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## Conceptual Misfits in Email-based Current-awareness Interaction

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**Abstract: Purpose** – This research aims to identify some requirements for supporting user interactions with electronic current-awareness alert systems based on data from a professional work environment.

**Design/methodology/approach** – Qualitative data was gathered using contextual inquiry observations with twenty-one workers at the London office of an international law firm. The analysis uses CASSM (‘Concept-based Analysis of Surface and Structural Misfits’), a usability evaluation method structured around identifying mismatches, or ‘misfits’, between user-concepts and concepts represented within a system.

**Findings** – Participants were frequently overwhelmed by email alerts, and a key requirement is to support efficient interaction. Several misfits which act as barriers to efficient reviewing and follow-on activities are demonstrated. These relate to a lack of representation of key user-concepts at the interface and/or within the system, including alert items and their properties, source documents, ‘back-story’, primary sources, content categorisations and user collections.

**Research limitations/implications** – Given these misfits we derive a set of requirements to improve the efficiency with which users can achieve key outcomes with current-awareness information as these occur within a professional work environment.

**Originality/value** – The findings will be of interest to current-awareness providers. The approach is relevant to information interaction researchers interested in deriving design requirements from naturalistic studies.

Keywords: Information seeking, monitoring, electronic alerts, user-study, CASSM, conceptual misfits

Classification: Research paper

### 1. Introduction

Studies of the information seeking and use practices of professional groups frequently demonstrate a richness and variety of methods used for obtaining information. Included within these is *monitoring* or *current-awareness monitoring*. Ellis (1989) defines *monitoring* as, “Maintaining awareness of developments in an area through regularly following particular sources” (p.177). Current-awareness monitoring is used for keeping up-to-date with latest developments, ideas, techniques and opportunities in a field. In professional contexts, current-awareness monitoring provides an important source of information for both supporting personal education and informing broader business development.

People use a range of methods for staying up-to-date. With the exponential growth in the volume and diversity of digital libraries, which increasingly meet the needs of professionals in a range of niche areas, electronic current-awareness alerting services represent a significant

monitoring resource. But despite the ubiquity of such services there have been almost no user-studies of their use (this is true for monitoring in general). Information seeking research has tended to focus on active information seeking scenarios in which information encounters are triggered by a change in a user's information needs—motivated by a developing problem at hand. In contrast, information encounters using current-awareness alerting services are triggered by the world changing and information being brought to the information-user according to relatively static characterisations of information need.

In this paper we report findings from a qualitative field study which looked at how users in a collaborative, professional work setting (the offices of large law firm) interacted with electronic alerting services. We focus on the use of email alerts (rather than RSS feeds) since this was the alert mechanism of choice among our users (only one participant used RSS feeds). Elsewhere we report findings which focus on collaboration surrounding current-awareness information in this setting (Attfield & Blandford, in press). In this paper we complement those earlier findings by looking in detail at interaction in the context of this collaboration and consider the appropriateness of the tools that participants used for achieving key tasks in a context of everyday use. From this we derive a set of requirements for systems supporting current-awareness alert distribution in a collaborative work setting.

We pay particular attention to the ease with which people are able to use current-awareness alerts in order to achieve work-related outcomes. In this sense the study can be related to Burke's notion of *information fulfilment* (Burke, 2009). Information fulfilment concerns the ease with which an individual can find information to support their work activities and the emotional fulfilment that arises from doing justice to work objectives as part of wider organisational endeavours.

The study is influenced by the observation that it has often been difficult to apply information seeking research findings to system design, and that to do so research needs to orient itself more towards information access technologies and work task contexts (Ingwersen & Järvelin, 2005). We make two proposals about addressing this: the first is to scope the object of research towards well-defined information seeking activities and particular kinds of supporting technology. The second is to employ methods designed to identify synergies and conflicts between the two as these occur in the context of use.

We apply an approach called CASSM ('Concept-based Analysis of Surface and Structural Misfits') (Blandford *et al.* 2008). CASSM is a usability evaluation method which assesses the quality of fit between the users' conceptual model of their domain of working and that implemented within the system they use. By providing a framework for explicitly comparing user and system, CASSM offers a method for identifying opportunities for improving design. This is done by identifying 'misfits' between user and system, which draw the analyst's attention to re-design possibilities.

Further, by attending to underlying concepts CASSM offers a way of addressing fundamental issues of system utility and conceptual design (Blandford *et al.* 2008). This contrasts with other usability evaluation methods which orient themselves around prototypical user-tasks or procedures in order to identify usability obstacles that the user might encounter (cf. Nielsen 1994; Wharton *et al.* 1994), and consequently can have a tendency to focus on low-level issues (e.g. Is the feedback helpful? Are labels appropriate?).

Previously, CASSM has been used to analyse a drawing tool (Connell *et al.*, 2003), a robotic arm (Blandford *et al.* 2008) and systems for supporting ambulance dispatch control room workers (Blandford *et al.*, 2002). We are interested in the application of the method to problems of information interaction, which to date has been limited to a study of library users' interactions with a digital library system (Blandford *et al.* 2008). Part of our motivation is to extend our understanding of the application of CASSM to information interaction.

The orientation of our research is interpretive and phenomenological. Rather than being guided by hypotheses structured around pre-defined dependent and independent variables, we use contextual inquiry interviews (Beyer & Holtzblatt, 1998) as a means of eliciting participants' own accounts of interaction and use these to analyse the concepts they find significant as an emergent property of, and as a means of making sense of that interaction. Interpretive research provides an opportunity for IS researchers to understand human thought and action in social and organisation contexts (Klein and Myers, 1999). Using this approach we consider the ways in which participants construct a part of their world relating to a particular interactive activity. We then use CASSM as theoretical lens for relating significant concepts back to entities represented within the systems they were using.

The paper is structured as follows. In section 2 we discuss background literature on monitoring and on CASSM. In section 3, we describe our data-gathering and analysis methods. We report our findings in section 4. In section 4.1, we provide context by summarising aspects of the collaborative context in which this interaction took place. In section 4.2, we describe a number of conceptual misfits between user, interface and system that were evident from our data. For the most part, we structure this in terms of two broad interaction activities: *reviewing alerts* and *follow-on*. In section 5, we discuss the implications of our findings in terms of alert system design requirements with a specific interest in collaborative work settings, and finish with some concluding remarks in section 6.

## 2. Background

### 2.1 Monitoring

Professionals need to stay up-to-date with developments in their field as a way of informing current and future practice. Current-awareness monitoring can give rise to both active and passive information-seeking (Bates, 2002). In a series of naturalistic studies aimed at understanding the range of information seeking behaviours of different professional groups, researchers have demonstrated the ubiquity of current-awareness monitoring among professional groups, including social scientists (Ellis, 1989; Meho and Tibbo, 2003), research physicists and research chemists (Ellis *et al.*, 1993), engineers and research scientists (Ellis and Haugan, 1997), and academic Lawyers (Makri *et al.*, 2008). These studies also indicate the wide range of methods and tools that professional groups use for staying up-to-date. These include: informal networks of contacts (i.e. colleagues, friends, students), attending conferences and reading proceedings, monitoring particular journals and monographs, scanning publishers' book lists, monitoring library accessions, periodic searching, regularly checking particular websites, subscribing to email alerts and listservs, reading newspapers, and even watching television (Ellis *et al.*, 1993). Ellis (1989) reported differing levels of attention being allocated to different channels dependent on a perceived likelihood of useful information. Makri *et al.* (2008) in particular draw attention to the significance of current-awareness monitoring for people working in the legal domain.

However, despite the importance and apparent ubiquity of current-awareness monitoring, it has attracted few user-studies in its own right. Studies of information seeking typically focus on issues that arise through the resolution of new information needs triggered by a problem at hand and leading to active information seeking (for legal domain examples see, Blomberg, Suchman and Trigg (1996); Yuan (1997); Marshall *et al.* (2001), Kuhlthau and Tama (2001)).

Of the few studies which have focussed on current-awareness monitoring, Fernandez (2002) reported a survey of cross-faculty researchers at a Canadian university. In an assessment of preferred monitoring methods they found a combination of *active* and *passive* methods with a preference for PubMed (the survey response rate from biology researchers was very high), scanning journal tables of contents, and subscribing to email alerts.

Hinze *et al.* (2006) identified a need for alerting systems that offer supporting background information in conjunction with current-awareness alerts. Based on findings from the healthcare domain they proposed an architecture for an alerting system build around a digital library that would provide relevant research for clinicians on the topic of an alert and educational materials for patients.

Finally, Farooq *et al.* (2007) explored the relationship between different kinds of trigger event and the preferred presentation of RSS alerts for a group of CiteSeer users. They found that presentation preference depended upon the query context (i.e. trigger event). For a feed that alerted users to papers that cited their own work, they wanted to see a title accompanied by the sentence(s) containing the citation(s); for feeds that alerted a user to papers corresponding to a defined topic or relating to their own work (but not referencing it), a title with an abstract summarising the paper were preferred.

These studies, and in particular Hinze *et al.* (2006) and Farooq *et al.* (2007), show that appropriate studies can lead to valuable user-requirements. Nevertheless the picture is patchy and more work is required. These studies also suggest that requirements may be specific to particular information domains and user groups. Both suggest the need for more research.

## 2.2 CASSM

CASSM previously went under the name of *Ontological Sketch Modelling* (OSM) (Connell *et al.* 2003). It was motivated by an apparent shortage of effective techniques for analysing systems as they are used within complex work settings and which translate findings into implementation requirements (Blandford *et al.* 2002). The term *ontological* referred to the idea of capturing the core essence, or nature, of a system in terms of concepts and relationships Blandford *et al.* (2004). The approach originated out of ERMIA (Green and Benyon, 1996), PUM (Young *et al.* 1989; Blandford & Young, 1996) and Cognitive Dimensions (CDs: Green, 1989; Green & Petre, 1996; Blackwell & Green 2003). As an approach to understanding the relationship between user and system, the CASSM framework was strongly informed by ETIT (Moran; 1983) and the Yoked State Spaces (YSS) (Payne *et al.* 1990). Each is concerned with comparing user and system representations of a given task, although ETIT and YSS were never codified into an evaluation methodology (Blandford *et al.* 2008).

CASSM is a usability evaluation method and modelling convention. It is based on the idea of identifying mismatches between the way users think about an activity and the representations implemented within a system for supporting that activity. Accordingly, it involves developing a semi-formal description of the users' conception of their work system, those that are represented by the system, and comparing the quality of fit between the two (Blandford *et al.*, 2002). The following example, taken from Blandford *et al.* 2008, demonstrates the idea of a conceptual misfit:

Imagine you are planning a journey to another continent. Let us say you live in York, England and are travelling to San Jose, California. One thing you need to do is book a flight. But where from, and where to? Is Leeds/Bradford or London a better choice? You much prefer direct flights, but when you select flights from anywhere in the UK to San Jose, they all involve transfers. You search for a US map that includes airport information; there appear to be three not far away from San Jose, but then you need to know their names, you need ground transportation information, and you still need to know whether you can fly there direct from the UK (and, if so, from which airport). An apparently simple task of booking a flight has become rather complex. This is an example of a conceptual misfit between what users require and what current flight booking websites

typically offer: sites work in terms of *flights between airports*; users work in terms of *journeys between places*.

Blandford *et al.* (2008) use this example to show that the identification of a misfit typically represents a design opportunity. A site that makes it easier to plan the journey as well as booking the flight (and possibly ground transportation too) could be more attractive to users. More generally, a user concept that is missing from the system representation indicates a possible design change. Notably the analysis doesn't dictate the precise form of the solution, but does make the case for a particular kind of solution.

A poor quality of fit between the conceptual scheme of a user, and the conceptual scheme offered by the system can occur in a number of ways. One way is for the user to have an inaccurate mental model of a system (Vicente, 1999). If so, the challenge is often in supporting users in acquiring a more accurate model (Blandford *et al.*, 2008). In other cases, a poor fit can occur because the system doesn't represent concepts (i.e. entities and attributes) that form an important part of the way users conceptualise what it is that they are doing when interacting with the system. In this case they may be forced to find longwinded and indirect work-arounds or they may simply not be able to do all the things they would like to do.

In the current paper we focus on the latter case. We orient our analysis around identifying concepts which we found to be significant for participants interacting with and collaborating around current-awareness alerts, yet which lacked adequate representation either at the system interface or within the system itself.

### **3. Method**

Data was gathered using contextual inquiry observations (Beyer & Holtzblatt, 1998) with twenty-one lawyers and knowledge management (KM) workers at the London office of an international law firm. Participants were recruited from the Real Estate and Dispute Resolution departments using a combination of general email requests and snowball sampling (Johnson, 1990).

Participants were asked in advance to allow current-awareness email alerts to accrue unopened in their inboxes for a period they found reasonable prior to an observation (usually about 1 day). At the beginning of each session they were asked to work through their current-awareness emails in the way that they normally would do. During contextual inquiry the researcher performs one-on-one observations with individual users as they work whilst simultaneously discussing their activity. Hence, the inquiry is structured by the activity being observed. The length of an observation depended on the time it took to work through the accrued emails and the time that the participant had available. Session lasted between 30 minutes and 1hr 15 minutes. All sessions were audio recorded and in one case a video recording of the user's computer screen was made. All participants were observed once except for one knowledge worker who took part in three sessions.

Since our aim was to consider the representation of the user's perspective on an activity within the system, the analysis focussed exclusively on eliciting user concepts (In a CASSM analysis it is also possible to consider concepts which are represented within a system which are redundant or unknown to the user.) Transcripts of the recordings were made and these were coded for core concepts. The coding and abstraction process was based on open coding as described by Strauss and Corbin (1998). In accordance with CASSM, user-concepts were then categorised as either entities or attributes of those entities. This distinction can not always be made in absolute terms, but the associations it provides help structure the analysis.

User-concepts were then considered in terms of their representation (or otherwise) at the user interface and within the system being used. The reason for making the distinction between

concepts represented at the interface and concepts additionally represented within the system is that a concept represented at the interface only may be sufficient if what the user requires is information. For full-blown interaction (i.e. changing system states) it is necessary for a concept to be represented within the system as well.

## 4. Findings

### 4.1 Interaction context

To provide some initial context we first describe the collaborative work-setting, the constraints under which participants worked, and outline some typical outcomes from participants' interactions with alerts. The collaborative work practices are reported in greater detail elsewhere (Attfield & Blandford, in press).

In the law firm we studied, staff received email alerts from numerous providers both within and outside the company. Alert content ranged from news and business information, technical legal information (e.g. legislation updates, legal judgements) and materials for performing standard functions (e.g. standard forms and practice notes). The content for each alert was determined by automated filtering expressions (i.e. queries) or hand selections made in accordance with pre-defined areas of interest (e.g. food safety, nuclear energy, insurance law) combined, in the case of in-house alerts, with rich conceptualisations of situational relevance.

The information that participants received via email alerts was used either to inform their own work or to communicate to others who they supported. The dissemination of current-awareness information around the company was primarily the responsibility of KM staff who produced bulletins and newsletters. Bulletins were essentially re-aggregations of incoming content with little or no editing. Newsletters might include more bespoke content such as articles written by KM staff on the basis of new developments. Both were circulated via email mailing lists. Beyond this, both KM staff and fee earning lawyers forwarded alert information on to individuals on an *ad hoc* basis. KM staff applied sometimes competing criteria to their decisions about what to pass on to others. These included questions of *recall* (maximising the amount of relevant information communicated), *precision* (minimising the amount of irrelevant information communicated) and *information quantity* (simply limiting the amount of information sent out).

The selection, re-aggregation and forwarding of current-awareness information gave rise to a complex distribution network of regular bulletins and newsletters. To illustrate this, figure 1 shows the part of the network as it involved participants in our study. Figure 1 represents regular alerts that people sent and received (ad hoc distribution is omitted). Study participants are represented by lettered squares. Regular updates are shown as numbered circles. Updates shown outside the main square are from outside the company; those inside the square were compiled in-house by KM staff. In the figure, current-awareness information moves from left to right. Lines coming into the left of each square (participant) show updates that a participant received. Lines coming out to the right show what that participant sent. Participants shown on the left (A to K) are KM workers, and hence are active re-distributors. Participants to the right (L to U) are fee-earning lawyers who performed case-work.

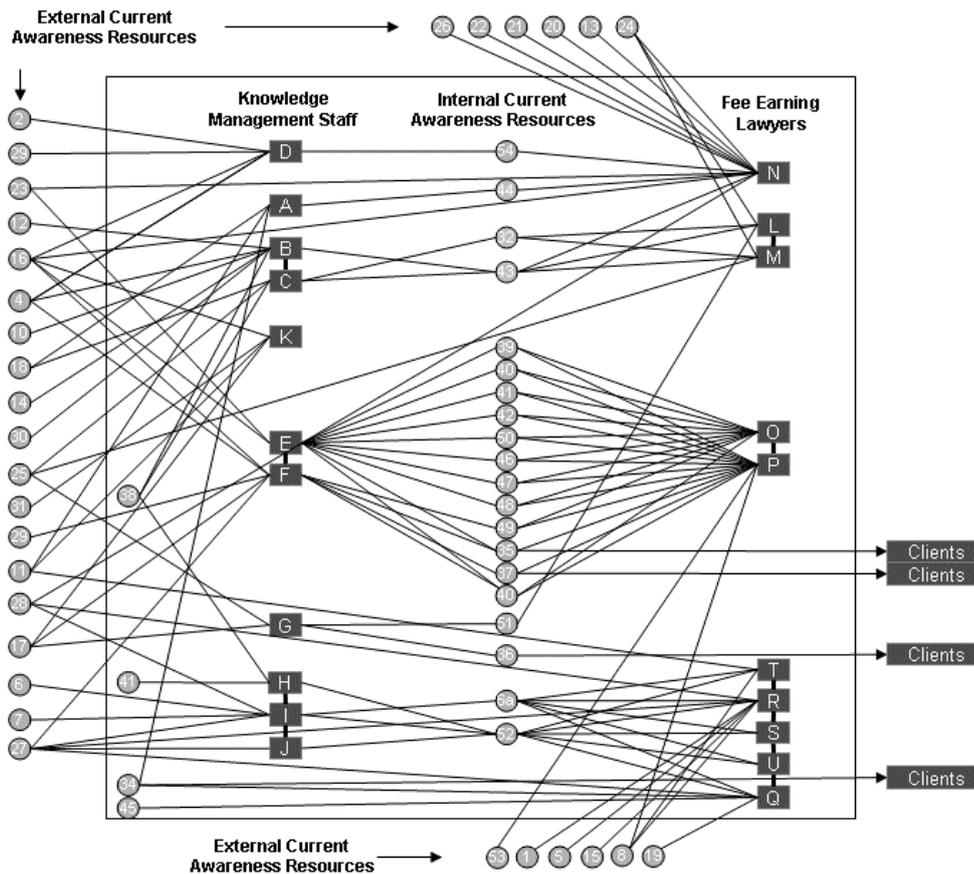


Figure 1. The distribution network of current-awareness updates received and sent by participants in the study as reported during the interviews.

Figure 1 illustrates the significance that the organisation placed on staying up-to-date and the role that email alerts played in this. However, participants frequently found themselves overwhelmed by the amount of current-awareness information they received. In the following extract Participant R expresses a view that was common among fee-earners,

R It's constant in the sense that I received, for example, all of these I have left in my inbox, my e-mails in relation to things I ought to know; news in relation to Real Estate and Property; I never have time to read those so leave them there in my inbox ((laughs)), but nevertheless I have to eventually look at them.

Related to this, accessing and reading electronic current-awareness information was extremely time-pressured. For fee earners in particular, interactions with current-awareness information were usually fleeting, intermittent and opportunistic. As one associate lawyer explained,

L So let's say if I was working on a case and I was at the stage where we instruct an expert, and I received this weekly e-mail and hypothetically speaking I had a spare ten minutes so I thought I'll have a look [...] very often you're not going to have time to look into these things because you're so busy...

To some extent, KM staff mitigated fee earner's information overload by filtering information and so reducing the time they had to spend reviewing information. Most KM staff said that they experienced information overload but saw this as an inevitable part of their role as "intelligent filters". This explains the function of internal bulletins and newsletters which

embodied the selection of information for specific audiences around the company. However, time constraints and the possibility of information overload were present for everybody. This has been observed in the health setting and one proposed solution is to improve personalisation (Hinze *et al.* 2006). However, given requirements for high recall, KM staff in our study preferred to be exposed to wide range of information, even if much of it turned out to be irrelevant. This then draws particular attention to the need for tools and information designs that enable users to process information quickly and with minimum effort.

From the perspective of participants in our study, reviewing an alert could have a number of outcomes. The first was learning; they might review an alert, learn of one or two significant developments in their area, and take no further action. Alternatively, an alert might provoke some kinds of follow-up action. For example, many participants saved content that might be of interest in the future in personal information collections. Many also set content aside for some more defined purpose, such as reading later or including in an internal bulletin or newsletter.

Having outlined the collaborative context we now focus on the CASSM analysis.

## 4.2 Conceptual misfits

For the purposes of the analysis we divide user activity into two major categories: *review* and *follow-on*. The former is concerned with the process of reading through an incoming alert; the latter is concerned with what might happen after that. This division provides a relatively clean separation between most concepts in the analysis, although some major concepts appear throughout.

Table 1 summarises the conceptual misfit analysis. It lists the core concepts and shows whether they were present or otherwise from the perspective of the user, the interface and the system. Recall that these are all user-concepts and so they are necessarily present for the user. In the table each row corresponds to a concept (numbered for reference in the text). Each concept is either an entity or an attribute of an entity (indicated 'E' and 'A' respectively in the left column). The *Concept (Entity/Attribute)* column gives the concept name (entities are left aligned and attributes are right aligned).

The next three columns (*User*, *UI*, *Sys*) correspond to the user, user interface and system respectively; they indicate the extent and nature of the representation of the concept in each.

- A concept is *present* (P) for the user if it is one the user recognises and understands and is relevant to the way they think about the task or activity.
- At the interface, a concept can be *present*, *absent* or *difficult* (D). A concept is present if it is clearly represented and absent if not. A concept is *difficult* if it is poorly represented and so difficult to work with. In a CASSM analysis this may mean that it is hard to interpret, its presentation is delayed or hidden, or it is unlikely to be discovered. Some concepts are indicated as both present and absent (P/A) or present and difficult (P/D). This is not standard CASSM notation but is used here to show differences across the alert services we observed in use. Participants received a range of alert services, each presenting information in a different way. This introduced some variation into the analysis, but had the benefit of allowing us to probe the effects of different presentational features on interaction.
- A concept can be *present* (P) or *absent* (A) within the system. A concept is present within the system if it can be affected through interaction (i.e. entities created or deleted, attribute set or changed). Representation at the interface is a necessary

condition of this, but not sufficient; hence it forms a separate column. Again, concepts which are shown both present and absent (P/A) reflect service variations.

	Concept (Entity/Attribute)	User	UI	Sys
1	E alert package (e.g. update, bulletin or newsletter)	P	P	P
2	E alert item	P	P	A
3	A location	P	D	A
4	A headline	P	P	A
5	A source	P	P	A
6	A doc. length	P	P/A	A
7	A doc. location in source	P	P/A	A
8	A % relevance to filter	P	P/A	P/A
9	A summary	P	D	A
10	A document	P	D	P/A
11	A back-story	P	D	P/A
12	A primary source	P	D	P/A
13	E content category	P	P	A
14	A categorisation dimension	P	P/A	A
15	E personal reference collection	P	P	P
16	E designated purpose collection	P	P	P
17	A collaborators	P	A	A

Table 1. A summary of the conceptual misfit analysis. This shows core concepts and whether they were present or otherwise from the perspective of the user, the interface and the system.

Next we elaborate the concepts in table 1 and describe the conceptual misfits as they affected user-interaction.

## Reviewing alerts

### *Alert package (1)*

The first entity in table 1 is *alert package*. Although this was not the subject of a mismatch *per se* (i.e. it was represented for the user, at the interface and within the system) it was a significant interaction concept which provides context for others that we discuss. An alert package is a published collection of current-awareness content. It is the ‘thing’ that is sent by the publisher to a subscriber. For users it encapsulates the notion of an ‘update’, ‘bulletin’ or ‘newsletter’ i.e. a collection of content within a single package. Although we show the alert package as a system entity, in truth the concept that the system ‘knew’ about was *emails*. However, given the simple mapping between *alert package* and *email* (i.e. emails made perfectly good alert packages), we do not draw a distinction between them.

Alerts presented the user with a series of *alert items* (2) each of which detailed a new development of some kind. Each alert item (discussed in more detail below) was typically a surrogate of a document (e.g. news report, case report or press release) and differentiated from others by space and text formatting. In this way, alerts resembled search engine results—which in some cases they were.

Time-permitting, participants looked through alert packages as they arrived or not long after. In each case interaction had a similar pattern broadly following an *iterative deepening* strategy. Where alerts were divided into sections users identified sections they wanted to review and those they felt they could ignore. Skimming headlines led to some being selected

for more focussed attention. This might involve attending to metadata or reading the item summary. Of these, some might be explored more deeply by source documents being retrieved or related information sought. In all cases, the outcome was to learn, make a decision about a follow-up activity (such as saving or forwarding), or both. In the case of learning, depth-wise exploration continued until enough had been learned, for example,

- P [Reading] “EDF Energy”, that’s a French owned company, and this is all about nuclear new-build which is something that the department does, but I am not doing personally, so having realised that it was about nuclear I might read it out of interest, I might read this summary here but I probably wouldn’t go on to request the article [...]

In the case of follow-up decisions, depth-wise exploration continued until a decision had been made.

- E Number four I'd have [for an internal climate change bulletin] [Reading] “New Forum to Channel Debate on Climate Change”. And it's a leading article as well, it's quite long. So I'd have that.

In applying CASSM, we are particularly interested in the ‘objects of interaction’ as seen from the perspective of the user and as represented at the interface and in the underlying system. One of the issues we return to below is that of the alert item as an interaction ‘object’. As a counterpoint to this, however, we note here the significance of the alert package as a focus for user conceptualisation. As aggregations of items, alert packages were seen as entities in their own right with an impact on how participants managed their time and how they related alert items to each other. Most participants treated their inboxes as to-do lists. They reviewed their inboxes for new emails to attend to and removed emails as they were dealt with. Hence, an email in an inbox represented something that needed action. In this context alert packages represented units of work alongside other items that required attention. When asked whether they would prefer alert items to appear individually in the inbox (given the need to manipulate them individually) participants felt that this would inundate the inbox, adding to their feelings of being overwhelmed by information and hiding other items needing attention. Also, items within a package might interrelate such that it was useful to consider them in the light of each other. As an Associate Lawyer said,

- C Actually, in a way, if they came in individually [...] I’m not sure that would necessarily help. [...] If you’ve got the situation where something’s come out from the FSA and at the same time, a couple of other relevant press releases have come out from other organisations, then you can make that connection. Whereas if each item is coming in separately, then you’re back to having to make that connection yourself.

#### *Item Headlines (4)*

Item headlines were particularly important for judging item relevance. Often headlines alone allowed users to extract sufficient gist to support learning and follow-up decisions. Consequently (and according to the iterative deepening strategy described above) reading the headline would often complete the interaction with a given item. For example, J said,

- J So this is interesting, I’ve never personally drafted a payment into and out of court document [...] they appear to have issued a practice note in respect of this. So what this [headline] tells me is that if I’m ever to come across payments into and out of court I know that PLC has information on it and that’s the place to go.

Headlines, then, were significant for users. As shown in table 1, they were also well represented at the interface, and so they did not give rise to a conceptual mismatch.

*Source (5), length (6), location in source (7) and % relevance to filter (8)*

Where users needed additional relevance indicators, particularly for judging whether to circulate items to colleagues, they sometimes considered attributes such as the source publication (5), the length of the article (6), and the location of the article in the source publication (7). And where alert content was the result of the application of an automated filter—percentage relevance to the filter terms (8). All of these attributes were used as proxies for the significance of the underlying article. For example, participant E said whilst triaging an alert for content suitable for her daily bulletin,

- E The headline is important. And which... well the source, there is a limited number of sources we're looking at, so The Telegraph I'd usually rank a bit lower than say The Times, The Independent, The Guardian and the FT. The FT I'd rank fairly high. [...] And then leading article, number of words and also these are very important [...] they rank how much the article is about a particular subject, but it's 92% about emissions, so it's very highly relevant to emission. And 90% climate change, very highly relevant to climate change.

Headline, source, length and location in source represent concepts significant to users and how they interacted with alert items. Headline and source were usually displayed (i.e. represented at the interface) but in many cases article length and location in source were not. Table 1 shows that all of these concepts were also absent from the system representation (see table 1). For the interaction in question, though, this wasn't important. Users didn't need to change these values in order to perform the review task. However, it was important that they were displayed at the interface in order that they could be used by the participant to make relevance decisions.

#### *Item Summary (9)*

To provide additional indication of content, alert items were usually accompanied by a small amount of summary text. These were often used for both gist learning and relevance judging. However, some summaries provided better support than others. Summaries that provided the first few sentences of a source article were considered helpful. As participant S said,

- S [...] it's like six lines of information which I think is quite concise; wouldn't really want any more than that

However, some automated alert services used Key Word in Context (KWIC) summaries. These displayed selected text extracts from the source document in which the user's filter terms appeared. These frustrated participants' efforts to understand the gist or the underlying article. As participant G said,

- G This is the worst tool [...] It chooses random sentences where a word comes up as opposed to choosing the first two or three lines of an article. Now in the first two or three lines of an article, as you're probably well aware, it should basically give you an overview of what's contained within that particular article. [...] it doesn't provide what I need, so I basically have to read most of the articles.

The summary concept was recognised by users and was useful to them. But by providing a poor content summary, Key Word in Context summaries caused users to iterate deeper in order to understand what an item was about. This extended the time and effort required to obtain the benefit that they wanted from an alert or in order to make any follow-up decisions. Where accessing a source document was problematic, a poor summary increased the chance that a KM worker would feel the need to guess item relevance.

#### *Document (10)*

A key concept associated with each alert item was the underlying article or *document*. Following the review of a document surrogate, a participant might access the source document for more information. Depending on the alert and the interaction it supported, this could be achieved in a number of ways. However, difficulties in accessing source documents frequently made this the stopping-point of interaction.

Part of the reason for this difficulty was the way in which source documents were associated with items in the underlying system model. Ideally, the association was made at the level of the respective item via a link at the document surrogate. However, some services connected documents at a different level of abstraction. Some associated source document containers with the alert package, making the link between item and source document indirect. For example, some alert packages came with source documents in an email attachment. From an iterative deepening perspective, once a user had identified a document they wanted to access from the item surrogate they would then have to open the attachment and navigate to the article they wanted to read. A variation of this was where alerts provided just a single hyperlink which launched an online version of the alert. After finding an item of interest in the alert, the users have to find the link at the top of the alert, launch the online version and then navigate again to the item of interest, and then select another link to the source document. This was particularly time-consuming in cases where the alert was long and the online representation multi-paged. Here participant G explains this long-winded process to the researcher and how instead he chooses to ignore the alert and revert to an equivalent online search,

G It's a long document and it's also very difficult to pick up the stuff that I want. [...] more often than not now I'll just run the searches myself rather than read the actual emails because it takes so much longer, I literally get piles of documents that high to read through. Then I have to tick them [physically] and then you have to go back into [digital library] and put the heading in to get the document out. Whereas in [service name] it was a click and here it is.

Res. So there's no link through there?

G Not through the individual items. Go through the full results online, create 752 results again. If you can pick the number out and go to the number that's fine, but it just seems to be an extra step that we shouldn't be taking as users. I'm all in favour of a one click result.

*Document*, then, was a significant user-concept naturally associated with an alert item. Hence in table 1 this is shown as an alert item attribute. However, this relationship was not represented in some alerts and so navigation to track down a document of choice was indirect and awkward.

#### *Back-story* (11)

Beyond source documents, interest in an item often extended to the *back-story*. The back-story is the wider, historical narrative of which an item forms one part. The back-story might be a government consultation, the drafting and negotiation of a new regulation or law, or a significant legal case. Items typically reported single events in these ongoing narratives which may extend over months or even years. Where a back-story was available this provide participants with a context which, if they were not already familiar, helped them to make sense of the latest development.

Where a development reported in an alert item was significant to a participants' work the back-story would often be significant and participants valued having an account of the available story, including history and future projections. Participant N explained,

N There might be some matters where some aspect of the case turns on a new regulation or a new rule and you can go back, "okay, let me know, I want to find out about how this regulation got to where it is and a directive or whatever, and what the intent was, different versions that it went through as it went through Parliament or Europe".

For some participants, exploring the back-story that provided the valuable learning opportunity. The value of the alert was to indicate a gap in the participant's knowledge rather

than to deliver useful content *per se*. In the following extract participant M discusses using Wikipedia to find out about the Alternative Investment Market (AIM) rules after finding mention of them in an alert,

- M I'm a huge fan of Wikipedia because I find that sends you on very interesting chains of enquiry, AIM, oh, what's AIM? Click. Sends you to another page, AIM is this, this is its history, this is its background, this is how it works, and you're like, "Oh, that's interesting." And then go back to the original piece and keep reading through.

Interest in the back-story was more common among junior lawyers. When asked, one young lawyer could not recall an alert ever providing her with information she found useful, but she estimated that around 10% indicated back-stories she wanted to explore further.

In some cases alerts provided users with access to the back-story by either providing access to overview documents or links to previous related news stories. This however was unusual.

#### *Primary source (12)*

Alert items and their source documents were informative, but typically they were secondary sources and not the origin of the development itself. If a development had particular significance for a participant's work, they might wish to consult or obtain the primary source. As participant L put it,

- L You're not going to say, "This is the law and I know it is because I've read it on [alert service]" [...] you would dig deeper and bring out the law report for that particular case, or if it was from a parliamentary consultation document or wherever it might be, you would go to the source document, basically, and refer to that.

The significance of a law report is that it is the ultimate authority for the judicial opinion on a case. An alert might announce the enactment of a new piece of legislation by a legislature, in which case the primary source would be the legislation itself.

#### *Content categories (13)*

Within the body of some alerts, content was divided into labelled categories (13) according to a classification dimension (14) chosen by the alert provider. Categories were used to separate content within an alert body and in some cases categories also appeared within a hyperlinked navigation block at the head of an alert from which the user could navigate down to one chosen section at a time. Participants found categories helpful as a support for visual filtering. In many cases they clearly associated different levels of interest with different category headings. For example, when viewing a hyperlinked navigation block a KM worker said,

- G And stuff of interest to ... well not to me but to my group would be 'arbitration', 'costs' we wouldn't be, and 'cost funding', 'damages' maybe, 'disclosure' yes, 'enforcement' yes, 'injunctive relief' yes [...], 'statements of case' probably not, and 'jurisdiction across borders' not at all.

Allowing the user to filter content categories could offer a time-saving device. They were perceived as particularly important for longer alerts and alerts which targeted a more diverse audience. Another KM worker said,

- H Where you're dealing with a wider audience that each person is likely to be interested in a smaller percentage then the more helpful it is to have a short summary list like that at the top.

However, not all classification schemes were equal and some were found to be positively frustrating. Compare the extracts above with comments made by H when reviewing an in-house, company-wide alert. H worked in Real Estate,

H Really, really annoying; partly because it's very long, the way it's divided up is not very helpful; the vast majority of it isn't relevant to me but there will be the odd thing [...] I've had to get all the way to the end, skim reading all of that because it's not divided into practice areas [...] a lot of it seems to be about Employment but [...] they've divided up purely by where they got it from, so Government Press Releases, Statutory Instruments, Official Publications, Cases [...] I don't care whether it's someone's case or not, all I want to know is whether it's to do with Property. [...] there could have been a list, like IP, Intellectual Property, Corporate Finance, Real Estate there could be nothing for Real Estate in which case I just delete it, or there could be Real Estate, I could have clicked and immediately got to that one tiny little thing that I actually wanted to see, but instead of that I've had to skim-read all of that to actually get to that one little thing.

H's comments draw attention to the influence that different kinds of information design can have on efficient reviewing and within this the specific effect of different kinds of categorisation. The problem arises due to a mismatch between a categorisation dimension on which the user is able to differentiate areas of interest and non-interest (14) and the categorisation dimension that has actually been used. H proposes using the dimension *practice area*; this is significant. Practice areas are a universal scheme for categorising expertise and specialisation in law. Lawyers and many other legal staff tend to specialise in one or maybe two practice areas (such as employment law, family law, criminal law etc.). H's practice is *property* and so she wants to quickly identify content that might be interesting to a property lawyer without having to look through all the rest. The use of an orthogonal, and for H, arbitrary dimension was as useful as no classification scheme at all.

In addition to representing the wrong dimension, another way in which a classification scheme could fail to be useful was where it was overly abstract. In the following participant J discusses an alert which used a three-way classification,

J I think it would be good to have a bit more there about what it is, I mean tell us what the "New Content" is. That's just useless. "Land Registration"... and a sort of one sentence. What is it? And ditto the "Planning".

Rather than there being a discernable mismatch (i.e. a lack of mapping) between the chosen dimension and one that the participant could use for discriminating areas of relevance, in this example the categories are overly abstract and so any mapping is inscrutable. One possible solution to this which users can find helpful is to intersperse otherwise abstract categories with underlying content so that the content helps disambiguate the meaning of the categories (Dumais et al., 2001). The following comment from R in response to a researcher question suggests that interspersing abstract category headings with headlines would be helpful,

Res It's a list of categories, "New Content", "Conveyancing Procedure", "Statutory Liabilities". [...] Does that affect how useful it is?

R Now that you mention it, it would be useful if we could have a sort of sub-heading in the first... like for example having all of these [indicates headlines] there [indicates category block]

Where the proportion of an alert relevant to individual recipients is low, category headings are a useful filtering tool. However, any advantage is lost if users are unable to map these to their own areas of interest and non-interest. This can arise either because the mapping fails, or it is unclear given the level of abstraction of the categorisation. In both, efficiency savings that may be offered in terms of the capacity to visually filtering content are lost.

## Follow-on

*The alert-item misfit*

Through the process of reviewing an alert one or more items might trigger some follow-on activity. Follow-on activities could include storing information for future reference, setting information aside for in-depth reading at a more convenient time, re-using content for creating internal newsletters and bulletins or forwarding chosen items to one or two colleagues. A misfit affecting all of these activities arose from the fact that within the system (email and email clients) alert items (2) were not represented as objects of interaction. Alert packages (i.e. emails) *were* represented and various interactions supported (creating, sending, reading, deleting etc.), but the system did not ‘know’ about alert items. Nevertheless, for users follow-on activities were predominantly oriented around the manipulation of alert items.

Typically, from the user’s perspective, follow-on activities involved the re-aggregation of alert items. For example, most participants created new collections of alert information. Two types of collection were created, which we refer to as *personal reference collections* (15) and *designated purpose collections* (16). *Personal reference collections* were used for archiving content for future use where characteristics and goals of the use situation were not yet known. Such collections could take the form of physical files of printed documents, but most often participants used email folders. Users often kept many such collections on different subjects. For example, one participant kept around 30 folders of alert information about a single Act of Parliament.

As suggested by the name, *designated purpose collections* were created to set information aside where the goals were in some way defined (e.g. reading later, including in an internal bulletin etc.). Email folders were also used for these collections, as were lists on pieces of paper and lists emailed between colleagues. Designated purpose collections had a shorter life-span (e.g. ‘for Friday’s bulletin’). Being identified with a specific purpose, their content also embodied decisions about task objectives.

From the users’ perspective, *personal reference collections* and *designated purpose collections* were collections of *items* selected from incoming alerts. However, alert items (2) were not represented as system objects and so could not be manipulated (e.g. moved and stored) directly (see table 1). This meant that re-aggregation was time-consuming. Participants overcame these difficulties in a number of ways:

- To store information in email folders (mapped to the users’ concept of a personal reference collection), they saved entire emails (alert packages) rather than just the items of interest. Consequently, more information was collected than was wanted with implications for how easy information could be re-located later.
- To send items to each other, they sent entire packages accompanied by a list to indicate items of interest.
- Re-aggregating information into a new alert (e.g. bulletins and newsletters) became a collaborative activity with a more senior member of staff making selections and communicating these (as a list) to a more junior member of staff who extracted the selected items and reformatted them into a new bulletin.

In addition to the impact this misfit had on the size of personal reference collections, it also had implications for how content was represented within them. The system did not ‘know’ about alert items but it did ‘know’ about emails. Consequently, collection content was represented as a set of emails (and their properties). However, the displayed email properties provided almost no indication to the users of item content. Subject lines were identical and emails were differentiated only by date of receipt. As a result, browsing was almost impossible and participants tended only to attempt known-item retrieval, and then only when they could recall the date of an item they wanted to see. As participant S said,

S I know it’s all in this folder here, so I can just go to my Know How and scroll through. [...] I would have to think when it was sent because this heading isn’t

very helpful; doesn't tell you much about it. I mean the only way I could differentiate one [...] from another is to look at the date, see when I received it.

To summarise, the alert item misfit, users wanted to 'break open' alert packages and interact with them at the level of alert items, and yet the lack of system-level representation of an alert item object made this more complex than it might have been.

#### *The designated purpose collection misfit*

Our final misfit concerns the collaborative use of *designated purpose collections*. Above we discussed how the alert item misfit created unnecessary work resulting in a distribution of labour in the construction of new bulletins. This meant that these collections needed to be shared artefacts. Whilst addressing the alert item misfit could potentially address this by making the construction of a new publishable aggregation a one-person task, there were other reasons for designated purpose collections to be shared. One of these was that the responsibility for the contribution of content for a given internal alert was sometimes distributed across multiple KM staff. This was done to enable greater recall, since two (or more) pairs of eyes may be better than one.

For this reason we have shown the concept *collaborators* (17) as an attribute of *designated purpose collection* (16) in table 1, since in the collaborative situation part of the way that participants conceptualised designated purpose collections was as shared artefacts. However, whilst this concept is present for users it was not represented within the system. They were unable to share email folders, and so this attribute is shown as absent from both interface and the system. To share collections, participants emailed item lists to each other with the result that local collections were un-synchronised and a synthesised master list was inaccessible to most collaborators.

This completes the identified misfits. Each draws attention to ways in which user activity is not fully supported. Often users work around these problems, but this introduces additional complexity and user-cost.

## **5. Implications for design**

We argued above that the value of a CASSM analysis is that it models both the user and the system and so assists the analyst in identifying design opportunities for improving system utility. In this section we use the misfits we have identified as a basis for a set of requirements for current-awareness alerting systems used within a setting like the one studied here. We begin however, with a general requirement.

*R1. Enable outcomes to be achieved efficiently.* In section 4.1 we outlined the collaborative work-setting within which the interactions we studied take place. Emerging from this is the effort that is committed to current-awareness distribution which in turn is testament to its importance. However, participants were frequently overwhelmed by information and experienced significant constraints on the time available to deal with it. Whilst potentially arguing for improved methods for content selection, this also provides the case for prioritising efficient interactions in support of key outcomes. Our analysis of conceptual misfits, and the requirements that follow, focus on design issues relevant to efficient interaction.

*R2. Use a categorisation dimension that maps to identifiable areas of interest and non-interest in the user-population.* The review strategy that users adopted was one of iterative deepening in which depth-wise exploration continued until learning or decision-making goals were satisfied. Content categories could support this by providing a visual filtering tool. This echoes findings by Dumais *et al.* (2001) who demonstrated efficiency advantages of categorised search results lists for known item retrieval tasks. What we additionally show is that whilst a useful categorisation scheme differentiates relevant from non-relevant information for the user, not all categorisation schemes will do this.

Alerting services route information from an evolving repository in response to relatively static information need profiles. We have shown elsewhere (Attfield and Blandford, in press) that participants in this context had some stable dimensions of interest relating to professional practice and others that varied according to changing case work. Categorisation dimensions should ideally map to stable areas of interest and non-interest within the user-population. One approach is to categorise in terms of specialisations within the user-population where these are known. Useful data might also be elicited using surveys designed to elicit levels of interest and disinterest in a range of categories derived from multiple, orthogonal dimensions and a range of levels of abstraction. More polarised expressions of interest would indicate categories that provide most discriminative power for a given user-population.

*R3. Where applicable, item surrogate titles should display headline, source, document length, location in source and relevance filters.* Item headlines were an important source of gist information in themselves and could support users in achieving outcomes (i.e. learning and/or follow-on relevance judgements). This can significantly reduce the time they needed to attend to a given item allowing the users to move on to the next item. When considering forwarding to others, document length, location in source and relevance filters (where applicable) provide useful relevance indicators and so should be made visible.

*R4. Use summaries that provide high-level overview of content (rather than KWIC).* Where additional information was wanted, users preferred summaries that provided content overviews. Key Word in Context summaries provided little indication of content and caused users to iterate deeper in order to achieve desired outcomes. Item summaries should aim to encapsulate the gist of underlying content.

*R5. Associate access routes to source documents with the alert items to which they pertain.* Accessing source documents was often an interaction stopping-point. One reason for this was that source documents were not always associated with item surrogates but were accessed via indirect routes (e.g. the intermediate representation of the alert package). Short paths should be provided between surrogate and document.

*R6. Provide easy access to alert back-stories.* Alert items have a back-story. This is the ongoing narrative of which they form part and which provides them with context. Users found access to the back-story informative and valuable. For junior staff, the back-story often provided the primary value with alert items having a secondary role of drawing attention to knowledge gaps. Access could be supported by associating each item with a document summarising the history and potentially the predicted future of an issue, or alternatively by associating an item with selected, past items on the topic.

*R7. Provide easy access to primary source documents.* Where a development was particularly significant to a user, the authority of the alert service itself was insufficient as a basis for professional practice. Consequently, access routes should be provided between secondary and relevant primary source documents. The nature of these may differ from profession to profession and alert item to alert item. In a legal context they typically include documents such as law reports, legislation and parliamentary consultation documents.

*R8. Give alert items system object status.* A common feature of follow-on activities was the manipulation of individual alert items, and in particular, the selection of items to add to collections and re-use in new internal alerts. However, alert items were not system objects and could not be manipulated directly in the way required—users could not simply select an item and add it to a collection, add it to a new alert or send it to a colleague. As a result users employed work-arounds, such as saving and sending entire alert packages (resulting in the collection and communication of more items than required). Where precise re-aggregation

was necessary (i.e. in constructing internal alerts) this was so work-intensive that it was distributed across multiple staff.

The lack of system status of alert items also had implications for how easy it was to re-find items in *personal reference collections*. For example, users may have benefited from interactive browsing structures based around item attributes such as content tags and headlines, and searches over particular fields such as headline, source and summary. But the lack of system representation of items meant that there was no representation of properties to be exploited in this way. A prerequisite of easy alert item manipulation and browsing structures based around item attributes is the representation of these as system objects.

*R9 Make designated purpose collections sharable.* Whilst requirement R8 might reduce the user-cost of content re-use in internal alerts, and in doing so reduce the need for a distribution of labour, there are other reasons why multiple users need to share designated purpose collections. One of these arises because of the distribution of responsibility for the contribution of content. Two pairs of eyes are better than one at finding good content (and, presumably, many are better than two). To support collaboration around collections they should be sharable.

## Conclusion

We have reported an interpretive qualitative study of electronic current-awareness interaction within a collaborative work-setting. In the interests of drawing implications for design we have employed data-gathering and analysis methods which engage with both the user and the system. By using a CASSM analysis we have compared significant aspects of the conceptual model of the user (as it emerges from the activities they perform) with concepts represented at the interface and within the system (i.e. the things that user's can interact with). This has enabled the identification of a set of requirements for a future system.

In the context of information overload and a general requirement for supporting efficient interaction, our findings point to the value of categorising content at the interface, but provide the additional requirement that, to be most effective, categories should map to polarised areas of interest and non-interest in a user-population. Requirements concerning the presentation of alert items include the display of headlines, document source, document length, location in source and relevance filters (where appropriate), and constraints on the use of summaries. Also, alert items often lead users to request further information. Easy access should be provided to source documents, 'back-story' and primary source documents. Our findings also point to the requirement of according system-object status to alert items. This arose from a need to support easy selection and manipulation for follow-on activities and to support the design of meaningful browsing mechanisms for subsequent re-finding. This last requirement poses the greatest challenge to email as the underlying system infrastructure for alert communication. If the unit of content significant to alert interaction is the *alert item*, then why not treat this as *the* unit of communicated information and abandon the alert package entirely? This, indeed, is the solution offered by systems based around RSS feeds. RSS feeds transmit content as RSS documents, each of which corresponds to an alert item; there is no alert *package* to speak of. Users then view documents aggregated from multiple feed providers within an RSS feed reader. Significantly, RSS feed readers support the manipulation of alert items and can in principle also offer ways of browsing based on item content. In this respect our findings argue in favour for RSS-based solutions.

However, our findings also provide arguments in favour of the alert package as a composite and intermediate unit of content (between providers, feeds or channels on the one hand and alert items on the other). The issue centres on the idea of an alert package as a unit of work, and relates to two complementary perspectives of interaction, which we will refer to as *user-as-recipient* and *user-as-distributor*. The *user-as-recipient* perspective concerns the user as

recipient not just of alert information but of information in general. Participants used their email inboxes as resources for monitoring incoming information. Incoming information represented work, whether this was simply reading or taking further action; inboxes were used as to-do lists. This contrasts with all other software in use (e.g. word-processors, spreadsheets, digital libraries etc.) since these depended on intervention by the user for changes to take place. In contrast, changes in the email inbox depended upon the outside world.

In this sense email inboxes evolved as a locus for passive monitoring, and offered a logical place for the receipt of current-awareness information. Increasing the number of places to be monitored would only increase the chance of missing something. As resources for task planning, however, atomisation of alerts in an inbox makes little sense since at this level the user-choices are at the level of activities rather than which alert item to read next. Hence the atomisation of alert packages into items at this level might obscure other inbox content, overwhelm the user and reduce the value of the inbox as a planning resource. Further, the prospect of missing connections between items within a given alert package argues in favour of presenting them as within single unit.

Considering the *user-as-distributor*, within the process of selecting and redistributing alert information, we observe that a *designated purpose collection* is used as the prototype for a new alert package. In addition to storing content, such a collection (sometimes in the form of a list) it represents a set of decisions about what to send to specific groups in the firm. However, decisions can be overridden over time and between collaborating partners during the publications process. One reason such revisions can occur is because of the constraint of information quantity and the aim of circulating only the top few relevant stories over a given period. The assessment of what these stories are cannot be made on an individual basis but requires some intermediate aggregated grouping in which each can be considered in the light of the others. Related to this, selection and review can be distributed across multiple, collaborating individuals, particularly where they have differing roles or levels of responsibility. In this case, proposals for circulation need to be retained and shared so that different people can look at them at different stages of generation. Hence, the alert package (which maps in this case to the designated purpose collection) offers a convenient unit of work within an evolving and collaborative publishing process. And so we conclude that in order to optimise interactions with current-awareness information it is important to support low-level manipulations on a per-alert-item basis, whilst also supporting a broader view in which alerts are aggregated into small collections which can act as a focus for work prioritisation.

We have shown that one of the major challenges in dealing with current-awareness information is its quantity. And so systems need to be designed to promote the efficient achievement of key user-outcomes. Based on a qualitative study, we have outlined a set of requirements specifically focussed on supporting efficient interaction in the context where such interaction naturally occurs. These focus on aspects of presentation of alerts and their underlying system architecture which both impact on the ease with which individuals and groups in a collaborative setting can obtain value from the electronic current-awareness information they receive. In particular, we have highlighted the need for both aggregation and separation of individual alerts to support the management of units of work around review and follow-on activities in current-awareness interaction.

The study concerns users collaborating around current-awareness alerts in a law firm. However, the user-concepts arising from our analysis are apparently domain independent (e.g. alert package, alert item, content category etc.). Consequently, we expect that the findings will generalise well to other time-pressured work situations in which people are collaborating around the distribution and use of current awareness alerts. As one example, the finding that users want access to an alert 'back-story' to provide context relates closely to the finding of

Hinze *et al.* (2006) that users in a medical domain had a need for supporting background information. This, in combination with the fact that monitoring current-awareness is a common need among many professional groups (*c.f.* Ellis, 1989; Meho and Tibbo, 2003; Ellis *et al.*, 1993; Ellis and Haugan, 1997), gives us confidence in the value of our results.

We anticipate that future studies might explore generalisability as well as identify new concepts. These may be interpretive and inductive in the style of the study presented here, and hence also open to observing new misfits in new domains and comparing the results to what we have reported here. Alternatively, the current study can form the basis for a number of predictions which relate the effects of different design variations to specific variables of user interaction, such as time and satisfaction. These predictions could form the basis for manipulations within studies adopting analytic-deductive methods. Such studies would provide opportunity to assess the reliability of our findings here, expand them, and so further improve our understanding of how to help busy users interact with current-awareness alerts in efficient and effective ways.

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