End-user Perspectives on the Uptake of Computer Supported Cooperative Working

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Abstract

Researchers in Information Systems have produced a rich collection of meta-analyses and models to further understanding of factors influencing the uptake of information technologies. In the domain of CSCW, however, these models have largely been neglected, and while there are many case studies, no systematic account of uptake has been produced. We use findings from Information Systems research to structure a meta-analysis of uptake issues as reported in CSCW case studies, supplemented by a detailed re-examination of one of our own case studies from this perspective. This shows that while there are some factors which seem to be largely specific to CSCW introductions, many of the case study results are very similar to standard IS findings. We conclude by suggesting how the two communities of researchers might build on each other's work, and finally propose activity theory as a means of integrating the two perspectives.

1 Introduction

This paper considers how far established knowledge in the field of Information Systems (IS) about the dimensions underlying the uptake of new technologies can help researchers and practitioners understand uptake in the specific domain of computer supported cooperative work, hereafter CSCW. CSCW is usually treated as a separate domain by its researchers and practitioners, and the community has yet to develop a systematic model of uptake. As we observe at the beginning of section 2, this is a topic where terminology is often ambiguous, but by 'uptake', we simply mean the sustained use of the technology for real work.

CSCW has emerged as a separate domain of research and practice since (at least) the 1988 CSCW conference held in the USA. Since then US CSCW conferences have been held biennially, interspersed with the European series of conferences from 1989 onwards. Other specialist conferences and journals flourish, and explicitly CSCW papers are also to be found in the more general human factors and human computer interaction literature. The boundaries of the domain is the subject of perennial debate in the CSCW community, but a key distinguishing element is a focus on people using technology with the primary aim of enhancing or enabling co-working rather than on people who work together using shared tools such as a multi-user database. Of course this definition would include some studies reported in mainstream IS, but it is the work reported under the specific label of CSCW that we are concerned with here, and more specifically the large body of case studies reporting the introduction of collaborative technologies. While their authors individually offer a variety of explanations for the success or otherwise of such interventions, there are no overall models of CSCW uptake. (Grudin's widely-cited discussions of groupware failure and challenges for CSCW systems - Grudin, 1998, 1994; Grudin and Poltrock, 1997 - address some uptake issues, but are more concerned with design challenges rather than the integration of the results of the body of case studies.) By contrast, the IS community has produced many meta-analyses and models of technology uptake, and the literature here is extensive. On the whole, these models are not drawn upon in the CSCW case study literature, although there are some notable exceptions: among others, Kraut *et al* (1994), Orlikowski (1992), Orlikowski and

Gash (1994) and Okamura *et al.* (1994). It is worth remarking that these researchers have their roots in the IS community, in contrast to many CSCW authors whose home disciplines are frequently in sociology, psychology or computer science.

As CSCW researchers and practitioners, we were interested to discover how far the existing IS models and dimensions of end-user uptake (as distinct from organisational acceptance) could account for the heterogeneous collection of CSCW case study findings. This important because:

- IS has a much mature model of user acceptance than has so far emerged in the study of CSCW and it is reasonable to believe that there are sufficient commonalties between the two disciplines to use insights from the former to inform the latter. Conversely as information systems are increasing including support for collaboration suggesting that CSCW has something to offer in return;
- decision makers (purchasers, IS managers, systems administrator and so forth) need to be able to anticipate potential problems with user acceptance of CSCW systems;
- and finally, this should be of academic interest to both IS and CSCW researchers as to date there has been relatively little dissemination between the two groups.

This paper first briefly reviews current accounts of uptake in IS, then applies the dimensions identified to a meta-analysis of case studies reporting CSCW introductions. We next explore the applicability of IS models in more detail, using the results of one of our own CSCW case studies and conclude by suggesting some directions for future work in understanding uptake.

2 End-user uptake: perspectives from IS and related fields

One of the persistent problems in synthesising and applying research in this field is the inconsistent use of terminology. Terms which may be taken as meaning uptake include acquisition, adoption, acceptance, implementation, assimilation, routinization, and, of course, use. While it is clear that some can relate only to specific stages – acquisition, for example, is simply purchasing the technology – others are used much more loosely and inconsistently. Adoption, for example, can mean the decision to purchase, or the routine use of technology by end-users. However, rather than being side-tracked into this particular debate, we have adopted a fairly catholic approach to this brief review.

We begin with the classic meta-analysis by Tornatzky and Klein (1982) of 75 innovation adoption papers which identified three key innovation characteristics: compatibility *with* existing practice, relative advantage *over* existing practice and complexity. These were found to have the most consistent relationships to innovation adoption, where the innovation is, in the broadest sense, any new technology or practice. A similar meta-analysis was reported by Rogers (1983) who added a number of other dimensions including trialability and observability. IS research has sought to apply these general models to the particular context of new information technology, leading to the identification of a number of extra factors which are held to influence uptake. Davis' (1989) technology acceptance model, for example, argues that user perceptions of usefulness and ease of use have a critical influence on acceptance and usage. Much work (of which Moore and Benbasat, 1991; Hebert and Benbasat, 1994; Miller, Rainer and Harper, 1997; Straub, Keil and Brenner, 1997; Loh and Ong, 1998) are among more recent instances) extends the now classic models of Tornatztky and Klein, Rogers, and Davis. To take just two examples, Moore and Benbasat differentiate perceptions of relative advantage, compatibility, ease of use, demonstrability of results, effect on image (of the user), visibility, trialability and voluntariness, while Loh and Ong found that perceived usefulness had a positive relationship not only with perceived ease of use, but also duration of use and user satisfaction.

Agarwal, Prasad and Zanino (1996) and Agarwal and Prasad (1998) have taken a slightly different theoretical base, drawing on the three innovation characteristics identified by Tornatsky and Klein. Their studies relate the adoption of new technology (here meaning use by an individual) to perceptions of relative advantage, ease of use and compatibility with existing values and practice. However, two additional moderating dimensions are proposed, the innovativeness of individual users and the media through which potential users become aware of the technology and its features. A field study showed that innovativeness interacted with perceptions of compatibility, but not the other dimensions. Agarwal and Prasad suggest that this may indicate that the cognitive costs of perceived incompatibility are so high that only more innovative individuals will decide to adopt the technology in question. As for media channels, both relatively impersonal channels such as presentations, videotapes and direct interpersonal channels had an effect on perceptions, interpersonal contact having the greater direct effect.

A further influential explanatory model has been critical mass theory, for example Markus (1987). Critical mass theory predicts that the utility of a communications medium to its users will rise with the number of people using the system, particularly when users are important in some way to each other. The meta-review conducted by Prescott and Conger (1995) finds critical mass as an element in inter-organisational IS uptake but not as a strong factor in intra-organisational technology. Additional intra-organisational characteristics identified by Prescott and Conger include management support, the presence of strong innovation champions, user training, organisational characteristics and organisational fit.

3 Accounting for end-user uptake: the CSCW perspective

Approaches to reporting case studies in the CSCW literature are heterogeneous in the extreme. Accounts range from 'snap-shot' evaluations to longitudinal studies and from controlled quantitative analysis to unstructured ethnographic observations. Furthermore, reports often fail to differentiate between stakeholder groups and rarely identify critical success factors or other metrics in advance. Finally, there are still comparatively few *detailed* case studies to draw upon. As a result of these difficulties we have necessarily adopted a fairly broad-brush approach to this part of the review. Since definitions of uptake, where present, were varied, we have operationally defined uptake simply as 'use'.

We have reviewed over 70 case studies reported between 1994 and 1999 drawing upon the principal CSCW conferences and journals (these include the CSCW, ECSCW, Group and CHI conferences, and CSCW the journal). The case studies surveyed include only those studies where technology was introduced into real-life organisations, in contrast to trial use under more experimental conditions, or workplace studies of collaborative working unsupported by new technologies. The start date of 1994 was selected so that the technology used to support CSCW was sufficiently mature as not to be a compounding factor in its adoption. Figure 1 maps the findings of those CSCW reports which explicitly comment on uptake factors to a number of IS dimensions[1] (these data are presented in more detail in table 1 through 5 at the end of this paper). These are the basic seven dimensions of Moore and Benbasat (1990, 1991) together with other aspects for which there is support in the more recent literature: user expectations and individual innovativeness (e.g. Agarwal *et al*, 1996, 1998 among others), mandated, championed or discretionary use (e.g. Prescott and Conger, 1995) and critical mass (e.g. Markus, 1987). As will be seen from the figure below, many case

[1] Note that many case studies map to more than one dimension.

studies make observations which fit comfortably with relative advantage (13), compatibility (13), ease of use (8), critical mass (6), mandated/championed/discretionary use (5) and innovativeness (5). There is rather less reported evidence of user expectations (3), demonstrability (3), and visibility (1), and none for enhanced image or trialability.

All in all the results of 41 CSCW case study reports (on the evidence reported by their authors) can be accounted for entirely in terms of existing IS models; a further 7 can be (included in tables 1-7) accounted for from a mixture of IS and CSCW dimensions and the remaining 11 more cite CSCW factors alone. The CSCW specific factors are considered below in section 3.1.

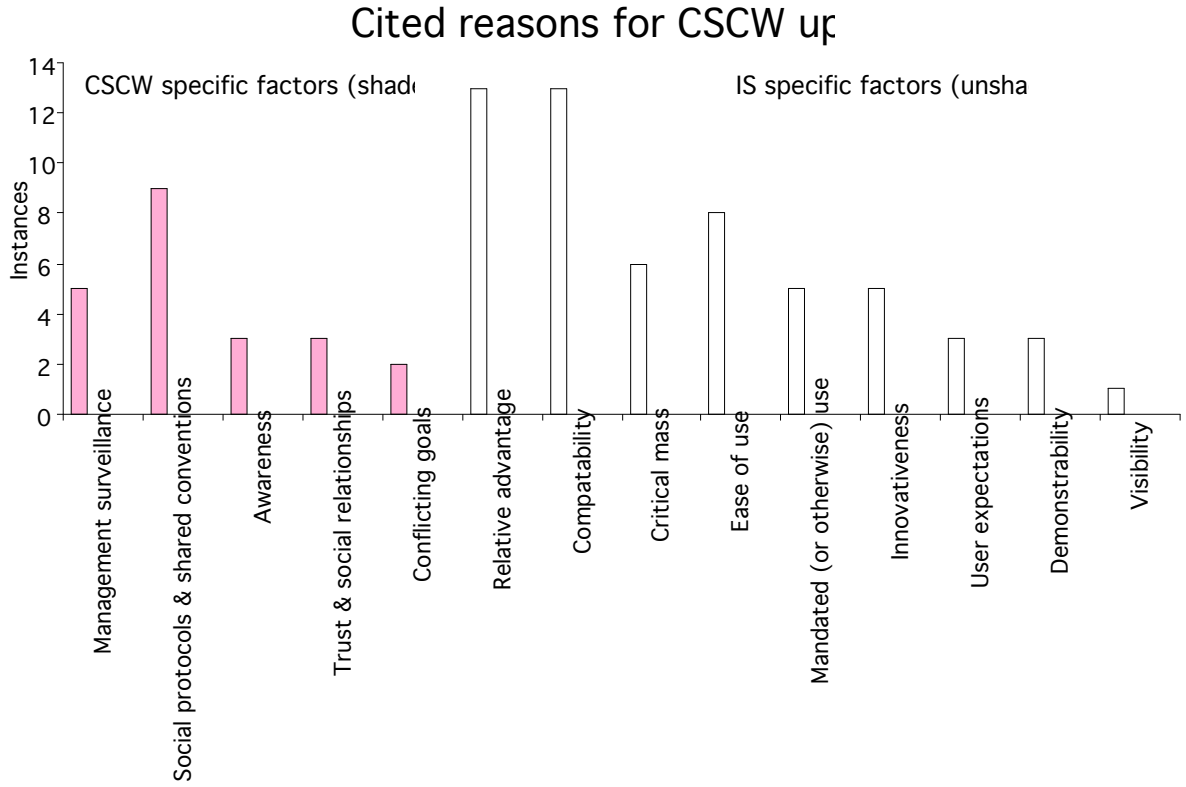

Figure 1

3.1 CSCW specific dimensions

Those factors found in the above accounts of CSCW uptake which do not fit within the existing IS uptake dimensions are almost entirely related to issues which might be grouped under the umbrella term 'social factors'. (Note that some of these are discussed in the more specialist IS literature, for example Zuboff (1998) and Rice and Tyler (1995), but here we are concerned with generic IS uptake models.) This is unsurprising because at its heart, CSCW would describe itself as being concerned with human-human co-working supported by technology rather than human-computer working. These social factors range from concerns over management surveillance to the need for pre-existing social networks. Considering these in turn:

3.1.1 Potential for management surveillance

Concerns about management access to the work of a group or an individual have been identified by a number of authors. Clement (1994) and Lee *et al.* (1997) both note concerns

about surveillance and privacy in the deployment of a video-based inter-office awareness tool, while Olson and Teasley (1996) have reported disquiet about the unwelcome potential for monitoring by management with the introduction of collaborative technologies in a distributed automotive design environment. Other related reports are Bowers (1994) and Whittaker (1996).

3.1.2 Trust and the need for a pre-existing network of social relationships

Rocco (1998) argues that trust is a prerequisite for success when a collaborative task involves risk of individualistic or deceitful behaviour by others, presenting empirical data that computer-mediated work can only be successful if an underlying network of social relationships based on face-to-face relationships already exists. Trust is also raised as a factor by Clement (1994), in the context of ownership of information about oneself conveyed through media spaces and Star and Ruhleder (1994) in discussion of the uptake of a shared information system for research biologists, who were reluctant to release early information which could be poached by others.

3.1.3 The establishment of social protocols and shared conventions

There are numerous CSCW reports of such issues. Watts *et al*., 1996 report implicit protocols of use in the use of voice loops for shuttle mission control; the development of group norms facilitated the use of an audio-only media space (Hindus *et al.,* 1996); the lack of social conventions impeded use of a system providing awareness of staff whereabouts in an HCI lab (Tollmar, Sandor and Schömer, 1996); common working conventions had to be established between different groups in technologically supported co-working in a ministerial department (e.g. Mambrey and Robinson 1997; Mark, 1997; Mark *et al.* 1997; Pankoke-Babatz and Syri, 1997; Lee, Girgensohn and Schlueter, 1997) note the need for social conventions in the implementation of a video-based inter-office awareness tool; and Grinter (1997b) in her review of workplace studies, cites the development of common social and technical protocols and shared understandings as factors in successful CSCW.

3.1.4 Awareness of what others are doing

The importance of the peripheral cues which support mutual awareness is observed by Watts *et al.* (1996) in a study of space shuttle mission control and by Mark, Haake and Streitz (1996) in the context of meeting room support systems. Grinter (1997b) also notes the importance of information afforded by the shared availability of individual work.

3.1.5 The reconciliation of conflicting goals.

The introduction of CSCW can also be obstructed by conflicting goals. Blythin *et al.* (1997) provide an example of this in a banking context, while Herik and Vreede (1997) observe how a lack of shared goals detracted from the efficacy of group support systems in ministerial policy meetings.

3.2 'Missing' IS dimensions in CSCW and the extent of overlap

The CSCW case studies provide no evidence for two of the dimensions identified in the IS literature – image and trialability – and there is little material on visibility, demonstrability and user expectations. Inevitably, some of this will have been an artefact of the way the case studies have been reported. We suspect that some of these factors will have been aggregated

with more general costs and benefits, but we find it interesting that few CSCW researchers have addressed individual characteristics as an element in uptake.

Figure 2 is an illustration of the extent to which the dimensions overlap.

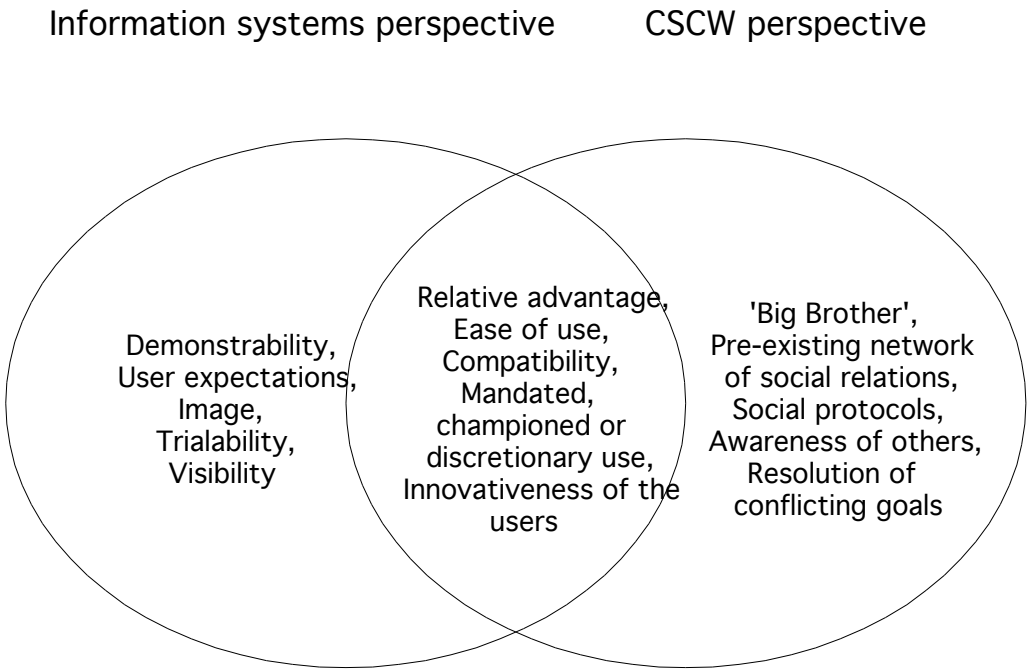

Figure 2

So, what does this figure mean? We can speculate that intersection of IS and CSCW perspectives may correspond to the *necessary* conditions of uptake from the viewpoints of the two disciplines. In practice the separate areas may be more detailed, or operationalised, aspects of the core dimensions, or may reflect the dominating research pre-occupations in the two disciplines. We return to this issue in section 5.

4 Analysing a CSCW case study using the IS dimensions

Having demonstrated how established IS models apply to many other CSCW case studies, we now illustrate these issues in more detail in the context of a field study we conducted with a large engineering organisation.

We should stress that the work in question was not undertaken for the purpose of formal hypothesis testing, the construction of new models or the extension or validation of existing theory. Rather, it was a pragmatic pilot trial of collaborative technologies with the dual aims of (i) demonstrating the potential of such technologies for the host organisation and (ii) identifying requirements and issues to be addressed in a more widespread introduction in the organisation or requiring further research. In this approach the project is typical of much other work in the CSCW community.

4.1 The genesis of the CSCW project

The project was concerned to determine what pragmatic combination of low cost, readily available technology and new working practice could meet perceived needs for distributed cooperative working at a major engineering consultancy, which we will hereafter refer to as *Metre*. Metre operated in the domains of marine engineering, command and control systems and software engineering with clients predominantly from the defence industry. The research discussed in this paper was confined to one particular business area within *Metre*, the Naval

Division. Naval Division was largely project-driven with project teams of 3 to 30 or more people, projects typically varying in duration from 6 months to 2 years or more. Team members in some cases were moved to a common location, in others, distributed across several sites. In all such cases, co-ordination was achieved through frequent meetings. Thus travel was a heavy overhead: senior staff and specialist experts (who were shared between projects) were commonly away their base at least one day a week and frequently as many as four or five days.

At the outset of this study interviews with senior management elicited the opinion that most staff would be receptive to technological change, although organisational change was recognised to be a more sensitive issue and to require careful handling. There was also some suggestion that since users often did not exploit current technologies to the full, the introduction of CSCW would need to be backed up by substantial training effort. The priorities were seen to be to identify appropriate off-the-shelf facilities, e.g. email and desk-top video conferencing, and then to demonstrate their potential. Their introduction would be the first steps in creating a climate sympathetic to the introduction of CSCW.

Further interviews (25 interviewees) and a substantial questionnaire survey (103 respondents) involving a wide cross-section of staff were undertaken after the initial work with senior management. The overall results showed somewhat mixed expectations of CSCW, but more positive views among senior staff and other frequent travellers. The questionnaires and interviews also generated detailed data about current cooperative activities. A detailed description of the methodology and findings may be found in Turner and Turner (1996).

4.2 The pilot introduction of CSCW

Given these preconditions the next step was to identify a suitable pilot project which it was hoped would demonstrate the advantages of a move from face-to-face interaction towards technologically supported distributed interaction. The choice of project was made by management at Metre.

The opportunity for a CSCW pilot was presented by the Matelot project, which involved the preparation of a huge collaborative bid to upgrade a category of naval warship for the British Ministry of Defence. At its height Matelot employed a team of some 240 people, who were distributed between sites in North-West England, Scotland and sites on the South coast of England. Matelot was scheduled to run for 14 months with our trial introduction of CSCW starting three months into the project and lasting eight months.

The tools selected were Fujitsu DeskTop Conferencing™ (DTC) and Lotus Notes™. DTC supported synchronous working through remote application sharing, a shared electronic whiteboard/flipchart and also includes file transfer. In contrast Lotus Notes supported asynchronous working by providing a structured, shared information space and integrated email. A number of purpose built Notes application / databases were also constructed, designed, primarily, to meet the needs of the project manager. All available users attended a day of demonstrations and hands-on training, with the opportunity to discuss the new tools with their developers and the member of Metre staff who would be supporting the technology and its use. Several staff could not attend this session and were introduced to the technology individually by the Metre support engineer.

4.3 The longitudinal evaluation of the pilot

4.3.1 Evaluation methods

The level of input to the evaluation exercise which could be expected from the users themselves was severely limited. This meant that exhaustive field data collection techniques of the type described, for example, in Kraut *et al*, (1994) were impractical. Furthermore, the work was both security classified and carried out in secure buildings, which meant that ethnographic approaches, as described, for example, in Hughes *et al* (1994), with their emphasis on observation of everyday work, were largely impractical. Accordingly, the evaluation techniques planned, drawing on some of those reported in Tang *et al* (1994) were:

- structured interviews before the pilot started and towards the end of the experimental period, establishing baseline information about the users, their working practices, and their perceptions of the technology;
- minimal records by users of communications to determine patterns of use and changing communication practice;
- automatic logging of technology use;
- unobtrusive observation of the technology in use.

In practice, time constraints on users at Metre prevented the full implementation of even these techniques – very few users logged their communications - so a pragmatic and opportunistic approach had to be adopted. For example, *ad-hoc* training and informal discussion proved a good source of alternative background information.

The structured interviews remained an important source of data. Questions raised with users addressed general issues such as benefits achieved, ease of use and the fit between the technology and the pre-existing working procedures which were derived from the IS and CSCW literature. These were supplemented by follow-up questions to specific issues raised by the users themselves in briefing sessions about the technology prior to its introduction. Each interview concluded with an open ended question designed to elicit any other outstanding issues.

4.3.2 Results of the evaluation

Despite the apparently promising scope for CSCW, after eight months of continuous availability and technical support the only application to have been used seriously was Lotus Notes email. This had been exploited primarily as a means of transferring files between North-West England and Scotland. However, users viewed this very positively, several commenting in evaluation interview that email had been *essential* to the team's work, and that its use for file transfer had avoided many car journeys between North-West England and Scotland.

End-users were asked in interviews to score the technology as a whole for usefulness on a scale of 1 to 5, 5 being the most positive score, before and after use. Somewhat surprisingly, since only email had been used, mean overall perceived usefulness increased from 3.5 to 4.5. The post-experience interviews (conducted with 13 of the original 14 users, and a further 5 who had joined the project during the pilot period) also elicited a number of expressed reasons for the lack of uptake of the remaining tools. Figure 3 is a plot of the five concerns most frequently voiced about the CSCW technology as a whole.

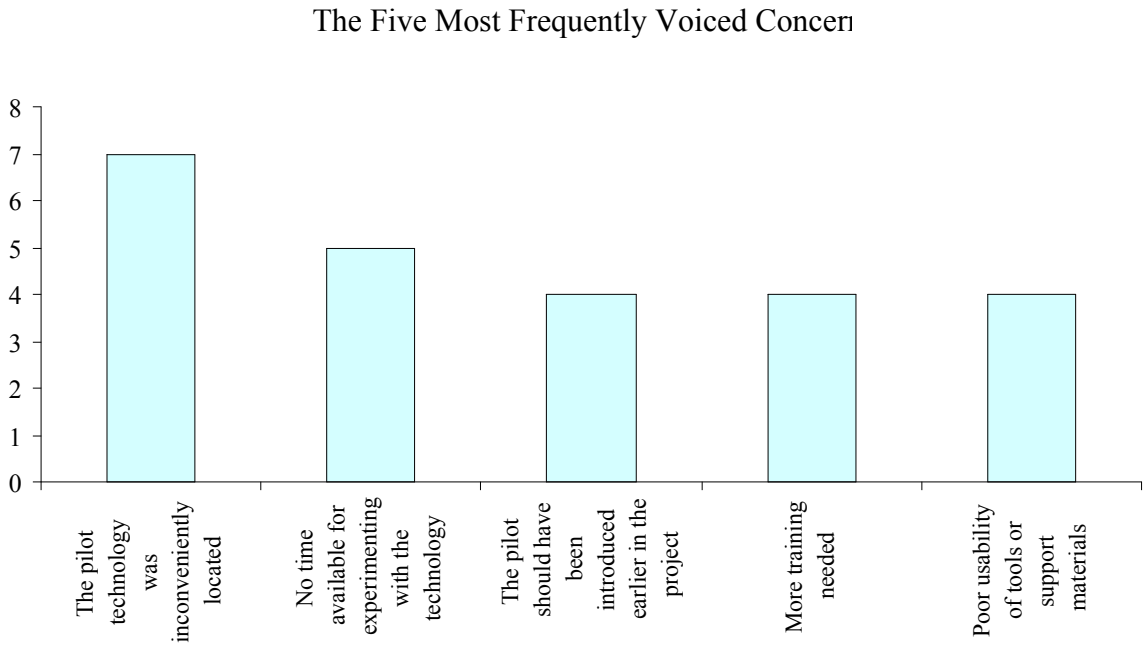

Figure 3

The suggestions elicited from the interviews as to how the pilot might have been improved echo this data. The underlying issues as stated by the interviewees reflect problems with access to the technology (although there is no evidence to suggest that if the users had been equipped with individual desktop tools, that the other services would have been used) and its fit with the Matelot project's work practice. Engineering designers at Metre used computers as a special purpose tool, rather their primary resource for work. One consequence is that the designers working on the proposal did not have a computer each. Other work practice related issues reflect that the group selected for the pilot was part of a very much larger project, with established tools, working methods and procedures, and that since much the project's work was security classified, only some of the group's business could be transacted using CSCW running over public communications media.

4.4 Analysing the findings

How, then, do the evaluation findings in the particular case of Matelot fit with the IS and CSCW dimensions discussed above?

The influence of *relative advantage* can be seen in the adoption of email. End-users specifically commented in evaluation interviews that sending an email was considerably better than driving 120 miles by car simply to deliver an urgent file. Evidence from observation of the Matelot users suggests that for other tools, less advantage was afforded. For example, some users had to travel to the other site for reasons outwith the Matelot work, so would take care of Matelot business in the course of the same trip. This negated much of the potential advantage of synchronous tools such as application sharing.

The *complexity / ease of use* dimension clearly lies behind elicited complaints about the complexity of the Lotus Notes interface, the procedures for starting-up the software, and the manuals supplied to pilot participants.

Lack of compatibility was evident with both the artefacts used and organisational structures, systems and procedures. At Metre designers exploited a number of design media, computers being but one. For example designs were frequently realised on multiple sheets of A0 paper

(which measure 1680 x 2376 mm), laid out on large tables allowing the designers to move between the representations with ease. It is difficult to imagine how this particular working practice could have been supported during the pilot. The technology was also disjoint from existing computer-based technical and organisational systems, and associated procedures – the pilot project was only part of the larger Matelot enterprise, and procedures and systems had been in place for some time. Among other things, this meant that the technology could not be used when working with members of the wider project, nor indeed with colleagues in other parts of Metre – not all project team members worked on Matelot 100% of their time - a feature which could also be considered as an aspect of *critical mass*. Even entirely within Matelot, work on security classified materials could not be supported with the technology. All this entailed pilot users on Matelot contending with two incompatible modes of working.

Once again, the use of email produced immediately *demonstrable* results, discussed here under relative advantage, above. Application sharing might have been similarly demonstrable, had other factors not detracted from its usefulness. However, tools such as the Lotus Notes discussion databases would only have produced a useful result after they had been in use for some time by a number of participants (this point is related to *critical mass* but contradicts Prescott and Conger's findings that critical mass is not strong factor in intra-organisational technology.). This immediacy of tangible benefits again maps onto demonstrability of results.

A lack of *trialability* also have contributed to lack of uptake. While the tools themselves were reasonably supportive of user experimentation, one of the most common comments was that pressure of work meant that there was no spare time at all to do this.

General end-user *expectations* at Metre as elicited from the requirements interviews and the questionnaire, together with expectations of usefulness obtained from the pre-pilot interviews, were a good predictor of the behaviour of the particular group studied in the pilot implementation. The manner in which users conceptualised the applications (*cf.* technological frames, Orlikowski and Gash, 1994) may have had an influence: there is evidence to suggest that users conceptualised the tools as a means for improving the transmission of materials for co-working rather than for collaborative design itself. For example, users would telephone someone at the other site to warn them that a file was about to be sent, email the file, then telephone again to discuss the contents of the file rather than viewing and editing the material together using the application sharing tool. However, incidents such as these may be just as easily explained by the perceived usability problems.

While we have no systematic evidence of the *innovativeness* of the Matelot team, senior staff interviewed at the early requirements stage had mentioned several perceived cultural factors which may have had a bearing on this trait. For example, many experienced design engineers felt that computers were detrimental to good conceptual design and some of Metre's consultants were former Royal navy officers who were regarded as 'traditionalists' by their co-workers.

Finally, while the pilot introduction of CSCW was *championed* by a senior manager, he proved to be too time pressured to maintain enthusiasm.

However, while the low level of exploitation can largely be explained by established IS findings on uptake, there are some further factors involved, which mirror other CSCW fieldwork results. Perhaps the most obvious from the evaluation data is the issue of *shared conventions*. The Matelot project did indeed have shared conventions, but these had been established for some months before the CSCW intervention, and therefore naturally did not encompass how the technology should be used. Moreover, since most of the project was not supported by the new tools, end users in the pilot groups had not only to develop new conventions for themselves, but also to switch to a different set of conventions when working with colleagues in the wider project. *Awareness* was also a factor, not so much as moment-by-

moment awareness of co-workers' activity, but evident in the way in which pilot end-users would exploit visits to the other site to catch up with events and tacitly remind colleagues of their continued existence, albeit at 200 kilometres distance.

5 Discussion and some suggestions for further work

A number of issues arise from the review and analyses we have conducted.

5.1 Using the IS uptake literature in CSCW research

It appears to be the case that CSCW research, in the quite proper emphasis on the needs and characteristics of varied stakeholder *groups*, has so far neglected the varied characteristics of the *individuals* comprising those groups. Factors such as individual innovativeness and expectations merit more consideration in researching user behaviour in the context of collaborative technologies, and may help to explain some of the widely differing results between apparently similar CSCW interventions. A further consideration for CSCW research is the apparent explanation of many case study results by IS models. As Plowman *et al.* (1995) note in their review of workplace studies, there is no need to approach the work *ab initio* each time an opportunity to either introduce or evaluate CSCW presents itself. Rather, case studies in this domain could more profitably focus on a deeper investigation of those 'social factors' where there is little empirical evidence from the IS work, rather than establishing yet again that technologies are used most when they afford relative advantage.

5.2 Expanding IS models of uptake

Conventional office technologies are increasingly collaboration aware. If generic IS uptake models are to take full account of this, some extension appears to be required. While some of the 'social factors' discussed above may be co-extensive with dimensions such as compatibility (defined in slightly different ways by different authors), others seem to be distinct issues, and would repay systematic investigation in the more formal IS tradition.

5.3 Further work: An integrated approach

It is already recognised that the dimensions of uptake are neither orthogonal nor entirely independent. However, the integration of factors pertaining to individuals, workgroups, organisations, tasks and technologies requires a view of working life which situates these elements and their relationships in the context of the wider system. We suggest that Activity Theory provides a promising basis for moving forward.

This introduction to the basic elements of Activity Theory (AT) is necessarily brief, and for a fuller account the reader is referred to Cole and Engeström (1993), Nardi (1996), or Kuutti (1996) among others, whose accounts contain a comprehensive explanation of the subtleties of the theory, and its philosophical and cultural underpinnings. We have limited our exposition to those elements which are central for the application of AT in this context.

Activity theory stems from the work of the Leont'ev, and has been adopted in many fields: originally in psychology and education, but now in many other domains, including in the study of work to inform systems design. While Kuutti *et al*'s medical informatics example (Kuutti and Arvonen, 1992) and more recently Bardram's work on the medical workflow SAIK project in Denmark (Bardram, 1997 and 1998) are perhaps the clearest demonstrations of this, there is a growing corpus of other studies.

Central to activity theory is the thesis that all purposive human activity can be characterised as an interaction between a *subject group*, the group's *object* (or purpose and outcome) mediated

by an *artefact* or tool. In AT terms, the subject is the individual or group carrying out the activity (perhaps the human factors team in our CSCW pilot project), the artefact is any tool or representation used in that activity, whether external or internal to the subject (the Lotus Notes databases, individual ideas for the design of controls, a full scale plot of the control room…), and the object encompasses both the purpose of the activity and its outcome (to win the tender, and design which it is hoped will achieve this). Subsequent developments of activity theory by Engeström and others (e.g. Engeström, 1995, Cole and Engeström, 1993) have added other elements to the original formulation and these are: *the larger community of stakeholders, horizontal and vertical power structures* and the *rules and norms of the user group*. Thus human behaviour cannot be divorced from its socio-cultural and economic context. To continue our example, the human factors design activity was undertaken as part of the wider community of the project; the praxis, or rules and norms, might include that all changed versions must be signed off, that all heads of teams must be informed of significant changes and so on. Finally the division of labour within the team would comprise, *inter alia,* the way in which responsibility had been allocated for different sections of the design and tasks such checking against the specification.

Activities are part of an continuum, having their roots in earlier activities and being the seeds of their own successors and are always subject to transformation in the light of *breakdown* – roughly speaking incompatibilities – between or within nodes and between activities. A contradiction in the current example might be that one of the artefacts, the Notes database did not readily support the rigid procedures established for signing off designs. However contradictions are not necessarily problems, as they essentially afford scope for development or change – in this case, the opportunity would have been there to exploit the possibilities of new technology to improve authorisation procedures.

In the specific context of the uptake of collaborative systems, we can see that AT as a conceptual framework offers the potential to integrate dimensions identified by both the IS and CSCW communities such as individual costs and benefits of technology use (interaction between *subject group*, *artefacts* and *object*, informed by comparison with earlier instantiations of the collaborative technology); and the establishment of group conventions and norms. We are currently exploring how far this approach allows a re-conceptualisation of uptake issues, and in particular how it can support a systematic, integrated exploration of such factors grounded in the context of any particular introduction of collaborative technology.

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Appendix: Evidence of the IS dimensions of uptake in CSCW case studies

Table 1: **Relative advantage** – end user perceptions of advantage over the current ways of working, also differential advantages between different groups

Authors	**CSCW case study summary**
Bardram (1997)	Co-working supported by hospital information systems: factors affecting use included adding minor functionality which nonetheless adds useful benefits.
Blythin *et al* (1997)	CSCW in banking: amount of extra work was a factor in the limited success of the project.
Grinter (1997a)	Software engineering: workflow tools welcomed provided the 'right' work is automated, thus easing tiresome everyday tasks.
Hepsø (1997)	Shared work process information for an oil installation: usage was linked to a strong need for asynchronous communication between offshore workers.
Mosier and Tammaro (1997)	Group scheduling tools in a geographically distributed department: strong need to streamline meeting organisation.
Olson and Teasley (1996)	Collaborative technologies for distributed automotive design environment: reasons for partial adoption included extra work and lack of incentive to contribute to the databases.
Rogers (1994)	CSCW in a travel centre: notes a variant of 'extra work', that the impact failure to maintain housekeeping procedures is much greater than for single user systems.
Sanderson (1994)	Desktop videoconferencing in collaborative research: very limited adoption partially ascribed to a lack of real need for interactive communication outside meetings.
Spellman *et al* (1997)	CSCW in a large distributed software R&D organisation: factors in success included the need to interact frequently and rapidly.
Star and Ruhleder (1994)	Specialist shared information system for biologists: usage related to perceived usefulness of the information provided.
Tammaro *et al* (1997)	Collaborative writing tool for a geographically dispersed department: factors in partial uptake included differential extra work and benefits.
Tang *et al* (1994)	Communication tools applications for software engineers: factors affecting usage included both extra effort and extra benefits for those working in different buildings.
Whittaker (1996)	Lotus Notes at Lotus: usage in part depended on extent of competition from other communications media.

Table 2: **Ease of use** – as perceived by end-users, also perceived complexity

Authors	**CSCW case study summary**
Ackerman and Palen (1996)	Online collaborative help system: success could be partially attributed to its technical simplicity.
Grinter (1997a)	Software engineering: uptake of workflow tools related to perceived usability/convenience
Grudin and Palen (1995)	Shared diary applications: uptake partially attributed to improved usability
Moran *et al* (1996)	Meeting capture tools: importance of ease of use and understandable representations in uptake.
Sanderson (1994)	Desktop videoconferencing in collaborative research: very limited adoption partially ascribed to usability problems and a low degree of technical support.
Star and Ruhleder (1994)	Specialist shared information system for biologists: effects of usability and convenience of the application and the underlying operating system on usage.
Tang *et al* (1994)	Communication tools applications for software engineers: factors affecting usage included usability and robustness.
Tollmar *et al* (1996)	Support for social awareness in an HCI lab: reports the influence of usability and convenience on uptake.

Table 3: **Critical mass** – the participation of sufficient users to make use of the system worthwhile

Authors	**CSCW case study summary**
Grudin and Palen (1995)	Shared diary applications: initial usage predicated upon critical mass after which peer pressure may effectively enforce uptake.
Kraut *et al.* (1994)	Two competing video-based communication systems in a research lab: critical mass was the best explanation of why one system survived and the other did not.
Mosier and Tammaro (1997)	Group scheduling tools in a geographically distributed department: otherwise successful use limited by the difficulty of communicating with those not on the system.
Spellman *et al.* (1997)	CSCW in a large distributed software R&D organisation: success factors included overlapping teams such that most people used the tools and a core set of habitual users.
Tollmar *et al.*(1996)	Support for social awareness in an HCI lab: uptake restricted by the unavailability of the system outside the pilot group.
Whittaker (1996)	Lotus Notes at Lotus: critical mass, characterised as diversity of users and large databases, encouraged participation.

Table 4: **Compatibility** – the degree of 'organisational fit' between the new and old system in terms of working practice, values and needs.

Authors	**CSCW case study summary**
Ackerman (1994)	Organisational memory system for software engineers: reports a need to preserve the visible status of contributing experts.
Ackerman and Palen (1996)	Online collaborative help system: success partially attributed to 'social mechanisms in place for maintaining the sociality'.
Bardram (1997)	Co-working supported by hospital information systems: factors affecting use included ensuring tools supported existing practice and were integrated with existing IS systems.
Bowers (1994)	CSCW in a UK government computer agency: notes *inter alia*, that this depends on sensitivity to existing practice.
Grinter (1997b)	Review of CSCW workplace studies: among other factors in uptake, cites the preservation of status cues.
Harper and Carter (1994)	Support for collaboration between architects and engineers in a building project: observes that such ventures only work if collaboration is genuinely desired.
Moran *et al.* (1996)	Meeting capture tools: notes the importance of fit with existing practice.
Olson and Teasley (1996)	Collaborative technologies for distributed automotive design: reasons for partial adoption included the fact that not all tasks were supported by the tools.
Pankoke-Babatz & Syri (1997)	CSCW for distributed staff in government ministry: shared workspaces successful where the work was not highly prescribed or sequenced. Also a need for shared conventions.
Prinz and Kolvenbach (1996)	CSCW for distributed staff in government ministry: requirement for integration with paper documents, also the need for an evolutionary design and implementation process.
Tammaro *et al* (1997)	Collaborative writing tool for a geographically dispersed department: factors in partial uptake included support for both individual and group working and task complexity.
Tang and Isaacs (1993)	Videoconferencing for software engineers: liked by users because of its support for collaborative process, as contrasted with collaborative product.
Tang *et al* (1994)	Communication tools applications for software engineers: factors affecting usage included integration with existing tools and compatibility with existing privacy norms.

Table 5: **Innovativeness** of users

Bowers (1994)	CSCW in a UK government computer agency: a pronounced reluctance to experiment influenced uptake
Okamura *et al.* (1994)	Computer conferencing in an research and development laboratory: expert users both adapted the technology and influenced patterns of use.
Orlikowski and Gash (1994)	Lotus Notes in a management consultancy: individual willingness or otherwise to collaborate as a factor in uptake.
Sanderson (1994)	Desktop videoconferencing in collaborative research: very limited adoption partially ascribed to the individual attitudes, some users unwilling to explore new facilities.
Tammaro et al. (1997)	Collaborative writing tool for a geographically dispersed department: not strictly innovativeness, but disappointing uptake in part due to collaborativeness of individuals

Table 6: **Mandated**, **championed** or **discretionary** use

Bikson and Eveland (1996)	GDSS at the World Bank: factors influencing use include involvement of a high level champion.
Blythin *et al* (1997)	CSCW in banking: role of management support as a factor in partial success
Eveland *et al* (1994)	CSCW in academic departments: important role of local user experts or product champions in adoption.
Grudin and Palen (1995)	Observe that upper management advocacy is the key element in large scale adoption.
Hepsø (1997)	Shared work process information for an oil installation: Strong and committed management support a key factor in the success of the project.

Table 7: **Less reported evidence**

Authors	**CSCW case study summary**
Visibility – perceptions of the tools as visible and salient parts of the change process	
Bikson and Eveland (1996)	GDSS at the World Bank: factors influencing uptake included that the presentation of the new tools was explicitly as a pilot trial.
Demonstrability of results – the immediacy and tangibility of benefits achieved	
Bowers (1994)	CSCW in a UK government computer agency: the 'work to make the network work' was a major factor in adoption.
Moran *et al.* (1996)	Meeting capture tools: the provision of indexing tools was found to offer immediate advantage in the successful introduction of the system.
Tollmar *et al.* (1996)	Support for social awareness in an HCI lab: uptake was restricted by insufficient unambiguous information as to the whereabouts of co-workers.
User expectations – of the system and how it will affect everyday working life	
Grinter (1997b)	Review of CSCW workplace studies: among other factors in uptake, cites the influence of perceptions/expectations.
Harper (1996)	'Active badges' in research laboratories: factors affecting usage included perceptions of the badges as symbolic of organisational loyalties and commitment to the project itself.
Orlikowski and Gash (1994)	Lotus Notes in a management consultancy: differential uptake between stakeholder groups explained in terms of users' 'technological frames' or expectations of purpose.