conference sessions devoted to understanding not just the impact of ERP but also the more contextual, social and organizational issues surrounding its design, implementation and use. A recent special issue in the *Journal of Strategic Information Systems* (JSIS 2004, 2005), for instance, makes a plea for further research on ERP and related technology "...within and across contexts so that we can examine the ways that such systems shape and are shaped by individual and group interests and preferences as well as organizational and societal structures and cultures" (Howcroft *et al.* 2004: 271). We welcome such calls not only because they break new ground in demonstrating the complex interplay between the social, institutional, cultural and technical elements that make up the typical ERP project but also because they highlight important issues of research design and methodology. In this respect, the authors note the need for studies that "focuses on different levels of analysis as well as research that adopts a processual perspective, examining [enterprise systems] design and use over time" (*ibid.* 272). We agree with this statement but wish to take it further. This is because in reviewing the most recent literature on ERP we must admit to finding aspects of this work to be weak in theoretical and conceptual terms, particularly in its understanding of the processes of innovation and the evolution of technology over time and across space, but also in its reluctance to consider issues of methodology and epistemology. A large number of studies appear to be framed, somewhat unreflexively, within particular well-established modes of research, constrained within particular loci, timeframes, disciplinary perspectives and concerns. Our contention is that these framings are producing unhelpful readings about the character and implications of the bulk of today's organizational information systems. In particular, studies of socially and temporally bounded locales are being given undue emphasis within information systems (IS) scholarship - the typical 'ERP implementation case study' has become the norm. Added to this, there has also been a surge in interest in deploying various constructivist and micro-sociological forms of analysis to understand the fine-grained nature of these systems - including (and despite the fact it has at its core the aim to move *beyond* the study of specific locales) Actor Network Theory (ANT). With powerful but highly uneven analytical tools, which include the deployment of qualitative methodologies and ethnographic forms of analysis that build rich local pictures and actor-centered analysis, these approaches have focused attention predominately on the *local interactions* and *choices* surrounding implementation and use (see the recent studies of ERP by Boudreau & Robey [2005], Pozzebon & Pinsonneault [2005], Wagner & Newell [2006] and Quattrone & Hopper [2006]).

However, it is increasingly clear that this form of study is ill-equipped to get to grips with systems as complex as ERP. We are particularly skeptical that the most useful way to study ERP is solely at the place where the user encounters it (Kallinikos 2004a). Lest we forget, we are dealing with technologies largely constructed at a considerable remove in time and geographical and social space from their use (*ibid.*). These systems, moreover, are often instantiated at multiple sites (Markus *et al.* 2000). Current studies, by contrast, are often rather 'flat ethnographies' that emphasize immediate action and downplay amongst other things the influence of technology supply and of the broader setting on the unfolding of the technology. Koch (2007) suggests we need better *spatial metaphors* for addressing these complex organizational technologies typically offered as standardized, packaged solutions and supplied internationally and across different sectors. He draws attention to the evolution of perspectives, moving away from single site research to multi-locale studies and has further advanced the suggestion that we should analyze ERP as a 'community' (Koch 2005, 2007).¹ Scott & Wagner (2003) argue the need to develop better *temporal* understandings of ERP to include the *multiple* and *different times* that surround and shape typical implementations. This includes how the timeframes in which local projects are carried out are often nested within wider conceptions of time (such as the timescales of wider sectoral and industrial transformation). Our task here is to sketch out an analytical framework for these endeavors.

To do this, the paper develops the emerging *Biography of Artifacts Framework* which is an attempt to develop an approach able to: (i) track the trajectory of artifacts and associated practices over time; (ii) and provide more adequate spatial metaphors to address how these generic and global technologies are instantiated at multiple sites and across distributed contexts. This framework has its roots in the suggestion that packaged solutions have a lifecycle

¹ There has been a certain theoretical convergence of view between a number of analysis - despite competing terminologies - around the study of a range of supply-side players and users, consultants and others involved in ERP, conceived as 'a community' (Koch 2007), as 'a movement' (Grabot & Botta-Genoulaz 2005), or 'innovation community' (Swanson & Ramiller 1997).

or, to use the term we prefer, 'biography'. This notion simply suggests that the career of an ERP system extends beyond that which can be studied at a particular local site. The implication being that major software solutions are seldom amenable to study through a simple (or singular) analytical lens. We argue that IS scholars should move beyond the current emphasis on flat ethnography and towards more theoretically informed, longitudinal selections of different sites and moments for study. There are various other locales and moments of innovation surrounding ERP (not to mention the numerous other actors who play a role in constituting these systems and the markets in which they are located) about which much less is known. We argue there is the need for a different type of qualitative study, a more 'strategic ethnography', if you like, which addresses the technology/society relationship at multiple levels and timeframes. Rather than study ERP in particular socially/temporally bounded locales we argue for a variable research geometry that can be applied to diverse themes and in differing contexts depending on the issue(s) being addressed and entities being tracked (cf. Robey 1996; Mingers 2001).

To develop this approach, and by necessity, we draw widely from the literature within Science and Technology Studies (STS), Organization & Management Studies, Cultural Psychology and IS research that we believe better equipped to address the multiple interfaces between technological artifacts and society. In particular we seek to explore how local outcomes may react back on and transform broader settings, through diffuse and gradual processes of influence, which may not readily be detectable within short-term local studies. These considerations inform our search for a research strategy that addresses the multiple locations and different timeframes in which technologies operate. To this end, we examine the utility of the notion of 'arena' (Jorgensen & Sørensen 1999) to explore the hybrid spaces in which different actor-worlds interact, and of an 'agora' of technological and organizational change (Kaniadakis 2006), which provides a framework for looking at the relationship between different arenas and levels, and how local actions are set within broader settings. We also need to provide a register of the multiple different historical timeframes at play (from the immediate moment of action to the long term in which institutions emerge and evolve) and we thus draw on relevant ideas from the area of distributed cognition (Hutchins 1995; Hyysalo 2004). Before turning to these issues, however, we briefly review the different kinds of research conducted into technology and work organization. We explore how these characteristic modes of empirical study impinge upon the framing of the research and their findings.

The Problem with ERP Implementation Studies

Single site implementation studies represent the bulk of research into new organizational technologies (for reviews of the extent of this literature see for example Esteves and Pastor [2001]; and Al-Mashari [2003]). The ERP Research Group (2006), for instance, has 600 articles in its on-line bibliography and the overwhelming majority, over 95% of these correspond to what may broadly be described as ERP implementation studies (including also closely related topics such as the management of ERP adoption, organizational outcomes and 'critical success factors'). Whilst much of the early work on implementation was typified by fairly unreflexive 'impact studies' that pointed to the straightforward and large scale organizational transformations brought about by these systems, much more scholarly research has begun to appear a few years later (Grabot and Botta-Genoulaz 2005). This latter work has a stronger social scientific grounding often being more rigorous, offering more critical insight. We note in particular the growth across a range of disciplines (including for example IS research, Organization Studies, Management of Change *etc.*) of more sociological research informed by a processual understanding of technical and organizational change and deploying qualitative, often ethnographic, research methods. This work yields a richer knowledge base, going beyond the standard unitary managerial view of the organization and addressing different perspectives across and within organizational departments/functions and the particular processes which underlie these outcomes.² Moreover, a great deal of this work has benefited from constructivist analysis of technology which includes the growing influence of interactionist studies of computing (Star 1995; Star & Ruhleder 1995), the ethnomethodological focus on software (Suchman 1987, 1994), frameworks such as the Social Construction of Technology (SCOT) (Pinch and Bijker 1984), and more recently and especially the application of ANT (Latour 1987).³ As a model for research, these approaches focus valuable attention on the local negotiations and choices around the implementation and use of new technologies. Particular consideration is given to immediate action and 'heroic' local actors who, in the face of

² The recent twin special issue in the *Journal of Strategic Information Systems* [JSIS 2004, 2005] on 'Understanding the Contextual Influences on Enterprise Systems Design, Implementation, Use and Evaluation' represents an exemplary instance of this work.

³ For a study of ERP based on the notion of interpretive flexibility (a key theme advanced by SCOT) see Cadili & Whitley [2005]. For the application of ANT to IS research see particularly Walsham (1997) and Monteiro (2000).

attempts to remodel or standardise their working practices, are seemingly able to rework the newly implemented information system in their favour (Boudreau & Robey 2005; Elbanna 2006). There is often in some of this work the (tacit) recognition that these forms of appropriation represent a presumed victory of the local over the global (Scott & Wagner 2003; Quattrone & Hopper 2006).

However, we would draw attention to the potential limitations that arises from the temporal and societal framing of implementation studies. Though these more sociological influenced studies may be more grounded than earlier impact ones, they are still typically of short duration compared to the extended timeframes involved in the complete adoption cycle (involving the initiation, procurement, implementation, use and subsequent review) for such kinds of radical technological and organizational change, with the result that researchers are liable *to leave too soon*. Implementation studies are still often based on short- or medium-term access, with fieldwork covering a few months or at most a year or two, and are therefore weak in terms of assessing longer-term outcomes of innovation episodes for organizational users. This may be important given the large body of research, dating back to Arrow's (1962) analysis of 'learning by doing', that stresses the significant post-implementation improvements in productivity as organization members discover and refine ways of using artifacts more effectively (see Boudreau & Robey's [2005] study which is particularly attentive to these processes).

Recent studies of ERP implementation, and especially research concerned to assess its outcomes, increasingly stress the need to look at this extended 'post-implementation' phase (Berchet & Habchi 2005). Various analysts have further divided this into the 'shakedown phase', and the 'onward and upward phase' as these complex systems are coupled with organizational practices and as their further utility for the organization are discovered and exploited (Markus & Tanis 2000; Somers & Nelson 2004; Robey *et al.* 2002). Implementation studies that end too soon may thus underestimate the eventual organizational consequences of an innovation. Indeed many short-term implementation studies in emphasizing the constraints to adoption of technology within particular organizational settings, and the gulf between promised benefits of an innovation and its outcomes, may have unintentionally replaced the 'Can Do' rhetoric of technology supply with a misleading 'No Can Do' skepticism about its ability to reshape organizational contexts, emphasizing the barriers to fulfilling their promise of delivering rapid organizational transformation – barriers that are rooted in particular in the diversity of local working practices (see Boudreau & Robey [2005]). In the short term at least, organizational structures and practices appear to be more robust than the organizational templates embedded in the machine (Webster 1990). However, there is a danger, and this is a very real danger when extrapolating from individual implementation studies, of overlooking the gradual alignment and harmonization of organizational practices that may occur around the organizational templates embedded in the technology.

Moreover, flat ethnographies encounter the problem, that Kallinikos (2004a,b) also identified, that many issues regarding the material character of artefacts are determined outside the setting of technology adoption (including the availability of technologies as well as the institutional context which provides resources and sets constraints for local action). Perhaps as a result, ethnographic researchers frequently have the sense of not being in the right place at the right time (cf. Law 1994; Magolda 2000). One temptation faced with this incompleteness of vantage point is to bracket off all those aspects that cannot be studied and elevate the importance of the particular settings and interactions which can. This could be exemplified by workplace studies of technology that present organisational information and communication processes, including the appropriation of IT, as of paramount importance, and correspondingly neglect technology design and other distal processes.

ERP Vendors Made 'Other'

One implication of the limitations inherent in current research framings is that scholars tend to treat software and its suppliers as something of a 'black box'. Lacking access to sites of technology development, researchers conducting implementation studies have little opportunity to scrutinize the development processes and history that had given rise to it. Any inference about supplier behavior made in these studies is thus primarily derived from observations and perceptions within the user organization. Those conducting implementation studies have been mainly reticent about the world of technology design. Rather paradoxically, perhaps, the software package vendor appears to have been made 'other', and, where discussed, one-sided accounts, and on occasion negative stereotypes have been deployed to characterize the behavior of vendors and of consultants (Hanseth & Braa 2000; Walsham 2001). Drawing perhaps on critical perceptions of supplier offerings and behavior within the user organization, these accounts often convey a negative sense of the role and contribution of external technology and knowledge providers that is hard to reconcile with the fact that it is the user organization that hires the vendor (Westrup 2005).

This brings us on to consider how to address technology supply. Here we are concerned to understand the material properties of organizational technologies (cf. Leonardi & Barley 2008). This aspect has not received sufficient attention overall in ERP research (see for instance the account by Quattrone & Hopper [2006] where the shape and affordances of technology play little if any role). Rather few studies have been undertaken of the contexts in which organizational technologies have been developed and have evolved. However, a number of writers share our concern about the need to look at the historical development of artifacts prior to their organizational implementation. This is in relation to earlier systems like Manufacturing Resource Planning (MRP II) (Clausen & Koch 1999) and current ERP systems (Kallinikos 2004b; Koch 2005, 2007). This fragmentation and framing of enquiry has consequences. It has meant there has been little focus on the relationship between supplier and user organisations with the result that very little is known about how package suppliers interact with or get to know about users. Whilst in the design of custom systems, close links between suppliers and users are assumed crucial this is not thought to be the case with generic ERP packages (Regnell *et al.* 2001; Sawyer 2001). Indeed, it has been argued, for instance, that there is little interaction between vendors and users other than that brought about through initial procurement activity (Bansler & Havn 1996). Regnell *et al.* (2001) go on to emphasize the *autonomy* of suppliers and the space they have to ‘invent’ requirements before they offer them to chosen users and markets. However, the idea that the market is driving development and that requirements are invented conveys a sense of the autonomous developer, and that generic software development is much like other forms of product innovation. Requirements engineering here is portrayed as something like market research about essentially anonymous users. This picture contrasts sharply with our own research, which, as far as we know, includes one of the very few detailed studies of the design and development of a new module for a major ERP system.

Here we witnessed how vendors (far from keeping users at a distance) utilised certain key groups to help guide the evolution of its packaged solution (Pollock *et al.* 2004, 2007). This was in the design and requirements-gathering stages where the vendor utilised a number of geographically dispersed ‘pilot sites’, each of whom were chosen to represent major markets as well as the potential different ‘classes’ of organization that might potentially acquire such a system. Many of these sites participated in the development on the assumption that they could influence the design of a generic package – and indeed many appeared to find success in wielding influence (Pollock *et al.* 2004). However, whereas in the early development of a packaged solution, the vendor could be rather flexible in taking on board requirements of new customers, quite rapidly a more selective and managed approach to user requirements emerged (Pollock *et al.* 2007). Package vendors have developed sophisticated strategies to create and further develop generic offerings by actively managing relationships with customers. They typically do this through shifting design to community forums and by actively differentiating between users, so that their response is segmented according to the strategic and commercial importance of particular pilot sites. Thus, user requests for new functionality would almost always include an assessment of the other potential users who might require it (*ibid.*)

This observation suggests that we need to attend to technology design and implementation in tandem. Yet there are almost no studies addressing ERP design and implementation together. Why is this? One reason may be disciplinary divisions: Organization and Management Studies are concerned with organizational process and outcomes and have therefore tended to focus on the organizational user and black-box the supplier and their technology (this is in contrast to the field of STS which has tended to ignore organizational processes in favor of unpacking technology). No less important is the very practical one that ERP development is in most instances not only socially but temporally separated from implementation. Moreover, the lag between design of a technology and its implementation typically exceeds the duration of most social science research projects. Researchers, contemplating the trade-off between depth of fieldwork and the number and range of fieldwork sites of technological innovation have tended to opt for one or other setting. This trade-off is arguably made more difficult by the emphasis within contemporary social science on ethnographic approaches. Though strong in capturing the richness of local processes in real time, ethnographic methods are labor intensive. Ethnographic researchers have often therefore opted for simple research designs – mostly involving single site studies or studies of a number of closely-related settings (see Marcus’ [1995] more general critique of single site ethnographies). We suggest that to overcome these problems, researchers must go beyond the current fashion in qualitative social science for deliberately naïve methodologies advanced by approaches like ANT and instead to utilize existing theoretical and substantive knowledge to sample a selected array of locales of technology design and implementation.⁴ We have developed the *Biography of Artifacts*

4 ANT has offered a critique of existing social science theory which tended to explain social outcomes in terms of the operation of power or interests rooted in existing social structures (Callon & Law 1982). In place of examining the world on the grounds of a priori theoretical categories and concepts, ANT espouses a simple methodological rule: researchers should ‘follow the actors wherever they go’ (Callon & Law 1982; Latour 1987).

Framework to focus on multi-site analysis addressing the settings of technology development and implementation/use and focusing particularly on nexuses between design and use and the interactions between them. The approach attempts to integrate the historical and contemporary; and it addresses different locales in the design/implementation cycle. We further argue that researchers need to look at artifacts at different stages in their biography. We have in our own research observed package developments at early and late stages of their lifecycle, studying both the birth and evolution of new artifacts, as these differ significantly in terms of the relations between actors and the institutional structure – in short, the mechanisms for mutual shaping of technology and society (Pollock & Williams 2009a). Let us look at these points in turn.

Departure from Mainstream Constructivist Approaches to Technology

Let us make explicit our point of departure from mainstream constructivist approaches to the analysis of technology and work. Early contributors to the self-styled ‘New Sociology of Technology’ (Pinch and Bijker 1984) primarily addressed innovations and innovators that established a new field of techno-scientific practice. As these were often at the interstices of existing institutional structures, ANT and SCOT theorists were able to ‘foreground’ the actors directly involved. Analysis often focused particularly on ‘heroic’ technical specialists, who were conceived as ‘Sartrean engineers’ (Latour 1987), apparently outside or able to operate free from constraint from social structure.⁵ They thereby relegated to the background, or ignored entirely, the historical and institutional factors which underpinned these developments. However, such actor-centered accounts yield unbalanced explanations. Their shortcomings are particularly problematic when deployed to analyze the development of workplace technologies and other instances of incremental innovation within well-established institutional settings. Local actions (ERP implementations) are sustained and constrained by an extensive network of technical, organizational and social arrangements whereby some (material, institutional) elements are difficult for local actors to change (cf. Kallinikos 2004a,b; Koch 2005).⁶

This suggests we need a more ‘contexted view’ (Morrison 2002) able to address the complex social fabric and its history which patterns the activities of those involved locally. Moreover, our explanatory frame needs to be one which avoids the simplifying logics of particular disciplinary approaches or schools, and which can match the intricacy of the settings and processes we are studying. We start with the observation that the character of ERP solutions is being fought for, and shaped, at a number of levels ranging from local contestation around features of design or its organizational implementation to the broad macro-level concept. The complex web of relationships involved moreover changes over time; it is as Koch (2007) observes a ‘moving target’. This alerts us to the need to address how individual actors (e.g., suppliers, potential users, intermediaries) and the relationships between them are conditioned by their broader setting. How then shall we conceptualize the broader setting?

Koch (ibid.) has criticised existing explanatory frameworks of ERP studies as being too simple. In an important series of articles, he maps out a broad framework: local studies (e.g. implementation studies) will no longer suffice, he argues; ERP is both ‘local’ and ‘an institution’. However, he also expresses dissatisfaction with dualistic analyses that counterpoise local and institutional developments (such as Avgerou [2002] and Soh & Kien Sia [2004]). He proposes, instead, that we should examine ERP as ‘a community’ (Koch 2003) constituted by joint involvement in a technology. Koch (2007: 440) observes that in future ERP studies need to go beyond the single space enterprise, as well as moving away from implicit assumptions of stable states of the system and to adopt instead a ‘multi-local’ analysis of technology. To this end Koch (ibid.) proposes, as a conceptual frame, a six-field matrix, encompassing short- and long-term, and micro, meso and macro elements, of which implementation is but one out of six aspects. We find ourselves in agreement with Koch’s analytical project (and particularly his call for more effective analytical templates addressing multiple locales and histories). We hope to contribute to this common goal in some way.⁷

5 ANT insists on explaining outcomes solely in terms of the success of innovation actors in enrolling others to support their project through various strategies. These strategies included *problematization*, the definition of difficulties/limitations in a way that the primary actors establish themselves as the source of solutions; and *interessement*, where they convince others that their interests are best met by aligning with their project. In this view, successful implementations are not a cause but an outcome of the ability of actors in enrolling and mobilising others (Callon 1986).

6 ANT helpfully problematized rigid theorizations concerning the prioritization of particular locales and settings (i.e. ‘localization arguments’) (Knorr-Cetina 1981; Callon & Latour 1981). Yet once having done this it provides rather few clues as to how these different scales should be addressed.

7 However, we have some reservations about the macro–meso–micro distinction. Though these are very convenient and communicative labels (and we will use them as such) they run the risk of being mechanistically misconstrued as fixed and separate levels when in fact they are interpenetrating. Moreover, these need to be seen as

Design and Use of ERP Should be Studied Together

The need to study design and use together is flagged by various approaches. It is for example axiomatic to the Social Shaping of Technology (SST) perspective which insists that the development of industrial IT applications is not just shaped by strategies of designers in the domain of technology supply but also the settings of implementation and use. Fleck's 'innofusion' concept, for instance, flags the innovation processes taking place in the so-called diffusion stage in the process and arenas of technology implementation, and the possibility that these experiences may feedback into future technology supply (Fleck 1988a,b, 1993; Fleck *et al.* 1990). The importance of paying attention to these coupling mechanisms comes immediately to the fore when we examine ERP solutions. Here there are an extraordinarily intricate web of formal and informal linkages between package vendors and organizational users (Keil & Carmel 1995). As already noted, we have studied the development and evolution of major ERP module along a number of different phases in its lifecycle, from inception through to 'maturity', paying attention to the various innovations that developed around the package over time. We saw, for instance, how one particular user organisation (in partnership with an ERP vendor) developed new functionality for its own site (a new interface that connected previously unconnected ERP modules and in-house systems) that when implemented was then appropriated by the vendor and marketed and sold as part of its global solution. Anecdotal evidence suggests that this strategy is extremely common amongst software package suppliers (Pollock & Williams 2009a).

We also studied the module at the supplier-user nexus through long-term participation in a particular vendor user-group where we observed the user community attached to the module and wider ERP system. Here we saw how the vendors used the group to source future requirements and sound out ideas at user group meetings. We witnessed cases where, for instance, having done initial research with key customers at user-group meetings, that the vendor staff subsequently decided not to pursue particular innovations. Indeed user groups represent one of the most important coupling mechanisms between users and vendors (and far as we know there are still no fine-grained studies available that describe their functioning and their linkages back to software vendors). Observation of these groups revealed the efforts of certain key users to look after and ensure the development and extension of 'their' ERP system. This ranged from simply attendance at user-group meetings, to the actual organisation of user-groups, to feeding back ideas to the vendor, and actively promoting the vendor's products to other organisations in their sector. As well as acting as a reference site (for which they were paid only a small nominal fee), many users actively marketed the systems to others across the world.

We claim to have a comprehensive knowledge of this particular module (having followed its career for more than a decade now). What we saw was that design – and the coupling between artifact design and its implementation and use - is being worked out through a range of different networks and intermediaries linking suppliers and users. It is also being worked out over multiple settings of organizational implementation (implementation cycles) and in aggregated form over multiple product cycles.

ERP Systems Are Surrounded by a Fine Structure of External Experts, Intermediaries and Knowledge Networks

When we focus on any one particular locale or moment in the ERP biography we ignore important influences (actors and factors) from other levels and moments. In conducting a study of software package 'procurement', for instance, we noted how new industrial technologies develop in parallel in a multitude of user sites and through the activities of many vendors and associated players (such as consultants) (Pollock & Williams 2007). This suggests that research on information system acquisition requires that the analytical lens moves beyond the immediate inter-organizational level of direct interaction between suppliers and users to focus on the broader terrain of suppliers of classes of products. Whilst conducting our study on the selection of a customer relationship management system, for instance, the primary empirical focus was upon the immediate level of organizational actors involved in the procurement decision but there were also the expert intermediaries who had been enlisted to assist with procurement, and the supplier (and its competitors and collaborators), all of which together constituted the immediate network of players directly engaged. Thus we can track an array of relationships out from the organization contemplating enterprise

relational categories. In other words, what is seen as macro and meso is relative to the sets of ('local') actors and issues under examination (Kaniadakis 2006). It is perhaps more useful to develop a generic model of the social shaping of complex, commodified organizational technologies such as ERP, rooted in empirical analyses, that can provide a complex template for our analysis.

system adoption. This is because the procurement of organisational software represents something of a difficulty for user organizations.

These large systems, whilst extremely expensive and of great strategic importance to the organisation are enormously complex, and their properties and match with the requirements of the potential adopter are hard to assess. Moreover, these substantial and often business-critical decisions about what may be major strategic investments are carried out infrequently by user organisations, which thus typically lack the expertise and experience needed for effective decision-making. Another of the difficulties adopters face is that they are assessing not just technical properties but also intangible issues regarding the future performance of a technology vendor (will it survive?), its behaviour (will it continue to invest in the particular market/sector in coming years?), the difference between technologies, and so on. Assessing these kinds of uncertainties is proving increasingly difficult and provokes confusion amongst adopters about how to proceed (Tingling & Parent 2004). Whereas in the past 'personal' or 'professional' networks would have offered advice, these informal avenues for knowledge no longer seem to match up to the challenge of appraising today's technologies in terms of the growing range, escalating complexity and rapid evolution of available products (Fincham *et al.* 1994; Swan & Newell 1995). These features frustrate the conventional mechanisms by which purchasers might seek to scrutinise the properties of a material product. Thus Finkelstein *et al.* (1996) have drawn attention to the influence of advertisements, supplier literature and demonstrations. They also point to the importance of observed use of the packages in other settings (for example, demonstration sites where the package has been installed [Pollock & Williams 2007]) and comparative studies provided by third parties (trade papers *etc.*) (on this latter issue see Wang & Swanson [2008]). As well as drawing information from knowledge and technology suppliers, potential adopters seek more impartial information through informal links with similar organizations (Tingling & Parent 2002). Moreover, out beyond these, we found the combined actions of players that constituted 'the market' of technology artifacts, the field of technological practice, and also intermediaries that channeled information through these collective spaces. Comparing the implementation of ERP today with Computer Aided Production Management (CAPM) systems in the 1990s (Webster & Williams 1993), for instance, we are struck by the increasingly sophisticated sources of specialized information available about this and other workplace technologies. The enterprise system (MRP, MRPII, ERP *et seq.*) arena is becoming ever more organized. This arena is comprised of suppliers, users, consultants and inter-organizational networks, which include sectoral networks, professional associations and latterly user-groups organized by vendors as well as industry analysts. In addition, it is the latter that constitutes a novel and increasingly influential category of player (see below).

Once a packaged solution is determined upon, a more tightly coupled set of contractual relationships will be established by the adopting organization with those charged to deliver an ERP implementation, involving a wide range of actors. As well as the vendor itself, there could be the suppliers of associated products (hardware and bolt-ons) and various sorts of external knowledge providers. These include groups such as consultants who offer expertise in ERP implementation and who, in turn, might be assisted by external providers of other sorts of relevant expertise (such as systems integration or change management experts more generally). The increasing resort to outsourcing the supply of business solutions (and their supply as packaged rather than bespoke solutions) and the increasing role of consultants in the supply of knowledge services radically transforms the institutional terrain in which changes in industrial technologies are adopted (though there may be some similarities in the process of implementation [Brady *et al.* 1992; Fincham *et al.* 1994]). In particular, it changes the character of the conflicts of interest from a primarily intra-organizational contest for political legitimacy and access to resources to a primarily inter-organizational contest for contracts and streams of income and services. This also changes the character and role of internal expertise and sets up complex alliances between organizational interests and external economic interests (such that public and private organizations carefully regulate such linkages) (Procter *et al.* 1996; Howcroft & Light 2006). The selection of consultants and the role delegated to them, shaped by established ways of working and reputation from previous projects configures the arena in which the project unfolds in ways that may give consultants more or less autonomy and influence over outcomes (Hislop 2002; Pozzebon & Pinsonneault 2005). We find that change is taking place in a complex social setting, and one that is patterned by pre-existing social relationships. Clausen and Koch (1999) similarly identified more or less stable couplings between particular groups of user organization and vendors, which they have described as 'segments' of the ERP market.

The segment

Clausen and Koch (1999) explored how the shaping of ERP in the 1990s took place across a structure comprising the Company Social Constitution (CSC) of the adopters, with their own internal dynamics, and various 'segments' of IT

suppliers and customers. They suggest that knowledge flows within these segments were shaping the evolution of ERP. This included implementation experiences, and the new demands and visions circulated between suppliers and their customers. Drawing on theories of 'organized capitalism' (see Lundvall 1985), Clausen & Koch (1999) see the persistence of these segments in terms of the benefits of these knowledge flows and a coalescence of similar views about business improvement. Crucially, they argue that different segments, and the different procurement strategies and associated forms of supplier-user coupling, offer different opportunities for local influence over the design of the ERP system. Later work by Koch points to the influence of broader and longer term changes affecting these 'Meso' structures, including the restructuring of the ERP supply sector in the 2000 economic downturn which swept away some of the weaker and small players. These segments are not stable. There have also been some realignments in the constellations of players around ERP provision (generic solution providers, suppliers of complementary products, implementers and other Value Added Resellers) in a complex pattern which combines elements of stability as well as dynamism (Koch 2004, 2005).

Organizing Visions

This final observation forces us to consider developments at a more Macro-level. This is, first, in terms of the relationship between changing conceptions of an organizational technology and the circulation of broader views of industrial improvement (which inform prescriptions of good/best practice). And, second, with visions of how these may be fulfilled by emerging technologies. Swanson and Ramiller (1997) have highlighted the role of 'organizing visions' in information systems innovation, encompassing interpretation, legitimation and mobilization, which help mobilize the material and intellectual resources needed for innovation. To give one important example, it was the Gartner Group who initially coined the phrase 'Enterprise Resource Planning' back in the 1990s to describe a then emerging type of information system and then, later, went on to map out visions of how this and related segments of the software market should develop (Wylie 1990). This is a vision that has had considerable influence in shaping that particular technology and its development (Mabert *et al.* 2001; Judd 2006).

Wang and Ramiller (2004: 12) go on to note that whilst initially the focus of attention is on the promise of the technology is, and why it should be useful, later attention shifts to issues in its successful implementation and exploitation by user organizations. They note how focus often evolves through various stages (in what they call an 'innovation community of vendors, consultants, adopters') from: *knowing-what* (interpretations that help to conceptualize the innovation); *knowing-why* (rationales for adoption that help to justify the innovation); and *knowing-how* (implementation and utilization strategies and capabilities that capacitate the innovation). This bears directly upon our analysis of the evolution and biography of ERP (and for example Koch's [2003] analysis of ERP as a political program for organizing change). A key part of the 'heterogeneous assemblages' (Koch 2005) of human and material elements that constitute ERP is comprised by inter-subjective elements: promises, visions of best practice and prescriptions for industrial improvement, and criteria for assessing technologies alongside artifacts, techniques and practices (Wagner & Newell 2004). The biographies perspective however helps us analyze how these communities operate across the diverse set of social actors involved: suppliers and users, consultants, industry analysts, policymakers and commentators. This brief review of developments around ERP brings us nearer to being able to sketch out a schema for analyzing these multi-local developments in more abstract terms.

Concepts for Exploring Multiple Locations

Arenas of Technology Development and Implementation

How then can we conceptualize this complex space, linking together material artifacts, practices and visions within an extended fabric of individuals, organizations and inter-organizational structures and associations? As Koch (2007) argues, we need better spatial metaphors for addressing this rich tapestry, which is characterized by gaps in time and space (e.g. between developers and users, as well as by more or less sharp differences of interest, expertise and commitment). We could theorize this as a 'distributed innovation process' (a concept recently advanced by innovation economists [von Hippel 1994]) or as the operation of an 'actor-network' (in the way Actor Network Theorists might do [Callon 1986]). These however represent a very imprecise way to characterize what is in fact a rather structured set of relationships. Also, as others have noted, networks are 'sparse social structures' (Knorr-Cetina & Bruegger 2002: 910) and it is difficult to see how the notion can account not only for the heterogeneity of players involved in a typical ERP implementation but also to the intricate and heterogeneous pattern of linkages that

exist between these players. We have been attracted by Jorgensen and Sørensen's (1999) concept of 'development arena'. The value of the concept for us is that, seeking to provide tools for ANT based explanation to deal with the broader interactions evident in global technology developments, it conceives of the arena as a space, using the analogy of a circus ring drawn in the sand, in which a number of more or less conflicting actor-worlds collide. In addition, they flag the possibility of radical reconfigurations of an arena through changing boundaries and realignment of players, providing tools to explain destabilization as well as alignment.

However, to characterize the development and evolution of organizational technologies such as ERP as a single arena may be to underplay the very different textures of the fabric of social relations (which for example range from contractual linkages between firms to weak associations of opinion across dispersed communities). We could alternatively describe the setting for development and evolution of ERP in terms of a multiplicity of overlapping arenas: these could be development arenas, implementation arenas and specific Company Social Constitutions (for CSCs are surely arenas too). This however might distract attention from the fact that many players will appear in multiple arenas. Characterizing these as separate spaces may not be helpful to our current concern to develop multi-local theorization of both the many kinds of supplier-user relationships and of the overall development of a technological field. Instead, we want to look at the various different kinds of relationships established between broadly similar or at least strongly overlapping groups. We also need to be able to analyze these at different levels of generality and timeframes.

The 'Agora of Technology and Organizational Change'

Kaniadakis (2006) has introduced the concept of the 'agora of technology and organizational change' which provides a framework for looking at the relationship between different arenas and levels, and how local actions are set within broader settings. He sees the agora as a meeting place and a market in which all producers and consumers of organizational technologies potentially interact. It refers to the broad space in which ideas are circulated both about good industrial practice as well as about how this can be achieved through new technologies. This is where technological fields come to be constituted, and certain concepts achieve wide currency, in a process catalysed through the activities of certain key players – in the case of ERP, notably vendors, consultants and industry analysts – but also ultimately sustained by the activities of wider communities of organisational users and others. These concepts and broader visions provide crucial resources within which vendors and management and technology consultants can articulate their offerings.

The agora, thus conceived, is diffuse and not clearly bounded. However various particular bounded perspectives on the agora are drawn (by actors and analysts) for different purposes (of action and analysis) depending upon their particular context and purpose. In other words, actors construct particular *viewpoints* of the agora: they see and engage with particular slices of the complex multi-local multi-actor space of the agora and set boundaries depending on their purposes and relevancies. How the agora is conceived depends upon the actor's relationship with it. Thus, a user organization has a very different view and orientation towards the agora than a technology vendor. Viewpoints are active constructs; it is not simply a question of where you stand. It is also a question of the purposes of players constructing it. The agora is also, and perhaps primarily, an analyst's construct. The researcher makes choices about which tranches of this complex structure to sample and with what closeness of view. The arenas we have discussed above may be seen as particular viewpoints within the agora. The agora has a structure. Thus, Kaniadakis sees the agora as having Micro-Meso- and Macro-levels. However, what appears as local and as broader context also depends crucially upon what is being examined and how. For a study of interactions in a particular workgroup, global technology developers may appear as established features of the macro-environment, along with other legal and institutional structures, that are not amenable to influence by the actors in the timeframes involved. In a study of these technology developers, however, the market of (unknown, distant and thus impersonalized to them) potential users may appear as an obdurate and immovable constraint. This is then a relational (not a relativist) conception. The concept of agora would seem to meet Koch's (2003) call to go beyond a dualistic local-institutional conceptualization and address ERP as 'a community'. Moreover, it opens up opportunities to address the intricate structure of this community and develop methodologies to capture this.

The agora may be a diffuse and plural array of players. However, it is not an open and equal community – in the way in which we might conceive of scientific communities operating under the Mertonian ideal, for example. Its internal structure comprises not just peer-like communities of practice (à la Wenger 1998), but also communities of (often conflicting) interest. It is characterised by asymmetries and entrenched conflicts as well as alignments of interest. Moreover, many parts of this segment of the agora are subject to commodification. This imparts a complex dynamics

to the agora. We have already noted the difficulties whilst procuring software in establishing the provenance of a provider and its products, and of demonstrating the benefits of that solution to a particular user organisation and of overcoming misfits. Not least, because ERP is a generic product, a substantial investment must be made in implementing it within an organisation before its outcomes – before actual and achievable fit – can be realistically assessed. These difficulties in assessing the qualities of a product mean, on the one hand, that the market is a rather inefficient discovery mechanism, which must be supplemented by network or community types of relationships (these include visits to ‘reference sites’ to view systems in action prior to the procurement decision, the exchange of information at user group meetings, and so on). On the other hand, outsourcing and commodification radically change the incentives faced by players in commercial relationships in the procurement of technology or (consultancy or integration) service, with sharp and very obvious conflicts of interest between competitors but also differences of interest and of commitment/world view between consumer and producer. Once the procurement process has been concluded, the arms-length externally policed contractual relationships invoked by economists might be presumed (hypothetically) to apply. However, in a context of necessarily ‘incomplete contract’ issues, this strict contract relationship remains notional. Though the existence of contracts changes the legal and governance character of previously voluntary relationships, the exigencies of joint learning in implementation are characterised by the erosion of boundaries and lines of responsibility. Here we may infer a spectrum of market relationships between what we might provocatively term, following Burns and Stalker (1961), mechanistic and organic relationships, between those in which a more strict versus a more collaborative relationship prevails. Thus, we see that in both phases of the market relationship, market forms are supplemented by communitarian and network forms of relationship (Fincham *et al.* 1994; Adler 2001). This is one way in which the relationships of the agora are unlike a community of practice or a scientific community but are shaped by the dynamics of commodification.

The agora refers to a linked array of locales in which economic and organisational interests, as well as meanings, are at play and are being played out. From our social shaping perspective, we are particularly concerned with economic interests and technological commitments. The agora for technology and organisational change is a site for the mobilisation of promise and expectation (and likewise a site for counter-enrolments and mobilisation of uncertainty and doubt) at various different levels of generality. This may range from particular organisational implementations and supplier offerings to classes of organisational technology, and ICT capabilities more generally. We thus see the agora as itself a product of a series of enrolment efforts and struggles, which may be described from different perspectives and at various levels of generality/pervasiveness and historical timeframes, ranging from immediate contexts of local action to more generalised patterns of behaviour, sustained over longer terms, which in turn constitute economic, technological and institutional structures. These broader ‘structures’ act to pattern innovation, providing resources and material constraints to actors in terms of their choices regarding which options appear doable, which factors can realistically be changed, and which are to be taken as part of the landscape.

This double-sided character of the agora, as both shaping and shaped by socio-technical processes, may usefully be approached through the concept of negotiation, with its two distinct connotations. First, this is negotiation as a meeting, a place for alliance-building, conflict and struggle with more or less obdurate or amenable human and non-human elements; and second, it is negotiation as a set of manoeuvres needed to accommodate or bypass those elements which are effectively ‘non-negotiable’. This second usage of negotiation, which is akin to the way we might negotiate ourselves down a mountain pathway, is informed by the fact that some of the things we encounter present themselves as more solid and permanent from the view of particular local actors, including institutions and technologies, which in this sense are a kind of materialised institution, and have to be negotiated around.

Intermediaries as Strategic Players in the Agora

The agora concept provides a space for analyzing the various kinds of social relationship beyond the immediate inter-organizational level of direct interaction between supplier and user. To be useful, however, the detailed operation of the agora needs to be filled out and explained. Our concern to analyze procurement stimulates us to address the broader terrain of suppliers of classes of products and the ways in which beliefs about the provenance of a technology are constructed across a community of supplier and user organizations. Our final addition to the framework is to examine the emergence of new kinds of intermediaries who are also market makers and conveyors of community information. We draw attention to the role of various kinds of intermediaries, and in particular the growing importance of a relatively distinctive class of intermediary - industry analysts. In our research we have found that groups like Gartner are important because as well as acting as a repository and organizer of what might be thought of as ‘community knowledge’ about the implementation of particular products and about the reputations of suppliers’, their sectoral reviews also consolidate the existence of a domain of technological activity. In terms of the

former this is the experiential type knowledge solicited from technology users and deployed in the construction of evaluative tools like the ‘magic quadrant’ (Pollock & Williams 2009b) whilst for the latter it is how their reviews and reports constituting a technology like SAP’s R/3 as an instance of ERP). Thus we speculate that industry analysts seem to play a crucial role in configuring particular development arenas and in mobilizing consensus. It might appear that in some instances it is they who hold the ropes and set the rules of game – defining the boundaries of technology and the criteria by which particular vendors and their offerings may be judged (*ibid.*).

To summarize, we have drawn upon concept of the agora (Kaniadakis’s 2006) to highlight the extended socio-technical space in which developments unfold as well as the possibility this framework suggests of researchers taking different analytical slices, from different viewpoints and for differing analytical purposes, through this space. We thus emphasize the integrity of this socio-technical space: the agora is an extensive, seamless web of social (or rather socio-technical) relations over time; there are no walls or gullies that allow what is ‘outside’ to be reliably fenced out/factored out of the analytic picture. The relations within the agora do not necessarily correspond to the relatively tightly knit arrays of actors that might tacitly be conveyed by established concepts such as community, arena or network (though parts of the agora may be constituted by these kinds of explicit and stronger linkages – including, for example, very strong contractual relationships between vendor and purchaser). Nor is there the sense that may be inferred by ‘network’ or ‘system’ concepts, of shared commitments or incentives. The agora then is a system characterized by differences in societal insertion, roles and incentives, knowledge, commitments and views. Here we draw attention not only to the heterogeneity of players but also to the intricate and heterogeneous pattern of linkages that exist between these players. Consider, for example, the varied kinds of linkage between packaged software vendor and its customers over different phases in the software lifecycle that we have highlighted above. The agora is moreover a markedly amorphous space, subject to imperfect alignments and competing pressures. Given this heterogeneity of linkages, we may need different analytical tools to capture the many different kinds of relation across the agora. Unlike ANT, we do not wish to do this by dissolving everything into the homogenizing framework of the language of actor-networks, compressing all the different components into an actor-centered account and linked by ANT’s limited repertoire of relationships (such as Callon’s [1986] generic translation strategies). Instead we wish to pay due attention to the complexity of operation of socio-technical phenomena, differently constituted and observed at multiple levels of generality.

Addressing Multiple Historical Timeframes

A corollary of our insistence upon the need to examine socio-technical change at multiple levels of generality, in terms of addressing immediate contexts of action and broader contexts, is that we need to consider also socio-technical processes temporally. This is in terms of the unfolding of multiple histories and also the different historical timeframes around which an object, event or activity may need to be analyzed.

Multiple histories and timeframes are intrinsic to our attempts to capture the evolution of a new technology, addressing, for example, both its development and adoption. In this way we seek to capture the complex sets of developments taking place across a variety of locales, encompassing both the ‘local’ context of immediate action and interaction and its patterning by a broader context. This broader context is constituted by the aggregate outcomes of previous actions which, in turn, provide a less-readily negotiable set of factors that frame and pattern outcomes and which need to be analysed over longer-term timescales. It is important to pay attention to the multiple dynamics and timeframes surrounding innovation as the dynamics of technology development and appropriation may differ. For example in the case of information & communication technologies (ICTs), where development cycles may have shortened to a year or two, appropriation cycles may be an order of magnitude greater, with new consumer products taking decades to diffuse into widespread use and having greater longevity (Williams *et al.* 2005) (though both timeframes are becoming shorter). This longevity in appropriation and replacement cycles is particularly marked in the case of organizational information infrastructures such as ERP. Particular episodes form part of multiple histories. Thus the implementation of a technology constitutes a moment in the history of a particular Company Social Constitution (Clausen & Koch 1999). It is also one of a number of sites of implementation of a particular supplier offering, contributing through its infusion and appropriation to the further elaboration and wider adoption of that specific artifact. And that specific story in turn forms part of the evolution of the class of artifacts with which the supplier offering is associated. We have coined the concept ‘biography’ to refer to this history of relationships and sites implicated in the evolution of a specific artifact and a class of artifacts. And the latter can, at a more general level, be seen as a phase in the development of organizational technologies more generally. In these latter cases, the specific history is nested inside another more long-term generalized set of relations. However, a technology

implementation can also be seen as the linking together of two specific histories that may not have been previously conceptualized together: the Company Social Constitution (CSC) of the organizational adopter and the biography of a specific artifact.

In theorizing the multiple tempos that we may need to address in analyzing particular episodes, we find considerable merit in the framework articulated by Hyysalo (2004). He draws on Hutchins' (1995) study of how quartermasters learn naval navigation in a system of distributed action, which portrays the simultaneous unfolding of different histories: "any moment in human conduct is simultaneously a part of the unfolding of a task, the development of the individual doing it, the development of the work community, and the development of the professional practice" (Hyysalo 2004: 12). Hyysalo also introduces us to attempts within Activity Theory to characterize time-scales for analyzing social and technological development. His study of the development of new healthcare technology highlights three key time-scales in the coupling of design and use: i) the prevailing ways of organizing design and use in industrial production. Hyysalo refers here to features of the innovation system liable to be stable over many decades: 'pervasive and relatively slow changing ways in which design and use are generally organized in industrialized countries' (Hyysalo 2004: 13); ii) the coupling of a technological field and a societal practice, which he sees as relatively stable institutions, potentially stable over years and decades, though noting the possibility of changes in practices, in technologies and in the ways these are coupled together; iii) and the development of a particular innovation and the organizations and people connected to it. We can adapt this schema to our own analytical concerns. Hyysalo's longest timescale i) *prevailing ways of organizing design and use* would perhaps correspond to the resort to packaged solutions for organizational technologies. Our concept of biography would also encompass his other shorter timescales: ii) *the coupling of a technological field and societal practice* which corresponds to the biography of a class of artifacts (e.g. ERP systems in general); iii) and the *development of a particular innovation* to address the biography of a specific artifact (e.g. SAP's R/3 system).

The comments we made earlier, in discussing viewpoints and research design, about different ways of slicing through the complex social space represented by the agora, depending upon our location/orientation to it and our concerns, also apply to the historical framing and timescales of our research. Such choices about the temporal framing of enquiry have important implications for what may be viewed. For example, local studies of immediate settings of action inevitably draw attention to the scope for discretion (user workarounds, appropriation strategies, resistance etc. [cf. Boudreau & Robey 2005]) but provide a poor vantage point for exploring longer-term processes of technology-organizational alignment (for example around common business process templates within enterprise systems [cf. Benders *et al.* 2006]). This may need to be captured by other modes of research (for example longitudinal studies). Rather than invoke one modality of research, our approach seeks to retain awareness of the multiple historical registers that surround a particular phenomena. The choices we make regarding which timeframes and historical registers are to be centrally addressed and parallels our earlier discussion of choices regarding the adoption of a local or of a more global gaze. Whilst the agora concept provides tools for looking at social space, the temporal distribution also needs attention.

We are minded here of the critique of constructivism made by Kallinikos (2004a: 12) on the grounds that the 'study of technology and its social impact cannot be exhausted at the very interface upon which humans encounter technology. Essential strips of reality are not observable...'. It might be argued that perhaps the object of Kallinikos' (2004a) critique might be more precisely characterized as 'atomistic interactionism' rather than the more ambiguous term of constructivism, which has been applied in many different ways (for a review of some of the different applications see Sismondo [1993]). Kallinikos is highlighting issues of social structure, of particular relevance when we consider technologies that typically come to us as the result of a more or less elaborate (occupational, organizational, and industrial) division of labor. If we are to address the material character of artifacts, many elements are developed at a remove (socially and temporally) from their sites of implementation and use and are not under the control of actors in user locales. This observation can also usefully be applied to the existing institutional context that provides resources and sets constraints for local action.

We are proposing a relational approach that brings to the foreground certain features for detailed analysis – but within a broader historical register that also records other levels of generality and tempi. Our work seeks to find ways of probing and addressing these other levels/tempi through the adoption of a complex methodology. We contrast this, inevitably messy, endeavor to other dominant social scientific research approaches which recognize only a single register for analysis (whether of immediate action or of broader structuring). We see this failing, for example, in the earlier structuralist explanations (Orlikowski 1992; DeSanctis & Poole 1994) that overlooked more micro aspects but also in the 'atomistic individualism' which characterizes much recent work from a constructivist background which only recognizes immediate contexts of action. We contend that this yields an unhelpful reductionist account of

complex social processes. Rather than propose a particular level of analysis, we emphasize the benefits of multi-level analyses, which may have different depths and centers of focus depending on the issues investigated. For us the matter of research design and epistemology should be driven by a critical reflection about which (spatial/temporal) slices of complex techno-social fabric are brought into the centre of our analytic gaze by particular modes of research and from what viewpoints.

Discussion

This paper challenges the current emphasis on the local social relations surrounding ERP systems and suggests that failings of interpretation arise where studies embrace *immediate interaction* and neglect historical and wider processes. Short-term implementation studies emphasise the constraints to adoption of technology within particular organisational settings but whilst doing so overlook incremental processes of restructuring as technologies become embedded in organisational practices over time. Moreover, when we focus on one locale/moment we also find that important influences (actors and factors) from other levels and moments are ignored. The practices of technology suppliers, for instance, to name but a few, have mostly remained invisible such that scholars are failing to appreciate the complex innovation processes and ongoing interactions between vendors and users. These are only some of the examples of the ways in which particular disciplines and schools of analysis have generated what we think are partial accounts (in both senses of the word 'partial') that address only a small fragment of the complex and interconnected relationships that constitute real-world phenomena, by means of studies that remain framed around and restricted to selective arrays of actors and settings, timeframes and issues.

We have argued instead for the importance of paying more attention to issues of methodology and analytical framework. In challenging the current emphasis on the local and immediate social relations around innovation, for instance, we suggest the need for *contexted* and *multi-level* analysis. There is a need for research investigating how local interactions are framed, nested and shaped by other settings and sites of interaction. This includes those more generalised sets of social relations that we may capture at a number of different levels as constituting broader contexts of development. These comments apply also to the historical framing and timescales of our research. These different framings in terms of level and focus of analysis are (partially) coupled with different timeframes of analysis. Social scientific enquiry encompasses different timeframes of action/interaction, ranging from those of interpersonal interaction, which may occupy split seconds, to the changes in the broad institutional level that may be measured in periods of several decades. We take the argument about the need for multi-level, contexted analysis further in relation to temporal framings, to argue that multiple histories and timeframes intersect in any episode that we may wish to analyse.

We have extended our earlier notion of biography (Brady *et al.* 1992; Pollock *et al.* 2003; Pollock & Cornford 2004) which highlighted the institutional setting - including the role of professional associations and of public policy in promoting ideas of best practice - but did not include a comprehensive set of conceptual tools for analysing the social fabric beyond the supplier-user nexus. This is what we have attempted here. We propose the concept of biography as an instance of a 'variable research geometry' that can be applied to diverse issues and in differing contexts, depending in particular upon what issue(s) are being addressed and which entities are being tracked. The biographical approach focuses upon social (or rather socio-technical) processes involved in innovation and how these are shaped by their context and history. Many kinds of biography are thus possible. We could study the biography of an artefact, which may be conceived narrowly in terms of the implementation of an innovation, or of the development of a particular ERP system, or the more broad class of system to which it belongs, or of the technological field and their complex couplings with social institutions, actors and practices.

This has been the (often tacit) objective of a diverse array of Social Shaping of Technology studies. These have deployed various research geometries in terms of the historical scale and the level of generality of the phenomena under study. However, what is at stake here is not only a matter of temporal and social framing - of zooming in and out to use a photographic analogy - but involves important choices also in terms of the methods and concepts deployed and the relationship of the study with existing knowledge. Multiple methods may be required, knitting together different kinds of evidence including historical studies, ethnographic research, qualitative studies of local and broader development and even perhaps the use of larger-scale research instruments and quantitative data (Mingers 2001). These differing kinds of evidence have differing strengths and contributions to mapping the dimensions of an issue. Local qualitative research, for example, may provide better tools for drawing out intricacies and particularities of social process and is particularly pertinent to exploratory research opening up new understandings of a novel and emerging phenomena, whilst larger-scale research provides a more effective base for

addressing regularities and trends as well as for testing hypothesis and models and confirming findings from exploratory qualitative studies (MacKenzie 1988). It may be further adduced that combinations of different kinds of evidence are liable to produce more robust and richer understandings.

As well as proposing a variable geometry in relation to the temporal and technical/societal framing of research, we argue for a certain level of critical eclecticism in relation to broader worldview, and the theories and concepts that inform it (Mingers 2001). Of course, theories and methods cannot simply be combined on a pick and mix basis; they are underpinned by different and often incompatible presumptions and tools. Though some have interpreted this truism as constituting a case for sectarian theoretical purity, we suggest a different response. We argue instead that we can interrogate differing analytical traditions in terms of their robustness and applicability to the phenomena in question and their compatibility with other perspectives; we can reason and make judgments about these questions (a process Robey [1996] has described as 'disciplined diversity'). Though informed by our close association with the Social Shaping of Technology perspective, particularly in our emphasis upon material and social structural influences, the biographies approach is not 'hard-wired' to a specific theoretical perspective, and many of the schools and analytical currents within STS have common and convergent concerns (Williams & Edge 1996).

We contrast our analysis with the widespread espousal within current STS of what we may call 'atomistic interactionism' in many explanations of the world with roots in social constructivism and phenomenology, which see the world as constructed and reconstructed anew in sites of everyday action. A similar analytical consequence arises from the rejection by ANT of explanation in terms of the operation of broader social structures, accompanied by their rejection, as unwarranted generalization, of social scientific theories regarding the operation of these structures. In place of basing their choice of research setting and methodology upon social science theory, these actor-centered accounts generally resort to a 'naturalistic' (or perhaps empiricist) approach; seeing society constituted in the observable actions and interactions they study. Flat ethnographies face the problem that many aspects of the material character of ERP are shaped and constituted beyond their local setting of use. The result, when faced with partial pictures, has meant that scholars have (over)emphasized the importance of particular settings and interactions. This propensity is exemplified within much IS scholarship that presents appropriation as of paramount importance and correspondingly neglect other distal processes. We would instead propose an alternative solution involving what we describe as 'strategic ethnography', addressing multiple sites, selected according to the matter in hand based on our preliminary knowledge thereof. Such an analytical move requires researchers to explicitly recognize and make accountable the strategic choices involved when deciding upon the location and boundaries of ethnographic work. It would in turn require reflection upon the theoretical commitments and presumptions that inform these choices (rather than pretend that it is possible to avoid such choices for example by empirical sensitivity).

ANT, with its nostrum of 'following the actor' (Callon & Law 1982; Latour 1987), does not limit itself to particular settings, but accepts that research involves making strategic choices about which sites and people should be tracked. It justifies these choices, however, in terms of empirical outcomes; in this sense ANT claims to be able to see 'where the action is' (Latour 1987). However, ANT does not provide tools to guide those choices or make them accountable. This claim to be able to resort to a naturalistic method leaves ANT open to criticisms of empiricism (Russell 1986). Moreover, a multiplicity of accounts would be possible from different perspectives; any ANT account of necessity involves choices about which actors and perspectives to foreground (Sørensen & Levold 1992). Since ANT has rejected other theoretical knowledge, these choices are made based on largely unacknowledged presumptions (though see Law [1991]) and common sense knowledge.

What is at issue here is a particular orientation to theory with which we differ. Across the social sciences, we can find a spectrum of styles and approaches to theorization, between work that in its insistence upon particular theoretical and methodological approaches becomes purist, and more eclectic approaches. The Biography of Artefacts Framework is rooted in and inspired by STS, most immediately Social Shaping analyses, but also deeply influenced by writings from ANT. However, we differ with the latter's rejection of existing social scientific knowledge (despite the articulate defense of this approach found recently in Latour [2005]). What we are proposing is not just an 'in-between' position – balancing between eclecticism and theoretical purism - but rather a different relationship to theory. Our approach addresses the technology-society relationship at multiple levels and timeframes and also acknowledges the multidimensional character of these phenomena and thus the potential pertinence of analyses of these phenomena from different (technical, economic *etc.*) analytical perspectives. The analysis of the biography of an artefact, by acknowledging these multiple dimensions of the phenomenon under study, brings the researcher into contact with other areas of (social and technical) knowledge that are relevant to the questions under examination. A multiplicity of theories and methods may therefore be pertinent.

References

- Adler, P. S. (2001) 'Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism', *Organization Science*, March-April: 214-34.
- Al-Mashari, M. (2003) 'Enterprise Resource Planning (ERP) Systems: A Research Agenda', *Industrial Management and Data Systems*, 102, 3: 165-70.
- Arrow, K.J. (1962) 'The Economic Implications of Learning by Doing', *The Review of Economic Studies*, 29, 3: 155-73.
- Avgerou, C. (2002) *Information Systems and Diversity*, Oxford: Oxford University Press.
- Bansler, J. and Havn, E. (1996) 'Industrialised Information Systems Development', CTI Working Paper No. 22, Technical University of Denmark, Denmark.
- Benders, J., Batenburg, R. and van der Blonk, H. (2006) 'Sticking to Standards: Technical and Other Isomorphic Pressures in Deploying ERP-systems', *Information Management*, 43, 2: 194-203.
- Berchet, C. and Habchi, G. (2005) 'The Implementation and Deployment of an ERP System: An Industrial Case Study', *Computers in Industry*, 56: 588-605.
- Botta-Genoulaz, V., Millet, P.A. and Grabot, B. (2005) 'A Survey on the Recent Literature on ERP Systems', *Computers in Industry*, 56: 510-22.
- Boudreau, M. and Robey, D. (2005) 'Enacting Integrated Information Technology: A Human Agency Perspective', *Organization Science*, 16: 3-18.
- Brady, T., Tierney, M. and Williams, R. (1992) 'The Commodification of Industry-application Software', *Industrial and Corporate Change*, 1, 3: 489-514.
- Burns, T. and Stalker, G. (1961) *The Management of Innovation*, London: Tavistock.
- Cadili, S. and Whitley, E. (2005) 'On the Interpretive Flexibility of Hosted ERP Systems', *The Journal of Strategic Information Systems*, 14, 2: 167-95.
- Callon, M. (1986) 'The Sociology of an Actor-Network: The Case of the Electric Vehicle' in M. Callon, J. Law and A. Rip (eds) *Mapping the Dynamics of Science and Technology*, London: Macmillan.
- Callon, M. and Latour, B. (1981) 'Unscrewing the Big Leviathan: How Actors Macrostructure Reality and How Sociologists Help Them to Do So' in K.D.Knorr-Cetina and A.V.Cicourel (eds) *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*, Boston, MA: Routledge and Kegan Paul.
- Callon, M. and Law, J. (1982) 'On Interests and their Transformation: Enrolment and Counter-Enrolment', *Social Studies of Science*, 12: 615-25.
- Clausen, C. and Koch, C. (1999) 'The Role of Spaces and Occasions in the Transformation of Information Technologies: Lessons from the Social Shaping of IT Systems for Manufacturing in a Danish Context', *Technology Analysis and Strategic Management*, 11, 3: 463-82.
- DeSanctis, G. and Poole, M. (1994) 'Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory', *Organization Science*, 5, 2: 121-147.
- Elbanna, A. (2006) 'The Validity of the Improvisation Argument in the Implementation of Rigid Technology: The Case of ERP Systems', *Journal of Information Technology*, 21, 3: 165-75.
- ERP Research Group (2006) 'ERP Systems and Related Issues Bibliography: 600 Articles' (updated 5 May 2006), Victoria University Australia. Available on-line: http://www.business.vu.edu.au/sap/Research.html#ERP_Systems_and_Related_Issues_Bibliogr (accessed 15th May 2007).
- Esteves, J. and Pastor, J. (2001) 'Enterprise Resource Planning Systems Research: An Annotated Bibliography', *Communications of AIS*, 7, 8: 1-52.
- Fincham, R., Fleck, J., Procter, R., Scarbrough, H., Tierney, M. and Williams, R. (1994) *Expertise and Innovation*, Oxford: Clarendon Press.
- Finkelstein, A., Spanoudakis, G. and Ryan, M. (1996) 'Software Package Requirements and Procurement' in Proceedings of the 8th International Workshop on Software Specification and Design, Schloss Velen, Germany, 141-146. IEEE Computer Society Press.
- Fleck, J. (1988a) 'The Development of Information Integration: Beyond CIM?' Edinburgh PICT Working Paper No. 9, Research Centre for Social Sciences, Edinburgh University.
- Fleck, J. (1988b) 'Innofusion or Diffusation?: The Nature of Technological Development in Robotics', Edinburgh PICT Working Paper No.4, Research Centre for Social Sciences, University of Edinburgh, Edinburgh.
- Fleck, J. (1993) 'Configurations: Crystallizing Contingency', *Human Factors in Manufacturing*, 3, 1: 15-36.
- Fleck, J., Webster, J. and Williams, R. (1990) 'The dynamics of IT Implementation: A Reassessment of Paradigms and Trajectories of Development', *Futures*, 22: 618-40.

- Fox, S. (2000) 'Communities of Practice, Foucault and Actor-network Theory', *Journal of Management Studies*, 37, 6: 853–67.
- Grabot, B. and Botta-Genoulaz, V. (2005) 'Editorial: Special issue on Enterprise Resource Planning (ERP) systems' *Computers in Industry*, 56: 507–9.
- Hanseth, O., and Braa, K. (2000) 'Technology as Traitor: Emergent SAP Infrastructure in a Global Organisation' in C.Ciborra, K.Braa, A.Cordella, B.Dahlbom, A.Failla, O.Hanseth, V.Hespo, J.Ljungberg, E.Monteiro, & K.Simon (eds), *From Control to Drift: The Dynamics of Corporate Information Infrastructures*, Oxford: Oxford University Press.
- Hislop, D. (2002) 'The Client Role in Consultancy Relations During the Appropriation of Technological Innovations', *Research Policy*, 31: 657–71.
- Howcroft, D., Newell, S. and Wagner, E. (2004) 'Editorial: Understanding the Contextual Influences on Enterprise System Design, Implementation, Use and Evaluation', *Journal of Strategic Information Systems*, 13: 271-7.
- Howcroft, D. and Light, B. (2006) 'Reflections on Issues of Power in Packaged Software Selection', *Information Systems Journal*, 16: 215-35.
- Hutchins, E. (1995) *Cognition in the Wild*, Cambridge, MA: MIT Press.
- Hyysalo, S. (2004) 'Uses of Innovation: Wristcare in the Practices of Engineers and Elderly', Academic Dissertation, University of Helsinki, Department of Education, Helsinki.
- Jørgensen, U. and Sørensen, O. (1999) 'Arenas of Development: A Space Populated by Actor-worlds, Artefacts, and Surprises', *Technology Analysis and Strategic Management*, 11, 3: 409-29.
- JSIS (2004) Understanding the Contextual Influences on Enterprise System Design, Implementation, Use and Evaluation, *Journal of Strategic Information Systems*, 13, 4: 271-419.
- JSIS (2005) Understanding the Contextual Influences on Enterprise System (Part II), *Journal of Strategic Information Systems*, 14, 2: 91-242.
- Judd, M. (2006) 'Open and flexible', *Internal Auditing and Business Risk*, June: 34-8.
- Kallinikos, J. (2004a) 'Farewell to Constructivism: Technology and Context-Embedded Action' in C.Avgerou, C.Ciborra and F.Land (eds) *The Social Study of Information and Communication Technology: Innovation, Actors, and Contexts*, Oxford: Oxford University Press.
- Kallinikos, J. (2004b) 'Deconstructing Information Packages: Organizational and Behavioural Implications of ERP Systems', *Information Technology and People*, 17, 1: 8-30.
- Kaniadakis, A. (2006) 'The Agora of Techno – Organisational Change', Unpublished PhD Thesis, Research Centre for Social Sciences, University of Edinburgh, Edinburgh.
- Keil, M. and Carmel, E. (1995) 'Customer–Developer Links in Software Development', *Communications of the ACM*, 38, 5: 33–44.
- Knorr-Cetina, K.D. (1981) 'Introduction: The Micro-Sociological Challenge of Macro-Sociology: Towards a Reconstruction of Social Theory and Methodology', in K.D.Knorr-Cetina and A.V.Cicourel (eds) *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*, Boston, MA: Routledge and Kegan Paul.
- Knorr-Cetina, K.D. and Bruegger, U. (2002) 'Global Microstructures: The Virtual Societies of Financial Markets', *American Journal of Sociology*, 107, 4: 905–50.
- Koch C. (2003) 'ERP-Software Packages: Between Mass Production Communities and Intraorganisational Political Processes in D.Preece and J.Laurila (eds) *Technological Change and Organizational Action*, London: Routledge.
- Koch, C. (2004) 'Innovation Networking Between Stability and Political Dynamics', *Technovation*, 24, 9: 729-39.
- Koch, C. (2005) 'Users? What users? Shaping Global Corporations and Generic Users with ERP', Proceedings of Workshop on User-driven IT Design and Quality Assurance, Royal Institute of Technology, Stockholm: 43–53.
- Koch, C. (2007) 'ERP – A Moving Target', *International Journal of Business Information Systems*, 2, 4: 426–43.
- Latour, B. (1987) *Science in Action, How to Follow Scientists and Engineers Through Society*, Cambridge, MA: Harvard University Press.
- Latour, B. (2005) *Reassembling the Social: An Introduction to Actor-Network-Theory*, Oxford: Oxford University Press.
- Law, J. (1994) *Organizing Modernity*, Oxford: Blackwell.
- Law, J. (1991) 'Introduction: Monsters, Machines and Sociotechnical Relations' in J. Law (ed.) *A Sociology of Monsters? Essays on Power, Technology and Domination*, London: Routledge.
- Leonardi, P.M., and Barley, S.R. (2008) 'Materiality and Change: Challenges to Building Better Theory About Technology and Organizing', *Information and Organization*, 18, 3: 159-76.
- Lundvall, B. (1985) *Product Innovation and User-Producer Interaction*, Aalborg: Aalborg University Press.

- Mabert, V., Soni, A. and Venkataramanan, M. (2001) 'Enterprise Resource Planning: Common Myths Versus Evolving Reality', *Business Horizons*, May–June: 69–76.
- Magolda, P. (2000) 'Being at the Wrong Place, Wrong Time: Rethinking Trust in Qualitative Inquiry', *Theory Into Practice*, 39, 3: 138-45.
- Markus, G.E. (1995) 'Ethnography in/of the World System: The Emergence of Multi-sited Ethnography', *Annual Review of Anthropology*, 24: 95-117.
- Markus, L.M. and Tanis, C. (2000) 'The Enterprise System Experience - From Adoption to Success' in R.W.Zmud (ed.) *Framing the Domains of IT Management*, Cincinnati, Ohio: Pinnaflex Education Resources.
- Markus, L.M., Tanis, C., and Van Fenema, P.C (2000) 'Multi-site ERP implementations', *Communications of the ACM*, 43, 4: 42-46.
- Mingers, J. (2001) 'Combing IS Research Methods: Towards a Pluralist Methodology', *Information Systems Research*, 12, 3 : 240-259.
- Monteiro, E. (2000) 'Actor-network theory' in C.Ciborra, K.Braa, A.Cordella, B.Dahlbom, A.Failla, O.Hanseth, V.Hespo, J.Ljungberg, E.Monteiro, & K.Simon (eds), *From Control to Drift: The Dynamics of Corporate Information Infrastructures*, Oxford: Oxford University Press: 71–83.
- Morrison, A. (ed.) (2002) 'Researching ICTs in Context', InterMedia Report, 3/2002, University of Oslo.
- Orlikowski, W.J. (1992) 'The Duality of Technology: Rethinking the Concept of Technology in Organizations', *Organization Science*, 11, 4: 404-428.
- Orlikowski, W.J. (2006) 'Material Knowing: The Scaffolding of Human Knowledgeability', *European Journal for Information Systems*, 15, 5: 460-66.
- Pinch, T. and Bijker, W. (1984) 'The Social Construction of Facts and Artefacts: Or, How the Sociology of Science and the Sociology of Technology Might Benefit Each Other', *Social Studies of Science*, 14: 399-441.
- Pollock, N. (2005) 'When is a Work-around? Conflict and Struggle in Computer Systems Development', *Science, Technology and Human Values*, 30, 4: 496-514.
- Pollock, N., Williams, R. and Procter, R. (2003) 'Fitting Standard Software Packages to Non-Standard Organizations: The Biography of an Enterprise-wide System', *Technology Analysis and Strategic Management*, 15, 3: 317-32.
- Pollock, N. and Cornford, J. (2004) 'ERP Systems and the University as an 'Unique' Organisation', *Information Technology and People*, 17, 1: 31-52.
- Pollock, N. Williams, R. & D'Adderio, L. (2007) Global Software and its Provenance: Generification Work in the Production of Organisational Software Packages, *Social Studies of Science*, 37, 2: 254-80.
- Pollock, N. and Williams, R (2007) 'Technology Choice & its Performance: Towards a Sociology of Software Package Procurement', *Information & Organisation*, 17: 131-61.
- Pollock, N. and Williams, R (2009a) *Software & Organizations: The Biography of the Enterprise-wide System or How SAP Conquered the World*, London: Routledge.
- Pollock, N. & Williams, R. (2009b) The Sociology of a Market Analysis Tool: How Industry Analysts Sort and Organise Markets, *Information and Organization*, 19: 129-51.
- Pozzebon, M. and Pinsonneault, A. (2005) 'Global–local Negotiations for Implementing Configurable Packages: The Power of Initial Organizational Decisions', *Journal of Strategic Information Systems*, 14, 2: 191-242.
- Procter, R., Williams, R. and Cashin, L. (1996) 'Social Learning and Innovations in Multimedia-based CSCW', *ACM SIGOIS Bulletin*, December: 73-76.
- Quattrone, P. and Hopper, T. (2006) 'What is IT: SAP, Accounting, and Visibility in a Multinational Organisation', *Information and Organization*, 16: 212-250.
- Regnell, B., Höst, M., Natt och Dag, J., Beremark, P. and Hjelm, T. (2001) 'An Industrial Case Study on Distributed Prioritisation in Market-Driven Requirements Engineering for Packaged Software', *Requirements Engineering*, 6, 1: 51–62.
- Roberts, J. (2006) 'Limits to Communities of Practice', *Journal of Management Studies*, 43, 3: 623–39.
- Robey, D. (1996) 'Diversity in Information Systems Research: Threat, Promise and Responsibility', *Information Systems Research*, 7, 4: 400-408.
- Robey, D., Ross, J. and Boudreau, M.C. (2002) 'Learning to Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change', *Journal of Management Information Systems*, 19, 1: 17–46.
- Russell, S. (1986) 'The Social Construction of Artefacts: Response to Pinch and Bijker', *Social Studies of Science*, 16: 331-46.
- Sawyer, S. (2001) 'A Market-Based Perspective on Information Systems Development', *Communications of the ACM*, 44, 11: 97-101.

- Scott, S.V. and Wagner, E.L. (2003) 'Networks, Negotiations, and New Times: The Implementation of Enterprise Resource Planning into an Academic Administration', *Information and Organization*, 13, 4: 285–313.
- Sismondo, S. (1993) 'Some Social Constructions', *Social Studies of Science*, 23, 3: 515-33.
- Soh, C. and Kien Sia, S. (2004) 'An Institutional Perspective on Sources of ERP Package-organization Alignment', *Journal of Strategic Information Systems*, 13: 375-397.
- Somers, T. and Nelson, K. (2004) 'A Taxonomy of Players and Activities Across the ERP Project Life Cycle', *Information and Management*, 41: 257–78.
- Sørensen, K.H. and Levold, N. (1992) 'Tacit Networks, Heterogeneous Engineers, and Embodied Technology', *Science, Technology, and Human Values*, 17, 1: 13–35.
- Star, S. L., ed. (1995) *Ecologies of Knowledge*, York: State University of New York Press.
- Star, S. L. and Ruhleder, K. (1996) 'Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces', *Information Systems Research*, 7, 1: 111–134.
- Suchman, L. (1987) *Plans and Situated Actions: The Problem of Human–Machine Communication*, Cambridge: Cambridge University Press.
- Suchman, L. (1994) 'Working relations of technology', *Computer Supported Cooperative Work (CSCW)* 2:21–39.
- Swanson, E.B. and Ramiller, N.C. (1997) 'The Organizing Vision in Information Systems Innovation', *Organization Science*, 8, 5: 458-74.
- Tingling, P. and Parent, M. (2002) 'Mimetic Isomorphism and Technology Evaluation: Does Imitation Transcend Judgement', *Journal of the Association for Information Systems*, 3, 5: 113–43.
- Tingling, P. and Parent, M. (2004) 'An Exploration of Enterprise Technology Selection and Evaluation', *Journal of Strategic Information Systems*, 13: 329–54.
- Von Hippel, E. (1994) *The Sources of Innovation*, Oxford University Press.
- Wagner, E. and Newell, S. (2004) 'Best for Whom? The Tension between "Best Practice" ERP Packages and Diverse Epistemic Cultures in a University Context', *Journal of Strategic Information Systems*, 13: 305–28.
- Wagner, E. and Newell, S. (2006) 'Repairing ERP: Producing Social Order to Create a Working Information System', *The Journal of Applied Behavioral Science*, 42, 1: 40-57.
- Walsham, G. (1997) 'Actor-network Theory and IS Research: Current Status and Future Prospects' in A.S.Lee, J.Liebenau, J.DeGross (eds.) *Information Systems and Qualitative Research*, Chapman & Hall, New York: 466–480.
- Walsham, G. (2001) *Making a World of Difference: IT in a Global Context*, Chichester: Wiley.
- Wang, P. and Ramiller, N.C. (2004) 'Community Learning in Information Technology Fashion', Proceedings of the Twenty-Fifth International Conference on Information Systems (ICIS), Washington DC.
- Wang, P. and Swanson, E. (2008) 'Customer Relationship Management as Advertised: Exploiting and Sustaining Technological Momentum', *Information Technology & People*, 21, 4: 323-349.
- Webster, J. (1990) *Office Automation: The Labour Process and Women's Work in Britain*, New York: Harvester Wheatsheaf.
- Webster, J. and Williams, R. (1993) 'Mismatch and Tension: Standard Packages and Non-standard Users' in P.Quintas (ed) *Social Dimensions of Systems Engineering*, Hemel Hempstead: Ellis Horwood.
- Wenger, E. (1998) *Communities of Practice*, Cambridge: Cambridge University Press.
- Westrup, C. (2005) 'Making ERPs Work: Accountants and the Introduction of ERP Systems', *European Journal of Information Systems*, 14, 3: 258-72.
- Williams, R. (1997) 'Universal Solutions or Local Contingencies? Tensions and Contradictions in the Mutual Shaping of Technology and Work Organisation' in I.McLoughlin, and D. Mason (eds) *Innovation Organizational Change and Technology*, London: International Thompson Business Press.
- Williams, R. and Edge, D. (1996) 'The Social Shaping of Technology', *Research Policy*, 25: 865-99.
- Williams, R., Stewart, J. and Slack, R. (2005) *Experimenting with Information and Communication Technologies: Social Learning in Technological Innovation*, Chichester: Edward Elgar
- Wylie, L. (1990) 'A Vision of the Next-Generation MRP II Computer Integrated Manufacturing', Scenario S-300-339, Gartner Group, 12 April.