



## Theorising big IT programmes in healthcare: Strong structuration theory meets actor-network theory

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### ABSTRACT

The UK National Health Service is grappling with various large and controversial IT programmes. We sought to develop a sharper theoretical perspective on the question “What happens – at macro-, meso- and micro-level – when government tries to modernise a health service with the help of big IT?” Using examples from data fragments at the micro-level of clinical work, we considered how structuration theory and actor-network theory (ANT) might be combined to inform empirical investigation. Giddens (1984) argued that social structures and human agency are recursively linked and co-evolve. ANT studies the relationships that link people and technologies in dynamic networks. It considers how discourses become inscribed in data structures and decision models of software, making certain network relations irreversible. Stones' (2005) strong structuration theory (SST) is a refinement of Giddens' work, systematically concerned with empirical research. It views human agents as linked in dynamic networks of position-practices. A quadripartite approach considers [a] external social structures (conditions for action); [b] internal social structures (agents' capabilities and what they 'know' about the social world); [c] active agency and actions and [d] outcomes as they feed back on the position-practice network. In contrast to early structuration theory and ANT, SST insists on disciplined conceptual methodology and linking this with empirical evidence. In this paper, we adapt SST for the study of technology programmes, integrating elements from material interactionism and ANT. We argue, for example, that the position-practice network can be a socio-technical one in which technologies in conjunction with humans can be studied as 'actants'. Human agents, with their complex socio-cultural frames, are required to instantiate technology in social practices. Structurally relevant properties inscribed and embedded in technological artefacts constrain and enable human agency. The fortunes of healthcare IT programmes might be studied in terms of the interplay between these factors.

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### Introduction

The following data fragments are taken from some ongoing ethnographic research studies. The first two address components of the £12 billion government-funded UK National Programme for Information Technology (NPfIT); the third considers a different technology-supported policy in the National Health Service (NHS). They are taken from an interim analysis document made by the principal investigator and provide an important reference point for the arguments of this paper, since our theoretical position depends on the analysis of specific conjunctures at a particular time and place.

#### Data fragment 1

Our team wanted to observe the use of a newly introduced electronic outpatient booking service (Choose and Book), which allows general practitioners (GPs) to offer their patients a choice of hospital and clinic date, and book the appointment in real time. When we applied for the grant, a quarter of practices in our intended field site used Choose and Book. We anticipated catching the late majority of adopters. But by the time the research began in mid 2008, all but one practice had abandoned it – allegedly because the technology did not “work” properly.

#### Data fragment 2

Summary Care Records (SCRs, centrally stored, Internet-accessible summaries of patients' medical records) had recently been introduced in one area, though uptake and use had been slow. A commercial IT company offered to fund a pilot study in which district nurses were issued with Portable Digital

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Assistants (PDAs) so they could access the SCRs of patients visited on their rounds. The nurses were positive about the scheme, though few regularly called up patients' SCRs. Their enthusiasm seemed due to a combination of perceived appropriateness (as a mobile workforce, they should have a mobile technology); the PDA's general communication functions (e.g. Internet access); and their optimistic hope that the current 'clunky' technology would develop into a universally-accessible, fully integrated electronic patient record.

#### Data fragment 3

Almost all GP practices in the UK now use electronic records, known as local detailed records (LDRs). We found that considerable work went into constructing the LDR (for example, by adding coded data via pull-down menus) and keeping it up-to-date. A high proportion of this 'data quality' work was oriented towards a financial incentive scheme known as the Quality and Outcomes Framework (QOF), a government-funded initiative oriented to promoting evidence-based care of chronic diseases and increasing the transparency and accountability of GPs' performance.

These data fragments illustrate the pervasive presence of 'big IT' (large-scale technology programmes) in UK healthcare and the strong influence of both government and the IT industry. Such programmes, built on a vision of a 'modernised' health service that is fully networked, integrated, largely paperless, and uses standardised decision protocols, are seen by policymakers as key to improving the quality, efficiency and safety of healthcare (Department of Health, 2008). But they have also been criticised as grandiose, unfit for purpose, ethically naïve, poor value for money, distorted by commercial interests and dogged by delays and scope creep (Kreps & Richardson, 2007).

In considering how we might explore aspects of these polarised perspectives, we began with the question: "How do we begin to theorise what happens at macro, meso and micro levels when government tries to 'modernise' a health service with the help of big IT?" The paper is an attempt to initiate a theoretical frame that is broad enough to encompass all these relations, and which is precise and disciplined enough to provide empirically substantiated propositions. Both macro (e.g. policymaking, contracting) and micro (e.g. the clinical encounter) feature a complex interplay of influence, authority, the pursuit of goals, and the allocation of resources within a particular set of social norms, meaning-systems, and constraints.

Given that the clinician–patient relationship is an intimate and sensitive one, new technology typically involves subtle but potentially far-reaching changes in roles, identities and mutual expectations. Occasionally (when it "works"), technology makes possible new or more efficient ways of communicating and interacting for staff and patients. At other times, it is associated with disorder, inefficiency, and the need for stressful workarounds. The same technology may meet the former fate in one setting and the latter in another. Context matters. Furthermore, since investment decisions made in Whitehall directly influence technologies available to clinicians, and since, conversely, clinicians can and do refuse to use technologies they see as unfit for purpose, the macro and micro levels are closely and reciprocally related. Meso-level structures such as NHS organisations, professional bodies (e.g. British Medical Association) or civil liberties groups (e.g. see [www.thebigoptout.com](http://www.thebigoptout.com)) mediate the relationship between the micro and macro and may allow particular actors greater or lesser influence in particular situations.

Extending previous taxonomies (Orlikowski & Baroudi, 1991; de Vaujany, 2005), we suggest that research on information systems generally takes one of four broad philosophical positions:

- *Positivist*, which assumes an external and knowable reality that can be objectively measured; an impartial researcher; and the possibility of producing generalisable statements about the behaviour of the natural and social world;
- *Interpretivist*, which assumes a socially constructed reality that is never objectively or unproblematically knowable and a researcher whose identity and values are inevitably implicated in the research process;
- *Critical*, which assumes that the social order is inherently unstable, and that the purpose of research is at least partly to help the oppressed challenge their position in society;
- *Recursive* (or integrative) which assumes that subject and object, micro and macro, social structure and human agency are reciprocally related, and that the purpose of research is to explore the flux between these various dualities over time.

Healthcare is traditionally a positivist field of enquiry. But the limits of technological determinism – the assumption that technology X will predictably produce impact Y notwithstanding barrier Z, and that the role of the researcher is to measure Y and overcome Z – are increasingly recognised (Greenhalgh, Potts, Wong, Bark, & Swinglehurst, 2009). In recursive traditions, researchers do not study 'technologies' and 'contexts' separately but technologies-in-use. In other words, context is not simply a given external milieu whose properties can be measured from afar and controlled for (positivist), nor is it merely a conceptual frame through which the technology is given meaning (interpretivist). Rather, context is a complex and emergent outcome of the interplay between social actors and their organisational and technological infrastructures, generated and regenerated when human actors use technologies in particular ways for particular purposes.

In this paper, we seek to develop and align recursive approaches to the study of big IT. We argue that social structures, human agency and technologies each exist in a recursive relationship with the other two, and that all three co-evolve in complex and often unpredictable ways over time. We describe two different recursive approaches, structuration theory and actor–network theory (ANT), and highlight their strengths and limitations for addressing the questions we posed above. We then introduce strong structuration theory (SST), which potentially overcomes some of the limitations but which has not previously (to our knowledge) been applied to the study of technology programmes. We suggest how the latter might be enhanced by concepts from Dant's notion of materialist interaction and then combined with selected aspects of ANT to produce a new way of conceptualising, theorising and empirically exploring the co-evolution of technologies and the social order.

Our own backgrounds are relevant here. TG is an academic general practitioner with a first degree in social and political sciences who researches innovation and change in healthcare organisations. RS is a professor of sociology who developed SST as a means of enhancing structuration theory's potential for guiding empirical research in diverse fields. Both authors are committed to building bridges between theoretical approaches to address empirical questions.

#### Structuration theory and technology structuration

In his theory of structuration, Giddens sought to bring together objectivist social theories (which assume that a hard social reality exists independently of individual actors and is to a large extent deterministic of their actions) and subjectivist ones (which assume that no social reality exists except the one that individuals construct in their interpretations and perceptions) (Giddens, 1984). Social actors are knowledgeable, active agents who may either reproduce social structures faithfully or choose to change them by

behaving differently. Structuration theory has been widely applied in information systems research (Jones & Karsten, 2008).

Giddens is generally interpreted as viewing social structures as internalised in what actors 'know' (i.e. their hermeneutic understanding) of the social world, and as instantiated in their actions. Social realists, on the other hand, emphasise the causal properties of social structures external to agents and highlight an analytical distinction between structure and agency (for example, they point out that human action is short-term; social structures are more enduring) (Archer, 1995). Stones has argued previously that there is more common ground between structuration theory and social realism than is generally acknowledged, and that it is possible and fruitful to combine the internal and external aspects of structure (Stones, 2001).

Barley applied structuration theory to technological change in healthcare in his classic study of the introduction of CT scanners in two U.S. hospitals (Barley, 1986). Using the script (a recurrent and observable pattern of social action which embodies and reflects social structures) as his unit of analysis, he demonstrated how the introduction of the new technology was an occasion for structuring – that is, it provided opportunities for (but importantly, was not deterministic of) changes in the social order of the organisation.

Two main streams of research have been built on Barley's early work. One is Adaptive Structuration Theory (DeSanctis & Poole, 1994), in which a key concept is appropriation (effecting change by using a technology differently). External social structures (the norms, standards and social constraints for human behaviour) are seen as built into technologies in a very concrete, material way as data domains and decision models. Another stream is technology structuration theory, which considers how organisational actors, working collaboratively around common tasks, engage in a process of adapting the meaning, properties and applications of technologies to a particular context, and a parallel process of adapting the context to the technology; this process is nested within the overarching duality between structure and agency (Orlikowski, Yates, Okamura, & Fujimoto, 1995). Orlikowski has in the past rejected the notion that social structures are 'built into' technologies ("While a technology can be seen to embody particular symbol and material properties, it does not embody structures because those are only instantiated in practice" (Orlikowski, 2000: 406)). Instead of 'appropriation', she prefers 'interpretive flexibility', which emphasises the actor's interpretation of their own action in social context (Bijker, Hughes, & Pinch, 1987).

In contrast to Barley's elegant demonstration of new social orders accompanying the introduction of the CT scanner, a recent systematic literature review uncovered no examples of this phenomenon occurring unproblematically when electronic record systems were introduced in organisations, though there were numerous cases of role confusion, disrupted routines and abandoned systems (Greenhalgh et al., 2009). So far, then, big IT in healthcare has not been an 'occasion for structuring' in any simple sense – probably because of the sheer complexity of the technologies and their embeddedness in wider programmes within and beyond the organisation.

One criticism of technology structuration theory is that the technical dimension is under-theorised. Technical artefacts 'do' things that cannot be attributed to or reduced to social practice (Hanseth, Aanestad, & Berg, 2004). Both Barley and Orlikowski have latterly acknowledged and begun to address this deficiency (Leonardi & Barley, 2008; Orlikowski & Scott, 2008). But it is interesting to reflect that Barley's classic study considered organisations 'before' and 'after' the introduction of the CT scanner, but not the CT scanner evolving over time (Barley, 1986). If *evolution* of technology (e.g. software upgrades) is added to the analysis, the structure-agency duality becomes, in one sense at least, three-

dimensional – and also non-linear, since each component evolves at a different pace.

Whilst a triadic structure-agency-technology relationship evolving over time provides a useful starting point, we must also theorise the technology artefact – a task for which ANT offers some insights.

### Actor-network theory

ANT considers networks made up of both people and technologies (Callon, 1986; Latour, 1992). The essential, given properties of people and things are not the focus of interest in ANT. What is of interest is what people and things become as a result of their position in a network ('relational ontology'), and the power that emerges from dynamic configurations of human and non-human actors (sometimes referred to as 'actants').

Actor-networks are often highly dynamic and inherently unstable. They can be stabilised to some extent when people, technologies, roles, routines, training, incentives, and so on are aligned. This alignment is achieved (or at least, attempted) through 'translation', which involves the four stages of problematisation (defining a problem for which a particular technology is a solution), interessement (getting others to accept this problem-solution), enrolment (defining the key roles and practices in the network), and mobilisation (engaging others in fulfilling the roles, undertaking the practices and linking with others in the network) (Callon, 1986).

Because actor-networks are heterogeneous and organically evolving open systems, and the strength of network relations waxes and wanes, a fixed input to the system will not produce a fixed output (Hanseth, 2007). Stability of an actor-network is always a truce of some sort, achieved through 'black boxes' – configurations of actors (human and non-human) which have become taken-for-granted as the way things are, and hence are no longer questioned. Elements of the network that are durable (such as materials) will lend stability; those that are ephemeral (such as opinions) will not. Inscription devices (for example, pull-down menus in a piece of software) may help to stabilise the network and thus shape and constrain clinical work. "Software", suggested one seminal paper in the ANT tradition, "is frozen organisational discourse" (Bowker & Star, 1994: 189).

Researchers have used ANT to describe the struggles (sometimes successful, sometimes not) of groups of actors who have sought to define and inscribe particular codes and standards into particular electronic record technologies, and shown how once these have become part of the network, they are hard to reverse (see, for example Ellingsen & Monteiro, 2003). Studies in this tradition have also shown that the tension between standardisation (which helps stabilise the network) and contingency (which reflects and responds to local needs and priorities) can never be resolved once and for all; rather, it must be actively and creatively managed – and this gets harder as the network gets bigger (Hanseth, Jacucci, Grisot, & Aanestad, 2006).

A criticism of ANT is that it has a 'flat ontology'. ANT holds that there are no pre-existing layers (such as 'structure' and 'agency') but only "a single plane of endlessly entangled translations" (Harris, 2005: 173). ANT's black boxes represent only a set of stable-for-now relations that could change at any time – without any further theorisation. By refusing more conceptually differentiated and refined analyses of institutional sources of power and inequality, ANT has little to say about the systematic exclusion that prevents some social groups from having a voice in the design and use of technologies. A second criticism is ANT's assumption of 'symmetry' between humans and things. Reducing humans to comparable status to technologies places human motives, desires

and virtues beyond the analytic frame and evades ethical questions (Mutch, 2002). Finally, there is the charge of cultural imperialism: a compelling researcher narrative is offered at the expense of any account which the 'natives' might have given.

Despite these limitations, ANT's emphasis on the dynamic and relational aspects of a problem is a useful lens for studying non-linear change and the unintended outcomes of technology projects – including the stochastic (that is, relatively rare but unpredictable and potentially catastrophic) events that are known to characterise big IT projects and programmes (Hanseth, 2007). The neat Gantt charts and project plans produced by management consultants trained in more predictable environments become absurdly inappropriate when, for example, an unexpected bug appears in a key software programme, the British Medical Association passes a motion of no confidence in a government initiative, or a major supplier pulls out of a contract.

The general format of a research question from an ANT perspective – “What is the network, and what phenomena are emerging from it?” – offers broad and flexible scope for mapping the relevant terrain. In relation to Choose and Book, for example, the socio-technical network includes the index technology; other technical systems with which it is interoperable (or not); the individuals (doctors, patients, administrators) who use it in primary, secondary and self care; a particular alignment of policy-makers, technical designers and technical components from which its infrastructure and data models were generated; civil servants and clinical negotiators who are busy creating financial incentives to persuade recalcitrant GPs to start using it again; and the media, lobbyists and publishing machinery which perpetuate the long-running story about the programme being 'behind schedule'.

Whilst ANT can help map the network and consider certain aspects of how power flows within it, it is inherently unsuited to micro-causal questions such as *why* – that is, through whose agency and enabled and constrained by which social structures – did the phenomenon in question emerge? For researchers who seek to answer such questions, ANT may provide conceptual tools and inspiration, but not a sophisticated theory of either human agency or the generative causality of social structures. Others have combined structuration theory with selected features of ANT to explain adoption of software by individuals, but did not address the sociology of translation in complex technology programmes (Pentland & Feldman, 2007). Below, we introduce an adaptation of structuration theory which we believe can be aligned more closely with ANT to achieve this goal.

### Strong structuration theory – an introduction

Strong structuration theory seeks to move beyond the abstract philosophical concepts in which Giddens was particularly interested (the ontology-in-general of 'structures' and 'agents') and explore empirical applications (the ontology-in-situ of *particular* structures and agents) (Stones, 2005). Its focus on empirical case studies in which individuals are situated in webs of networked relations gives it a close elective affinity with ANT.

However, whilst proponents of ANT are typically wary of strong conceptualisation and formal explanation (see Law, 2009: 66–71), SST proposes that the recognition of social (or socio-technical) complexity and the need for conceptual and methodological discipline go hand in hand. Thus, for example, SST holds that the recursive relationship between structure and agency remains a useful concept and, furthermore, that four analytically distinct components of this duality can be studied empirically: (a) external structures (conditions of action); (b) internal structures within the agent (how and what individuals 'know'); (c) active agency (in which agents draw, routinely or strategically, on their internal

structures); and (d) outcomes (in which both external and internal structures are either reproduced or changed). Rather than considering the script (as Barley did), SST considers the *conjuncture* (a critical combination of events or circumstances).

External structures are mediated largely through position-practices. A position-practice is a social position and associated identity and practice, together with the network of social relations which recognise and support it (known as 'position-practice relations') – which include various institutional reciprocities and asymmetric power relations, and institutional infrastructures including technological ones. Position-practices are not merely structural 'slots' within which agents are largely interchangeable; rather, they are perpetuated (and changed) through their enactment by active agents within the network of relationships.

The internal structures of these agents may be further analytically divided into:

- (a) *General dispositions*, which include such things as socio-cultural schemas, discourses and world-views, moral and practical principles, attitudes, ambitions, technical and other embodied skills, and personal value commitments and orientations – roughly what Bourdieu called 'habitus' (Bourdieu, 1986) and overlapping with what Habermas, following the phenomenological tradition, referred to as the lifeworld (Habermas, 1987). Many of these dispositions are not amenable to change.
- (b) *Conjuncture-specific knowledge* of the strategic terrain and how one is expected to act within it, based on one's hermeneutic understanding of external structures.

Within the conjuncture, the agent-in-focus actively and more or less reflexively and creatively draws upon these internal structures to produce action (observable behaviour). To study active agency, SST draws synthetically on three theories linked to social psychology. The first is phenomenology: the study of agents' shifting fields and horizons of action arising from the focused activity at hand (e.g. Habermas, 1987). The second is ethnomethodology, which assumes that social action is an irreducibly situated, contingent and skilful accomplishment in which each utterance, written comment or action occurs in a micro-sequence that takes detailed and tacit account of the utterances, comments or actions preceding it (Garfinkel, 1967). In the workplace, for example, it is not so much abstract patterns and routines that make meaning but “the moment by moment management of contingent detail through sequential orderings” (Rawls, 2008). The third is symbolic interactionism, which focuses on the subjective meaning of human behaviour and how social actors interpret and respond to the actions of other actors. We can adjust to the actions of others only because we denote them symbolically and treat the actions and those who perform them as symbolic objects (hence notions such as the 'social self' and 'role playing' (Goffman, 1958)).

Thus, whilst each of us brings generic capabilities, dispositions and strategic knowledge to any particular conjuncture, what we *actually do* in that situation will depend on a host of specificities which we cannot predict in advance but which depend crucially on our horizon of action, the contextual particularities of other external structures and happenings, and the constraints of time and space. Our knowledge of how we might be expected to act (that is, our knowledge of the 'strategic terrain'), and of the rewards and sanctions likely to follow from our actions, can be thought of in terms of the widely-cited (but highly abstract) terminology originally used by Giddens: interpretive schemas (structures of signification), normative expectations (structures of legitimation) and capacity to mobilise authority and resources (structures of domination). SST focuses particularly on the concrete ways in which

agents *combine* these and other analytic components when considering the strategic terrain. The agent's knowledge of this terrain may be more or less adequate.

Outcomes may be intended or unintended, and as Fig. 2 shows, feed back on both external and internal structures – either preserving them faithfully or changing them as they are enacted.

The 'quadripartite' study of structuration thus involves seeking empirical evidence with which to explore and test key concepts and the relations between them, depending on the explanandum at hand. Data sources may be multiple and selected pragmatically (e.g. depending on access and availability) and include combinations of documents, ethnographic field notes, semi-structured and other forms of interviews and surveys, and multi-media data such as video or screen capture.

The above summary of SST provides a framework for fieldwork and analysis of the structure-agency duality – but it does not address the technology artefact as it evolves over time in a recursive relationship with each of these. In the next section, we offer one approach to this.

### Strong structuration theory – adding a technology dimension

In seeking to enhance SST with concepts from ANT, we accept a number of ideas from the latter, but for each, we offer a caveat. First, we accept that it is useful to conceptualise technologies and human actors as part of the same network, and to view both as having a position-practice in that network (Fig. 1). However, we reject ANT's assumption of ontological symmetry between people and technologies. Humans act, and technologies 'act' – but in different ways, and we prefer to use different vocabulary to describe these phenomena and different theories and methods to explore them.

Secondly, we accept ANT's notion that aspects of the social order can be inscribed in technologies and this may to some extent 'freeze' certain position-practice relations within the technology. It follows that by asking where such things as codes and standards in software came from, and whose interests these codes and standards serve, we may be able to illuminate how technology reproduces and perhaps magnifies particular conditions of social action. But there are limits to this. How far it will be useful to characterise the crystallisation of technological form in terms of particular inscribed social structures is likely to vary a great deal from case to case. Some or all of the socially-relevant inscriptions in a given case may be unintended. However, the social relevance of the codes, procedures, standards and material which are inscribed in the technology-in-focus, whether intended or unintended, will still constrain the potential range of uses it can be put to, and in many contexts can play a significant role in orienting (without determining) the human agent to use it in a particular way. Whilst Orlikowski was right to emphasise the necessary moment of instantiation by agents – and thus to emphasise, *inter alia*, the importance of social context, cultural phenomenology and active agency – the intrinsic properties of technology can still play a powerful constraining and influencing role on actors, for both good and ill.

Thirdly, we accept that human behaviour is shaped and constrained by complex forces in the socio-technical network and hence may in some senses be an 'effect' rather than a 'cause' of what we are studying. But we reject the idea that human agency can be reduced entirely to network effects. Indeed, we propose that the study of translation (the phases of problematisation, interessement, enrolment, and mobilisation described above) would be enhanced rather than diminished by a more sophisticated theory of structures and agency. We propose that ANT's emphasis on the

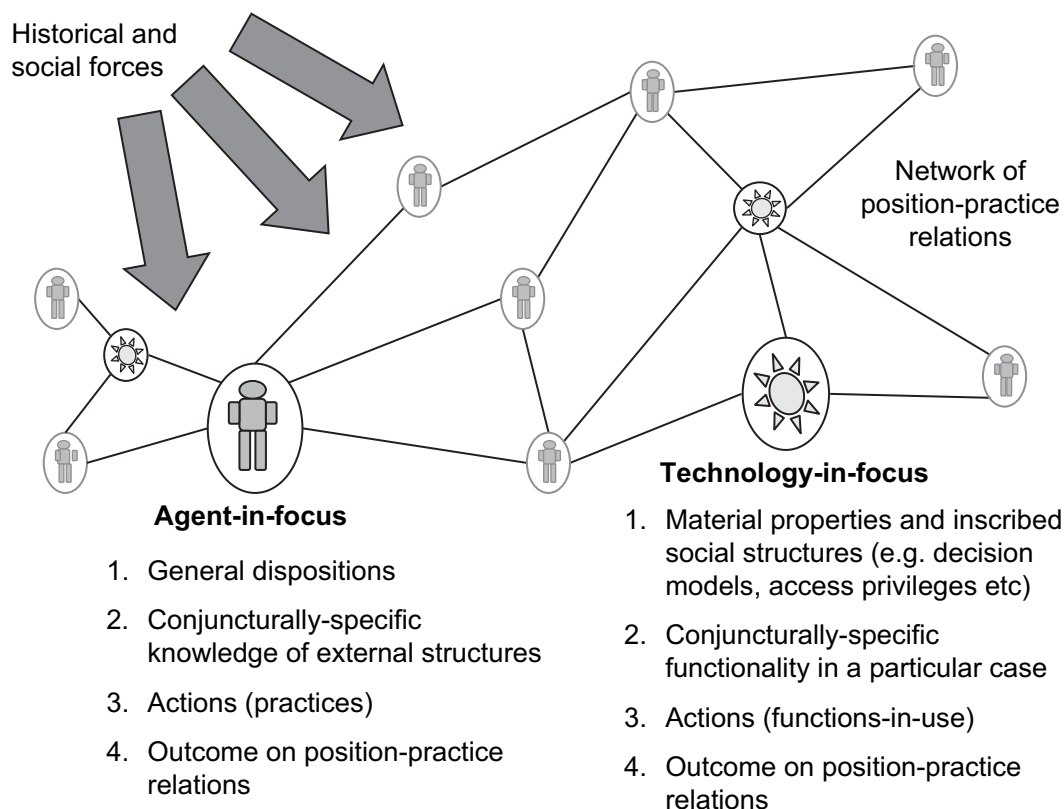


Fig. 1. Strong structuration theory: A network of position-practices (people and technologies) influenced by historical and social forces.

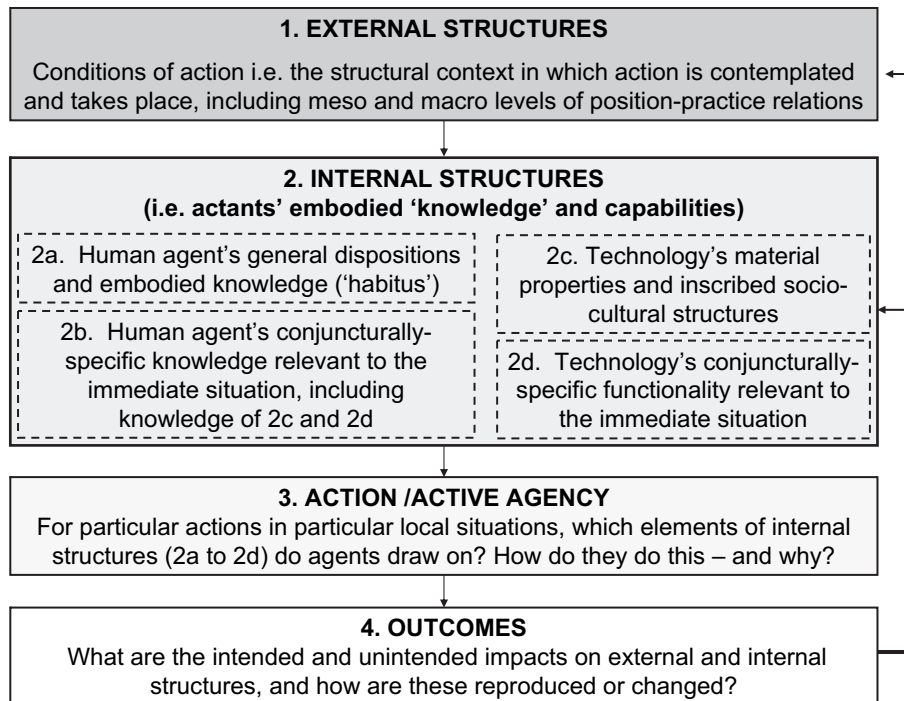


Fig. 2. Strong structuration theory incorporating a technology dimension (adapted from Stones, 2005).

material properties and socially-relevant inscriptions within technologies (box 2c in Fig. 2) be integrated with SST's conception of agency to produce a more complex notion of the actant.

In relation to this third point, we note Tim Dant's criticism of ANT – informed by Heidegger and Merleau-Ponty's work on technology and embodiment, respectively – for its failure to engage closely with the phenomenology of the "lived relationship between human beings and material objects" (Dant, 2004: 81). A parallel criticism of SST would point to its under-theorisation of the material properties of technology within interaction. To remedy this, we adopt Dant's innovative conceptualisation of the embodied shifting phenomenal, perceptual and manipulatory fields (that is, active agency – box 3 in Fig. 2) within which actors draw on technology (box 2d in Fig. 2) in 'material interaction' oriented to the task at hand. Dant's corrective dovetails closely with SST's emphasis on the phenomenological and embodied dispositions and capabilities drawn on by active agency (in Fig. 2) whilst providing clear conceptual engagement with the material-technological sphere.

Fig. 2 thus summarises a new conceptual model for considering the fortunes of big IT programmes. The model comprises a network of position-practices (of both human agents and technologies), which evolves over time and is influenced by more macro historical and social forces. These forces – institutional, political, economic, technological – exist more or less independently of the agents who are in-focus within a particular study, and they contribute to the external conditions of action in any given conjuncture. In addition, social structures are embodied and reproduced by both agents and technologies. Human agents use technologies in particular ways, thereby bringing into being a technology-in-use through which a particular context and social meaning is constituted.

Technologies also play their part in reproducing and changing social structures in two ways. First, social structures may be *built into* the technology in the qualified ways described above, both enabling work practices but also potentially constraining them through those of their characteristics that are inflexible and non-

negotiable in relation to here-and-now social action. Second, the technological component of social structures may be positively instantiated when people choose, using interpretive flexibility, to use the technology in a particular way both within and outside the intended scripts, and also *negatively instantiated* when they either actively refuse to use it or, importantly, are unable to use it either at all or in the ways they would like.

Thus, the recursive relationship between structure, agency and technology evolves continuously at the micro-meso level. But this relationship is also played out at a more meso-macro level and on a longer timescale, with many more sets of networked relations in play, where change may well be discontinuous. Box 1 shows a provisional list of questions to guide an approach based on SST to studying the fortunes of a technology project or programme. It is neither prescriptive nor definitive, since the relevance of particular questions will depend on the specific explanandum at hand and the precise conceptual synthesis appropriate for that question. The introduction of the technology might be studied diachronically (i.e. in a single site over time), either prospectively (if repeated bouts of extended fieldwork are possible) or through the use of historical documents and accounts. It may also be studied synchronically (i.e. across a sample of cases at a particular time) – as Barley did in his original study (Barley, 1986). Synchronic and diachronic approaches can be combined pragmatically to suit the constraints of fieldwork and funding timeframes (Leonard-Barton, 1990). Different field sites will respond to the change in different ways depending on local configurations of socio-cultural dispositions and knowledges and how these articulate with relevant configurations of position-practice relations.

### Three brief worked examples

For each data fragment introduced at the beginning of this paper, we offer a preliminary empirical illustration of how this adaptation of SST allows us to gain purchase on two key dimensions of social action. The first is focused around the question: what is the

Box 1. Questions to guide a study of an unfolding technology project or programme from the perspective of strong structuration theory.

#### Macro Level Questions in Relation to an Unfolding Programme

##### Mapping the network-in-focus

1. What is the prevailing political, economic, technological and institutional context within which the technology is being introduced locally or nationally?
2. What is the socio-technical network of this project or programme? Which agents and technologies are represented, and what are their position-practices?
3. What are the key relationships (agent–agent, technology–technology, agent–technology) in the network and how are they changing over time?
4. To what extent has stability of the network been achieved – and why?

#### Micro Level Questions Focused on Specific Conjunctures within the Unfolding Process

##### Mapping the relevant part of the network ('network-in-focus')

1. Who are the key human agent(s) involved in this conjuncture?
2. What are the key technologies involved in this conjuncture?
3. What technological, financial and organisational infrastructure is needed to support the conjuncture?

##### Actant's internal structures relevant to the conjunctural situation

1. Human agent's general dispositions (e.g. socio-cultural schemas, hierarchies of values, virtues, cognitive capacity, embodied skills, past experience)
2. Relevant technology's material properties and inscribed socio-cultural structures (2c in Fig. 2)
3. Human agent's conjuncture-specific knowledge (perhaps imperfect): of relevant external structures (the strategic terrain) – including socio-cultural knowledge of how other agents view the world (i.e. knowledge of domain of heading 1 in Fig. 2); of technology-in-focus's material properties and inscribed socio-cultural structures (i.e. of 2c in Fig. 2); and of technology-in-focus's range of functionality relevant to the immediate situation (i.e. of 2d in Fig. 2).

##### Active agency

1. What does the human agent do – i.e. how does s/he reflexively relate to, and draw on, general dispositions, conjuncture-specific knowledge, and technological properties (actant's internal structures) in an unfolding sequence of action?
2. How do the social structures (e.g. norms, duties, physical and cognitive demands, rights, rewards/sanctions) inscribed, deliberately or inadvertently, in the technology-in-focus enable, influence, or constrain the active agency and strategic orientations of agents?

##### Outcomes

1. What are the immediate consequences of specific actions (intended and unintended)?
2. How do these consequences feed back on the position-practices in the network and wider external structures?
3. What significance – both positive and negative – do these consequences have for others in the network in terms of power, legitimacy, and other factors?
4. What role has the technology-in-focus played in the production of these positive and negative consequences?

##### Policy/political implications

1. How modifiable are the inscribed technological features of 2c (in Fig. 2) that have contributed to negative consequences? By whom are they modifiable, over what timescale and at what cost?
2. Addressing 1 ('how modifiable?') should be linked to lessons learned from analysis of prior negotiations about standards, codes, fields, access privileges, interoperability, and other 'technical' questions. E.g., who were the players in these negotiations, who 'won', and why?

broad strategic terrain within which macro actors (as policymakers, contractors, and so on) apply their (possibly imperfect) knowledge and take action with respect to technologies? The second is a micro question relating to the local circumstances of technology users within a particular conjuncture: at *this* time and in *this* place, what does *this* agent, with *this* technology, do and why – and what happens as a result? Each agent, when deciding how to act in a particular conjuncture, takes account of the strategic terrain which includes the (assumed) hermeneutic understandings of other agents in the network (what has been termed "the ghosts of networked others"), and operates within particular time-space constraints. Similarly, each technology "works" (or not) in a particular way, and contains inscribed properties which both shape and constrain the actions of other agents and technologies.

Take the first data fragment, for example, and consider why all but one GP practice in a particular Primary Care Trust decided to abandon Choose and Book at a particular point in mid 2008. In terms of the broad strategic terrain, electronic booking of

outpatient appointments, along with choice of hospital, was a Labour campaign promise in the 2005 general election. In the traditional outpatient referral, the GP dictated a letter which was typed by a secretary, posted, and processed by a clerk, with a hospital doctor prioritising cases according to urgency. The vision for Choose and Book was that the appointment would be booked by the GP during the consultation, hence shifting power from hospital to primary care (GPs could assign 'urgent' slots directly) and from clinician to patient (who was 'empowered' to choose their preferred hospital and time slot), and achieving shorter waiting times (another election promise). The technology was designed to facilitate and channel these intended power shifts (which reflected a wider neo-liberal ideology on citizen choice).

At the micro-level of material interaction, however, there was a gap between this vision and how the technology's inscribed properties were made use of. Choose and Book – a bolt-on software application intended to open when the GP clicked an icon on the main screen – proved technically cumbersome and incompatible

with the severe time constraints of the 10-min appointment. Occasionally, clicking the icon crashed the system, necessitating a time-consuming reboot. These drawbacks were exacerbated by a mismatch with patient dispositions. Patients rarely had their diaries with them at the time of booking and often sought to consult with relatives before confirming what was 'convenient'. Whilst self-booking using a take-home password was another option, many did not trust an anonymous telephone contact to make a booking for which their own family doctor would previously have taken responsibility. Few patients valued 'choice' of hospital – most assumed they would go locally and reacted with surprise and even suspicion when offered other options. Furthermore, electronic booking took away the GP's ability to address a letter to a specific, known and trusted consultant – thus removing a choice that was sometimes clinically important (e.g. for a female gynaecologist). Finally, making Choose and Book referrals required an unanticipated increase in secretarial time.

For all these micro-level reasons, Choose and Book took on a particular significance for these GPs. Using the technology for referrals came to represent a sell-out to the government (who were seen as intruding unreasonably into the hallowed space of the clinical encounter), a concession to lower (and less patient-centred) clinical standards, an increase in unwanted bureaucracy, and a waste of money. It is interesting to note that subsequent to 2008, uptake of Choose and Book in several practices in the study area increased again, due to a combination of changes in the technology (e.g. improved technical reliability and the facility to name particular consultants), changes in the wider strategic terrain (notably the introduction of financial support for secretarial input) and feedback from the consequences (some patients were seen more quickly). This example is considered in more depth in a separate paper (Greenhalgh, Swinglehurst, Myall, & Stones, in preparation).

In the second data fragment, district nurses were given PDA devices to access patients' Summary Care Records via the Internet on home visits. The macro strategic terrain was similar to Choose and Book – a national IT programme introduced after an election promise, which represented 'modernisation' of the NHS by central government. Also evident was the commercial IT supplier, who offered the PDAs as a 'free' pilot in anticipation of a major contract if their product was taken up nationally. Inscribed in the technology was a somewhat stereotypical script of the geographically distant nurse using the PDA to access patients' records remotely, thereby making fewer phone calls to GPs and providing more 'seamless' care.

At the micro-level, some nurses did indeed use the technology in this way, thereby instantiating the 'technology-enabled, autonomous nurse practitioner' structure that had been the architects' original vision. Whilst most were disappointed with the technology's current performance, they talked about the potential for improving care and reducing administrative effort at some future date, once additional data fields had been added to the SCR and it was better integrated with other NHS systems.

Other nurses interpreted the technology more flexibly and instantiated different structures. Some, for example, used the Internet function of the PDA to search for educational materials for the housebound patients they visited. The potential inscribed in the current technology thus enabled nurses to pursue *and extend* their traditional educational role, since housebound patients could now be shown diagrams or even videos on the PDA screen. Some used the PDA as a map, entering the patient's postcode into the 'Google maps' website, thus instantiating – and modernising – the 'mobile workforce' structure. The inscribed properties of the PDA technology thus allowed the nurses to interact with it in creative and effective ways – intended and unintended by its creators – that

both served patients and increased their own sense of status and recognition.

A minority of nurses in the pilot did not use the PDAs at all. Some had problems learning to use the technology and saw it as potentially undermining the delicate trust relationship they had with patients:

"...and they [patients] expect you to know what you're doing. But obviously if you don't know what you're doing with one part of the care, then they think 'God, they really don't know what they're doing'. And even if they're not thinking that, you're thinking that they think that." (front-line district nurse in focus group, FN25/01)

Other non-users had been alarmed by the opening screen on the SCR viewer, which displayed the word 'STOP' and demanded to know whether the nurse had a 'legitimate relationship' with the patient before revealing the record. Built into the technology at the request of information governance officers (who in turn were mindful of civil liberties lobbyists and the British Medical Association) was a complex series of access controls and automated alerts. The tabloid press had run a story that the Prime Minister's centrally stored personal medical record may have been accessed inappropriately by an NHS staff member (Aitken, 2009). In this heavily politicised context, staff had been told that their work would be closely audited and if they were found to be accessing patients' records without authorisation they could face dismissal. When the 'legitimate relationship' screen appeared on the PDA, distant authority and the threat of surveillance encroached on the intimacy of the clinical encounter and created powerful preconditions for non-use of the SCR (though importantly, it did not *determine* this non-use).

"The way that they'd trained us, when you got to the legitimate relationship screen, they'd absolutely petrified everyone into being convinced that we could not go past this screen. [...] It was inferred that you haven't got a legitimate relationship, and he [trainer] didn't really explain that the reality obviously was that if you're seeing that patient you obviously have that relationship." (district nurse manager interview, FN24/02)

Non-use of the PDAs, for whatever reason, instantiated and reproduced social norms about nursing work, especially when it occurred in the patient's home, being 'high touch' rather than 'high tech'. Had this pilot project continued (which sadly, it did not), we could have followed how the consequences of the actions of different nurses fed back into changing social structures as illustrated in Fig. 2.

The final data fragment represents a very different strategic terrain. Electronic local detailed records (LDRs) emerged within UK general practice decades before the government-led NPfIT began. They were developed and refined largely by technically-oriented GPs who wanted to make tasks such as repeat prescribing, patient recall (for check-ups) and item-of-service claims easier. The Quality and Outcomes Framework (QOF), which used data from the LDR to calculate GPs' pay, was professionally led and aligned with wider efforts from within general practice to improve the 'tail of poor practice' through structured, template-driven care linked to financial incentives. The QOF was couched in the deeply-held professional values of evidence-based medicine and quality improvement, and is generally believed to reflect best evidence about important clinical outcomes and the processes likely to achieve these.

At the immediate micro-level, the GP in the surgery has little scope to alter the assumptions about good clinical practice that have been inscribed in QOF software. He or she is also typically influenced by the financial rewards consequent on specific forms of



interaction with the properties of the technology. GPs are not, of course, compelled to act in these ways by the technology, but they cannot prevent those networked external structures from imposing a material cost on their resistance.

At a broader strategic level, the situation is different. There is an annual round of negotiation which feeds into the redesign of both the QOF targets (what actions GPs will get rewarded for) and the software templates which support efforts to meet these targets. GPs collectively have a great deal of scope to negotiate changes in the topic areas, decision models and financial reward systems linked to these. Why, asked GP negotiators, is the management of high blood pressure generously rewarded while giving extra time to people with learning difficulties and dementia is not rewarded at all? Arguably, the relative stability of the socio-technical network relating to the QOF has much to do with this annual cycle of redesign in which GPs' concerns can be addressed and incentives shown to be unnecessary or perverse removed. In the language of ANT, this is 'translation' in practice. But at the micro-level, there is preliminary evidence from multi-media data (Swinglehurst, D., PhD work in progress) that the inscription of QOF targets in the software of the local detailed record has intensified the internal tension between the 'voice of medicine' and the sensibilities and requirements of the patient's lifeworld (Mishler, 1984).

## Conclusion

The challenge of studying the introduction of new technologies in the highly institutionalised field of healthcare, and especially in the UK under a government hungry for big IT successes, throws us sharply up against the perennial but progressively evolving sociological question of what social structure is, the extent to which it exists independently of human agency, and the extent to which it enables and constrains human action. Adding technology as a third 'strand' in this recursive relationship productively complicates the ontological picture. What exactly is 'inscribed' in software? Do technologies have agency – and if so, in what sense? How do technological innovations change the opportunities and constraints in the social order – and how does the social order change technologies?

These questions cannot be resolved entirely at the level of abstract theorising. The hybrid theoretical framework presented here draws on theories that focus on empirical detail and suit a disciplined but pragmatic approach to addressing questions of practice and policy. Whilst it was possible to build the outline framework using fragments of real data, the detail of the approach will be developed by applying these provisional ideas to specific questions ranged upon a full empirical dataset and to the design and execution of new research studies.

We do not claim to have resolved the tensions between the incommensurable world views that underpin structuration theory as originally articulated by Giddens and ANT as originally articulated by Callon and Latour. But the approach presented here goes some way to addressing the concern voiced by a number of previous scholars that these perspectives have developed in parallel but not in dialogue with one another.

Despite the millions spent on researching healthcare IT systems around the world, the research community has yet to resolve basic questions such as whether big IT (and particularly, densely networked distributed records) will make healthcare more seamless, efficient, patient-centred and safe (Department of Health, 2008) or more fragmented, time-consuming, technology-centred and risky (Hanseth, 2007). Our theoretical synthesis is likely to be judged not primarily on the purity of its philosophical roots but on its ability to support informed judgements on the planning, design and implementation of these systems.

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