Articulating Resources: The Impact of Electronic Health Records on Cross-Professional Healthcare Work

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1. INTRODUCTION

The UK National Health Service is in the midst of enormous technological and organisational change. By 2005 all acute hospital trusts will have made the transition to Electronic Patient Records (EPR). By 2008 the national Electronic Health Record (EHR) service is supposed to be up and running. Despite the widely held belief that computerisation is the way forward the enormous complexity of the task in combination with the rapid transition concerns many healthcare professionals. While the NHS goes to great length to ensure good systems and a smooth implementation, major concerns arise from previous computerisation disasters in the NHS combined with a lack of progress with implementing electronic health records. This situation leaves even hard-nosed advocates with a sense of unease.

It is in the context of such debate that we intend to investigate organisational and cross-professional issues related to the introduction of EPR/EHR systems. In this paper we present the conceptual resources underpinning our research, much of which seems highly relevant for information handling in a much wider context than medical records, i.e. medical digital libraries and beyond.

2. CONTEXT: TECHNOLOGICAL AND ORGANISATIONAL CHANGE IN THE NATIONAL HEALTH SERVICE

Currently, NHS institutions are undergoing far-reaching reforms involving the introduction of large-scale information systems. The electronic health record (EHR) is a vital part of this government-led modernisation campaign. The NHS (1998) defines EHRs are complete, longitudinal, i.e. lifelong patient records containing the data of one patient from many healthcare providers. At the national level EHRs are going to be implemented as an Integrated Care Records Service (ICRS), which will eventually reach across health care institutions. At the level of single healthcare providers, such as acute hospitals trusts, electronic healthcare record will be implemented in the form of an electronic patient record (EPR), which is an episodic record of care for a single patient (NHS, 1998).

A number of critical issues emerge from the evaluation of the implementation process.[1] A previously widespread piecemeal approach to technological infrastructure has left the NHS with problems of legacy systems and incompatibilities between systems (Protti, 2002:22). In addition to technological impediments, political, cultural, social and organisational aspects also influence the introduction of ICT.

Political ideas and expectations are being translated into policies and targets, the latter of which puts a system of performance management into place that, together with a strong emphasis on star ratings and other performance metrics, potentially diverts and sabotages the information agenda (Protti, 2002:6). A lack vision in change management is in danger of leaving valuable lessons underutilised and groups of future users uninvolved.

Furthermore, evidence based medicine and multidisciplinary treatment of patients increases the complexity of health information management. Applications like EPRs/EHRs and medical digital libraries have to provide the right information to the right people at the right time and the right place. This requires co-ordination and alignment of various organisational processes with knowledge management. Co-ordination and alignment issues like the ones mentioned above are often perceived as organisational and cultural obstacles to the introduction of a more or less perfect information infrastructure. However, no information infrastructure is just "out there" to be implemented; ICT development and organisational change ideally co-evolve and inform each other. Therefore, what appears as an impediment to the introduction of ICT rather is a lack of co-ordination and alignment at the level of change management. ICT. Current developments in the NHS seem to confirm this view: While NHS management has called for organisational changes with the aim of tearing down obstacles to ICT and instilling an information culture in all NHS trusts, experts, NHS employees

[1] Clearly this raises an enormous number of issues, and we can only hope to scratch the surface here. For instance, we have not spoken about the critical issues of privacy and security that emerge in a consideration of EHRs. See (Protti, 2002) for a more comprehensive discussion.

and politicians are divided over the current organisational changes. Given that the NHS has been subject to many changes particularly over the past thirty years, it seems understandable that many employees see the current re-organisation simply as yet another one in a long row of rapid changes with which they will have to catch up. Some employees even doubt that the latest changes including the introduction of ICT hold any advantages for them or for the patient (Protti, 2002). Demotivated employees like these will not support the change to ICT and can cause the EPR/EHR system to fail.

3. UNDERSTANDING COORDINATION IN HEALTHCARE WORK

In an early and influential discussion of Computer Supported Cooperative work, Schmidt and Bannon (1992) argue that a defining feature of cooperative work (as opposed to other forms of, possibly socially organised or influenced work) is that there are interdependencies between individual workers' activities. Furthermore, these dependencies are managed – the activities and tasks are "meshed" – through "articulation work" (Strauss, 1988). In other words, when people act collaboratively, dependencies between the work of individuals or groups create the need for alignment or coordination, which often requires explicit action – "articulation work". Studies of this articulation work, necessary to join together activities into a collaborative whole, are often especially revealing, as the articulation work is, in many cases, "invisible" and neglected (Star and Strauss, 1999).

In this section we review some of the analytic concepts that have proved illuminating in studies of how complex collaborative work is articulated and coordinated, and which will shape how we conceptualise the changes to medical records that are afoot in the NHS. We draw on research in the fields of Computer Supported Cooperative Work and Science and Technology Studies, namely Common Information Spaces, Boundary Objects, and Information Infrastructure. The role of each of these is as a lens through which coordinating technologies and articulation work can be rendered visible, placing them in the foreground of our understanding of collaborative activity.

3.1 COMMON INFORMATION SPACES

In order to coordinate or articulate their activities, it is necessary for participants to come to some form of agreement. That is to negotiate a common set of meanings of shared artefacts and information. The virtual space in which such coordination and construction of common meaning is termed by several authors "Common Information Space" (Schmidt and Bannon, 1992; Bannon and Bødker, 1997; Bossen, 2002).

In their account of CIS, Schmidt and Bannon (Schmidt and Bannon, 1992), one form of articulation work is the creation and maintenance of "common information space". In other words workers create common interpretations of the objects of work, constructing and using *interaction mechanisms* through which interdependencies are handled by simplifying the necessary articulation and reducing the amount of work involved. Interaction mechanisms include standards, plans, schedules, standard procedures, and conceptual schemes such as categorisations and classifications. Interaction mechanisms also encompasses material artefacts that as characterised by Schmidt and Simone's (1996) notion of "coordination mechanism".

Bannon and Bødker (1997) emphasise the point that common information spaces are, in their view, not simply about the information, objects, representations and so forth that are "out there" and available for sharing by actors. CIS is additionally concerned with the way in which information is made common. They characterise CISs as both "open" and "closed"; open in the sense of information being interpretively flexible and malleable, closed in the sense of being "immutable" or portable – stable when it moves across the boundaries between communities Cf. the distinction between "immutable mobiles" (Latour, 1987) and "boundary objects" (Star, 1989), discussed in below.

With the aim of refining the CIS concept and illustrating the breadth of its applicability, Bannon and Bødker identify five cases of common information space

- Coordination centres such as control rooms, where participants are co-present and can communicate face to face
- Cooperation at a distance often implying a fixed division of labour – a bureaucracy.
- CISs that are open for some and closed for others, where different users of information have different interests and concerns
- CISs that are reliant on human mediators who carry out some of the interpretive work necessary to articulate the work of others.
- CIS on the web

Randall (2000) problematises the CIS concept and the aim of identifying information that is "common":

"One thing is clear, and that is that the notion of CIS is radically underspecified. It is not possible to distinguish its putative features by reference to technology, to information, or to organisational structure." Randall goes on to locate the problem – and the value – of the CIS concept with classification practices through which workers establish standardised frames of reference, a topic that is highly pertinent to any understanding of distributed health records.

Bossen (2002) takes up the challenge posed by Randall and augments the CIS concept, making it a more useful analytic tool, Based on a case study of work in a complex clinical environment, Bossen refines the notion of CIS by describing seven "parameters of CIS" that serve as a framework to organise analysis and clarify the CIS concept:

1. Degree of physical distribution of people. Are people physically co-located, as in an operating theatre, or more dispersed as in a department, a hospital, or the NHS as a whole?
2. The multiplicity of "webs of significance." In a complex organisation such as a hospital, there are many communities of practice, professional cultures and clinical specialisms. Each will have its own ways of understanding and interpreting which will sometimes be disjoint, and sometimes congruent.
3. The level of required articulation work. To what extent are tasks and activities interdependent?
4. The multiplicity and intensity of means of communication. In a given situation, people may be provided with a variety of communicative resources that will influence their ability to negotiate common frames of

meaning,. For example, Symon, Long and Ellis (1996) describe situations where face-to-face interactions between radiologists and other physicians support the repair of misunderstandings in a much more fluid way than is possible when work is coordinated through paperwork.

5. The web of artefacts ("mechanisms of interaction" and "coordination mechanisms"). Some settings are replete with subtly evolved systems of artefacts that serve to mitigate the complexity and amount of articulation work demanded of workers. For example, the many notes, signs, whiteboards, and so forth present in a hospital ward allow different professionals to integrate and coordinate their work through time and space (Bossen, 2002).
6. Immaterial mechanisms of interaction. To what extent is articulation work mediated through means such as standards, classification systems, procedures, organisational structure, and so forth.
7. The need for precision and promptness of interpretation. In some cases the work system as a whole will be robust to certain kinds of mis-alignment – either of interpretation or of timeliness.

The parameters above provide a useful methodological focus for studying Common Information Space. The notion of CIS has been most usefully applied to medium and small scale systems such as control rooms (Bannon and Bødker, 1997), airports (Fields, Amaldi and Tassi, 2003), and hospital wards (Bossen, 2002). However, to provide a richer conceptualisation of the way coordination takes place, especially in complex heterogeneous collaborations, such as hospitals, trusts or the NHS, we turn to a further body of literature: that on *boundary objects* and *social worlds*.

3.2 BOUNDARY OBJECTS AND IMMUTABLE MOBILES

Articulation work, as it evolves around CIS and other co-operative contexts, was first introduced by Strauss (Strauss, 1978) as essentially distributed and layered activity. Star (1989) follows Strauss' conceptualisation of articulation work, focusing on articulation work across boundaries. This articulation work involves the production of boundary objects (Star and Griesemer, 1989).

Boundary objects are conceptualised as material and immaterial artifacts that organise shared but distributed cognition among different social worlds. The latter are being defined by Strauss as groups and organisations committed to a particular activity. In carrying out this activity people build up shared ideologies and resources. Medical disciplines and health care professions are examples of social worlds. Social worlds can segment into sub-worlds and can intersect. At these intersections arenas emerge when different social worlds, organisations and other collective actors share a concern (Clarke, 1991). Participants in an arena may share some common ground, but their tasks, views, tools and practices are often sufficiently different to complicate communication and coordination between them. Boundary objects are used for communication and co-ordination between different collective actors/social words without presupposing a fully shared definition of an object. On the one hand they are flexible enough so that each social world can give specific meanings to the object. On the other hand they are sufficiently robust to maintain a common identity across sites. As such they enable cooperation and communication among heterogeneous practices and provide heterogeneous CIS such as hospital wards with the required flexibility and simultaneous stability.

According to Star (1995) two movements are essential to make boundary objects travel among heterogeneous practices. In order to be transferable to another context, local meanings have to be stripped off making the presentation more abstract and more universal. This de-contextualisation process leads to immutable mobiles (Latour, 1987:241), which can be transferred from site to site without change or loss of information. In order to be usable in a specific context, the abstract and standardised representation has to be adapted to the particular situation. This re-representation into a local context is the inverse process of de-contextualisation and therefore could be called re-contextualisation or, as it is often called, localisation.

3.3 INFORMATION INFRASTRUCTURE

Emphasizing the layeredness of collective action, Fujimura (1995) studies the process of making and keeping the work process "doable". She argues that doability evolves with layered alignment processes co-coordinating activities in a vertical fashion. Bowker (1994) adds to this concept of layered articulation work by introducing the concept of infrastructural work. Articulation work does not only coordinate and align various practices, in doing so it de-emphasises certain aspects while foregrounding others. As a result of this we perceive infrastructure as something unproblematic and largely invisible. Bowker calls this figure-ground gestalt shift an infrastructural inversion and applies it as an analytical category to make infrastructural work visible. This perspective is further developed by Star and others (Star and Ruhleder, 1996; Bowker and Star, 1999).

The term *infrastructure* conjures up images of large scale, widespread, ubiquitous, pervasive, and for the most part invisible technological systems that 'keep things running'. When an infrastructure works well it goes largely unnoticed, operating as a "substrate" on which other things "run". For most of us, most of the time we can turn on the lights, run the tap, or browse the web without having to understand or even be aware of the technical and political complexity of the infrastructures that support such everyday activities. This property of invisibility is an accomplishment of a form of articulation work or resolving the tensions between the local and the global that Duncker (1998) (citing Bowker) refers to as infrastructural work. This property invisibility necessitates a shift of emphasis in order to bring into focus the properties of the infrastructural substrate. The required re-focusing or "infrastructural inversion" is a process of bringing into the foreground infrastructures rendered "invisible" or "backgrounded" by infrastructural articulation work.

Star and Ruhleder (1996) and Bowker and Star (1999) identify the following dimensions of infrastructure:

"***Embeddedness:*** *Infrastructure is sunk into, inside of, other structures, social arrangements and technologies*

Transparency: *Infrastructure is transparent in use….*

Reach or scope: *This may be either spatial or temporal – infrastructure has reach beyond an single even or one-site practice.*

Learned as part of membership: *The taken-for-grantedness of arefacts and organisational arrangements is a sine qua non*

of membership in a community of practice (Lave and Wenger, 1991) ….

Links with convention of practice: *Infrastructure both shapes and is shaped by the conventions of a community of practice….*

Embodiment of Standards: *… infrastructure takes on transparency by plugging into other infrastructures in a standardised way.*

Built on an installed base: *Infrastructure does not grow de novo; it wrestles with the inertia of the installed base and inherits strengths and limitations from that base….*

Becomes visible upon breakdown: *The normal invisible quality of working infrastructure becomes visible when it breaks…*

Is fixed in modular increments, not all at once or globally: *Because infrastructure is big, layered and complex, and because it means different things locally, it is never changed from above…*" (Bowker and Star, 1999, p35).

Susan Leigh Star and others have investigated the way as information systems, both computer systems and less tangible systems such as standards and systems of classification, function as infrastructure (Bowker and Star, 1999). They then go on to identify four "methodological themes" that help us to achieve the *infrastructural inversion* needed to bring into sharp focus the role and nature of infrastructures, and in particular standards and systems of classification.

3.3.1 UBIQUITY

Infrastructures and the infrastructural articulation work that supports them are everywhere. Information systems, standards and standard operating procedures, systems of categorisation and classification pervade almost every aspect of medical work. The variety of such infrastructural elements and their saturation in healthcare work implies a highly heterogeneous and interconnected system; a system of healthcare records will have many components and will pervade all levels and areas of specialisation within the healthcare system.

3.3.2 MATERIALITY AND TEXTURE

Bowker and Star make the point that "abstract" information infrastructure such as systems of classification are not simply ideal or symbolic. Rather they are embodied in the artefacts of the material world. Understanding this embodiment and properties of the physical artefacts in which infrastructure is embedded is a vital part of understanding how the infrastructure functions in practice.

A system of healthcare records needs therefore to be studies not only as a collection of abstract categories of information, not as a technical system of repositories and databases. It should be seen instead as a constellation of material artefacts, perhaps embodying abstract categories, that are used, transmitted, translated and physically manipulated in practical healthcare work.

3.3.3 INDETERMINACY OF THE PAST

The understandings we have of past events are reconstructions from a particular perspective. As our perspective shifts, we gain new knowledge and experiences, so to, out retelling of history also changes. Further, different people, with different perspectives, construct history in different ways.

A central concept of the EHR, the "longitudinal health record about an individual" (Protti, 2002), can be seen as a resource that allows medical practitioners to construct patient histories. Different practitioners will employ the same shared information resource from different vantage points and at different junctures in the patient's trajectory through the healthcare system.

3.3.4 PRACTICAL POLITICS

The fourth methodological theme of Bowker and Star concerns the practical politics of making an infrastructure work. One of the features of large-scale infrastructures is that they create a tension between local practice and global standards and categories. Indeed it is precisely when this tension has been practically resolved that an infrastructure is able to fade into the background, to become invisible. Of course, this settlement of local-global tensions requires negotiation, conflict, trade-off – practical political work.

Bowker and Star discuss how the insurance regime in the US healthcare system has created categories of disease and ailment acceptable to the insurers but used by medical practitioners. Thus physicians or therapists may collude with patients to record a diagnosis that will attract reimbursement from the insurance company while meeting the needs of both practitioner and patient (such as being non-stigmatising).

4. PROJECTED RESEARCH

For the purposes described above we will carry out a qualitative longitudinal study to understand the dynamics of co-ordination around patient treatments as they involve various professionals, medical specialists, hospitals, hospital units, community care units etc. We have two approaches to capture these mechanisms: We will follow patients to observe the multi-professional co-ordination as the case evolves, including the creation of the patient record. We will also study the 'information space' of various healthcare professionals from the professional's point of view by looking at the methods and 'information artefacts' that are being used for information exchange and co-ordination with other healthcare professionals.

We conceptualise multi-professional, co-operative work settings in the terms described above as common information spaces, which are inhabited by the people who communicate, and a number of material and immaterial 'information artefacts' that help them to do so. These artefacts support (or hinder) information exchange and co-ordination across organisational, professional and disciplinary boundaries. For instance, in an orthopaedic hospital ward nurses, orthopaedic surgeons, anaesthetists and physiotherapists have to co-ordinate their work and record their activities. Material information artefacts on such a ward include whiteboards with lists of tasks and their status, paper snippets with lists of things to do, clothes with notes on them, referral, request and report forms, X-ray and MRI images and patient records. Immaterial artefacts are rules, standards and customs that regulate the work process such as the general division of labour between surgeons and anaesthetists or the custom of accompanying urgent requests between hospital units with a phone call.

On the one hand, EPR and EHR systems will support some, but not all of the functions fulfilled by this wealth of information and co-ordination artefacts. Electronic referral, electronic prescription of medication and electronic monitoring and reminder systems may complement simple electronic record keeping. On the other hand EPR and EHR systems will offer

facilities that are not available with traditional information systems. Most importantly the EPR/EHR is expected to provide medical research with up-to-date standardised medical data. Electronic search for particular symptoms or diseases could provide researchers with previously unknown amounts and quality of data. For such features to be implemented. EPRs/EHRs will have to embrace medical standards across all sites. However, not only have consultants and surgeons a tendency to adjust the categories of patient records to their needs (which would not be possible with standardised EPRs), there are also numerous standards to chose from. These debate about these standards are still going on. Whose standards will prevail?

Last but not least, the NHS has called for organisational changes to instil an information culture, i.e. to tear down barriers to a successful implementation of EPR and EHR. Whilst organisational changes undoubtedly will come with the introduction of new information technology, experts are somewhat divided over the current structural changes in the NHS. Given that the NHS has been subject to many changes over the past thirty years, many employees see the current re-organisation simply as another one in a long row of rapid changes with which they will have to catch up. They doubt that the latest changes and the introduction of IT hold any advantages for them. Observing the day-today activities of healthcare professionals over a long period of time will not only enable us to establish whether or not the introduction of IT was advantageous for everybody. The study will also explore, whether the day-to-day realities hold up to the empowerment promises of the NHS management.

5. REFERENCES

Bannon, L. and S. Bødker (1997). *Constructing Common Information Spaces*. In European Conference on Computer Supported Cooperative Work ECSCW'97.

Bossen, C. (2002). *The Parameters of Common Information Spaces: The Heterogeneity of Cooperative Work at a Hospital Ward*. In Proceedings of Computer Supported Cooperative Work CSCW'02, ACM Press.

Bowker, G. C. (1994). Information Mythology: The World Of/As Information. In *Information Acumen. The Understanding and Use of Knowledge in Modern Business*. L. Bud-Friermann ed. London, Routledge.

Bowker, G. C. and S. L. Star (1999). *Sorting Things Out: Classification and its Consequences*, MIT Press.

Clarke, A., E. (1991). Social Worlds/Arena Theory as Organizational Theory. In *Social Organization and Social Process. Essays in Honour of Anselm Strauss*. D. Maines ed. New York, Aldine**:** 119-158.

Duncker, E. (1998). *Multidisciplinary Research at the University of Twente*. PhD Thesis, University of Twente.

Fields, B., P. Amaldi and A. Tassi (2003). Representing collaborative work: The Airport as Common Information Space. *In Submission*.

Fujimura, J. (1995). Ecologies of Action, Recombining Genes, Molecularizing Cancer, and Transforming Biology. In *Ecologies of Knowledge*. S. L. Star ed. New York**:** 302-346.

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers Through Society*, Open University Press.

Lave, J. and E. Wenger (1991). *Siutuated Learning: Legitimate Peripheral Participation*, Cambridge University Press.

NHS (1998). Information for Health. NHS policy paper. http://www.nhsia.nhs.uk/def/pages/info4health/contents.asp.

Protti, D. (2002). Implementing Information for Health: Even More Challenging Than Expected? Report submitted to Department of Health/NHS Information Authority.

Randall, D. (2000). *What's 'common' about 'common information'?* In Workshop on Common Information Spaces, Copenhagen, Denmark.

Schmidt, K. and L. Bannon (1992). Taking CSCW Seriously: Supporting Articulation Work. *Computer Supported Cooperative Work: The Journal of Collaborative Computing* **1**(1): 7-40.

Schmidt, K. and C. Simone (1996). Coordination Mechanisms: Towards a Conceptual Foundation of CSCW Systems Design. *Computer Supported Cooperative Work: The Journal of Collaborative Computing* **5**(2/3): 155-200.

Star, S. L. (1989). The structure of ill-defined solutions: boundary objects and heterogeneous distributed problem solving. In *Distributed Artificial Intelligence, Volume 2*. L. Gasser and M. Huhns eds., Pitman.

Star, S. L. (1995). The Politics of Formal Representations: Wizards, Gurus and Organizational Complexity. In *Ecologies of Knowledge: Work and Politics in Science and Technology*. S. L. Star ed.**:** 88-118.

Star, S. L. and J. R. Griesemer (1989). Institutional Ecology. 'Translations' and Boundary Objects: Amateurs and Professionals in Berkley's Museum of Vertibrate Zoology. *Social Studies of Science* **19**: 387-420.

Star, S. L. and K. Ruhleder (1996). Steps Towards an Ecology of Infrastructure: Design and Access for Large Information Spaces. *Information Systems Research* **7**: 111-134.

Star, S. L. and A. Strauss (1999). Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work. *Computer Supported Cooperative Work: The Journal of Collaborative Computing* **8**: 9-30.

Strauss, A. (1978). A Social World Perspective. In *Studies in Symbolic Interaction 1*. N. K. Denzin ed. Greenwich, JAI Press.

Strauss, A. (1988). The Articulation of Project Work: An Organizational Process. *The Sociological Quarterly* **29**(1): 163-178.

Symon, G., K. Long and J. Ellis (1996). The Coordination of Work Activities: Cooperation and Conflict in a Hospital Context. *Computer Supported Cooperative Work: The Journal of Collaborative Computing* **5**(1): 1-31.