How local government policy workers use information: An interview study and design recommendations

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Abstract

Most information behaviour research focuses on information *seeking* and stops short of looking at what people do with information after they have found it. Furthermore, the information behaviour of local government policy workers has not been widely studied. We conducted semi-structured interviews with local government policy workers from UK local authorities and local government organisations. This was with the aim of examining how these policy workers use information to prepare documents. During the interviews, we asked the policy workers to demonstrate how they extracted information from source documents and how they made use of it. We found that the document preparation process involved three key phases: 1) information management (storing and recording information retrieved online for later use), 2) writing and editing (extracting information from source material and using it to support the writing process) and 3) review and sign-off (managing an iterative process of obtaining feedback from multiple stakeholders and making amendments). We discuss key challenges the interviewees faced during each of these phases and make recommendations for the design of future digital information environments aimed at providing holistic support for local government policy workers' information use behaviour.

Keywords: Information use; using information; design; digital information environments

1. Introduction

1.1 Research motivation

Most information behaviour research focuses on how people find information and *"often stops short of examining what people do with the information once it has been received"* (Bartlett & Toms, 2005, p.1). This makes information use the least studied aspect of information behaviour (Vakkari, 1997) – an area that has been *"mostly neglected in Human Information Behaviour research – particularly in comparison to research in information-seeking"* (Fidel 2012, p.4.). This may be because information use is a particularly complex aspect of information behaviour (Albright, 2010). Fidel (2012) notes that information use is such a complex process because it introduces new constraints, such as the scope and boundaries of the information considered 'useful,' the availability, the authority and credibility of the information and any time constraints in making use of the information (e.g. a writing deadline).

The complexity of information use should not, however, dissuade us from gaining a detailed understanding of this behaviour. We should therefore *"consider what happens with the information once it has been obtained, and how it is applied to accomplishing a specific task or goal"* (Bartlett & Toms, 2005, p. 1). Our study is motivated by the need to develop a more holistic understanding of information behaviour in order to inform the design of user-centred digital information environments that support people beyond information seeking (i.e. resources that also support information use). This is important because people seek information in order to use it in some way and the act of using information can inform their future seeking. Therefore information-seeking and use should be regarded as closely interrelated. However, most existing research does not take this holistic view. Similarly, most existing digital information environments are designed with a strong focus on supporting users in finding information (e.g. through search and browse functionality), but how the information is actually used is often overlooked (Kuhlthau and Tama, 2001). Furthermore, much existing theoretical work on information use (e.g. Wilson, 2000; Spink and Cole, 2006) considers information use in broad terms that does not directly inform design. This is presumably because this work was not undertaken with the purpose of resulting in design recommendations. The same can be said for existing empirical studies that have examined information use (see Auster and Choo, 1993; Byström and Järvelin, 1995; O'Hara et al., 2002). There is little existing research that shares our motivation of gaining a detailed understanding of information use behaviour and feeding this understanding into the design or improvement of digital information environments.

This study examines information use behaviour in a workplace context where 'information intensive work' (Kuhlthau and Tama, 2001) is carried out. Specifically, we examine how local government policy and scrutiny workers use information in their day-to-day activities. Gathering and using information is an essential part of much local government work. This is particularly true of the development of public policy, which is heavily based on research and evidence (Rich and Oh, 2000). Local government policy workers manage a great deal of complex information and use this information to create detailed policies and strategies. They have to maintain a constant awareness of a complex and ever-changing political, economic and social landscape and often not only have to plan for expected future developments, but also react to unforeseen circumstances. For example, some of the policy workers in our study had to write detailed briefings about the impact of a new government, based on the manifestos of the major political parties in the run up to the 2010 UK General Election. The briefings addressed every potential outcome of the election, including what effects a coalition government might have on local government policy. Local government policy workers' information use is strongly evidence-based and research-led, often involving the

construction of complex, persuasive arguments. Interpreting and using information is therefore an essential part of a policy worker's role. This makes the domain particularly fruitful for study when seeking to understand information use behaviour.

Our study examines the information behaviour exhibited by local government policy workers at each of the stages of document preparation – from managing source documents, to extracting useful information from them, to submitting documents for review and making amendments to them. This is with the aim of gaining a detailed understanding of the manual and computer-aided information behaviour involved in preparing documents. We then feed this understanding into recommendations for the design of future user-centred digital information environments that directly support the behaviour identified in our study.

1.2 How the rest of this paper is structured

We begin by reviewing some of the existing literature on information use, including existing studies of information needs and behaviour in a local government setting, existing models of information behaviour that incorporate information use and existing digital information environments that were designed to support information use. We then describe our interview methodology and present our findings related to the information use behaviours identified in our interviews. We also discuss our findings in relation to previous studies of information behaviour. Next, we present design recommendations for an integrated digital information environment that provides the potential to holistically support the information use behaviours we identified. Finally, we discuss the implications of our findings and design recommendations and make suggestions for future research.

2. Background

Although information use has not been widely studied, it is increasingly being acknowledged as an important part of information behaviour. Kuhlthau (2008), for example, states that *"information behaviour can only be understood within the context of how the information will be used"* (p. 71). Spink and Cole (2006) also advocate a holistic approach which encompasses "*the environmental factors of the human information condition to the moment where that information environment directly connects with the individual user in information use"* (p. 25). Information use has also been recognised as a highly important activity for knowledge organisations. Information use is important for organisations in order to facilitate the creation, sharing and dissemination of information – both internally and externally. Choo (1996; 2006) highlights that organisations use information in three main ways:

1. To make sense of changes in their environment. Choo highlights that the environment in which many organisations operate is often uncertain. Information use supports organisations in understanding current and potential future environmental changes and their impact or likely impact on the organisation.
2. To create new knowledge for innovation. Choo explains that organisational learning can occur through the creation of knowledge and that information use can spur creativity and, in turn, drive innovation.
3. To support decision-making. Choo states that decision-making in organisations is often not a rational process. However, using information to support decision-making allows organisations to rationalise their decisions (or project an image of rationality at the very least).

A detailed understanding of information use behaviour in a knowledge work context has the potential to help us understand how people create value from the information they find and, in turn, to assist us in considering how we can design digital information environments to help support them in doing so.

In this section, we review some of the existing literature that includes aspects of information use. We focus on studies of the information needs and behaviour of public policy-makers (particularly those few that were conducted in a local government context). We also discuss existing models of information behaviour that include aspects of information use and studies of existing digital information environments that support information use in some way.

2.1 Studies of information needs and behaviour of public policy-makers

Strachan and Rowlands (1997) reviewed existing research from the Library and Information Science and Policy Sciences literature on the information needs and seeking behaviour of public policy-makers. Many of the studies reviewed have examined and theorised about policy-makers' *propensity* to use information rather than the process and behaviours involved in making use of the information. For example, Badura and Waltz (1980) examined variables that influenced *"the demand for social science knowledge"* (p. 352) in the German Federal government. Also a number of authors have proposed models of factors that they claim influence policy-makers' propensity to use information (see Webber, 1987; Oh & Rich, 1996). Strachan and Rowlands (1997) also suggest a number of purposes for which information might be used by policy-makers (p. 67):

- To develop a general knowledge in a particular policy area (e.g. to create a niche political role);
- To help conceptualise and define issues;
- To gain recognition for successful programmes.

Strachan and Rowlands (1997) assert that *"whilst a number of studies have looked at the information that policy-makers trust, much less is known about their more general information-seeking habits"* (p. 67) and highlight the importance of identifying patterns of policy workers' information seeking and use (p. 72). Indeed, there are very few existing studies that have focused on policy-makers' information behaviour and even fewer that have examined their information *use* behaviour. There is also little existing work on the information use behaviour of local government workers in general (i.e. even including those workers whose jobs do not have a policy-making role).

One study which does highlight aspects of information use behaviour of local government workers is reported in Wilson (2003). This study, which was carried out in the 1970s, was not carried out with the explicit aim of understanding how these workers use information, but with the aim of gaining an understanding of the information needs of UK local authority services staff. Through a series of observations, Wilson identified a number of personal, work and organisational characteristics of the local government workers' information behaviour and some of these characteristics suggested the importance of information use for. Wilson found the workers relied heavily on personal collections of information, such as notebooks and personal files, and information was rarely updated in a systematic way (Wilson, 2003). One of the work-related characteristics identified by Wilson was the pressured and fragmented nature of a typical working day, with 75% of 'encounters' with documents lasting five minutes or less (Wilson, 2003). Wilson suggested the need for information services to support short, fragmented interactions by enabling the user to collect information and return to it later. Wilson also identified the need for office and personal files to be organised in a way that support internal communication. Although Wilson's study makes interesting suggestions for how information services might better support aspects of information use behaviour, this study is now almost four decades old. Workplace 'information services' (many of which are now provided through digital information environments) have changed significantly since the 1970s, suggesting the need for a fresh look at how local government workers use information.

In a more recent study, Byström (1997) examined the information needs and seeking behaviour of municipal administrators in two towns in Finland. These administrators had a role to *"prepare a given case for the decision-making organs of the town*" (p. 134). Byström was particularly interested in examining their needs and seeking behaviour in the context of task complexity. She found that most tasks undertaken by the administrators were routine and did not require specialist domain knowledge, commenting that *"it is usual that the task performers know from the beginning what information becomes necessary to complete the task in hand"* (p. 138). Whilst this study provides some insight into the information seeking behaviour of the municipal administrators, it was not conducted with the aim of examining how they *use* the information that they acquire.

In another recent study, Berryman (2008) investigated how public sector policy and research workers judged when they had obtained enough information. From the findings of a series of semi-structured interviews, Berryman constructed a rich description of the information use environment of these government workers. Typical information tasks were complex and ambiguous and often commenced with vague objectives. Sometimes all the policy workers knew was that they needed to find and use useful information to help them produce the document they were working on (e.g. a paper or report). The workers needed information to *"serve as authoritative evidence in their work"* (p. 121). This required them to draw upon and manage multiple sources of information whilst seeking this evidence. Whilst seeking information for specific tasks, they would also monitor their sources for updates that could be used in future work. The policy workers followed an iterative decision-making process, with drafts of created documents being passed between the policy worker and senior stakeholders. In particular, feedback was sought from colleagues and supervisors on how well they were achieving their information tasks.

Whilst Berryman's study provides a useful description of some aspects of information use in a public sector policy environment, it was carried out primarily to gain an understanding of the public sector workers' *decision-making processes* (concerning when they thought they had enough information). Indeed, we are unaware of any recent studies that have focused on understanding the information behaviour of local government policy workers or any studies at all that have focused directly on how these workers *make use* of the information that they find once they have made sense of it.

2.2 Existing models of information behaviour that include information use

Whilst we are unaware of any recent studies focusing on information use by local government policy workers, there is an increasing recognition of the importance information use as an important (and integral) component of information work. Whilst information use is outside the scope of most traditional models of information behaviour (such as those by Ellis, 1989; Sutcliffe & Ennis, 1998), several existing models *do* incorporate aspects of information use. In this section, we provide an overview of some of these models, focusing in particular on how they incorporate aspects of information use.

2.2.1 Blandford & Attfield's Information Journey

The information journey (Blandford & Attfield, 2010) is a descriptive model of the process of finding and making use of information. The journey first involves recognising a need for information – to solve a problem, feed in to a work-task or to help make a decision. Next, information is found that aims to address the need (for example, by searching or browsing for it using digital information environments, or by visiting physical information environments such as the library or a bookshop. Next, we make use of the information. This involves validating and interpreting it in light of the information need (which often makes us aware of deficiencies in our understanding or expression of that need, resulting in further information acquisition). It also involves making use of the interpretation we have made (to solve the

problem we were faced with, feed in to our work task or help us to make our decision). The information journey is shown in figure 1.

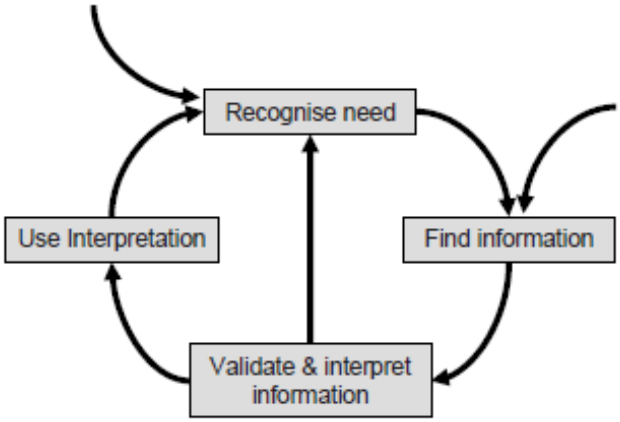

Figure 1: The information journey. Reprinted from Blandford & Attfield (2010) with permission.

The information journey highlights that information use cannot be fully or properly understood without researchers understanding the *context* in which the information is being used - i.e. who has found the information? And for what purpose? It is a model that facilitates understanding of the work context in which information is acquired and used and emphasises that information-seeking and use are strongly inter-linked; we often seek information in order to use it in some way and our reasons for wanting to use information drives us in seeking the information in the first place. This model motivated us to gain a detailed, contextual understanding of how local government policy workers made use of information for the purpose of writing policy and strategy documents.

2.2.2 Kuhlthau's Information Search Process model

Kuhlthau's Information Search Process (ISP) model (see Kuhlthau, 1991) focuses on the cognitive and affective aspects of information seeking. The model comprises six sequential stages:

- **Initiation** – becoming aware of the need for information to address a lack of understanding or knowledge.
- **Selection** – identifying the general subject to be investigated.
- **Exploration** – seeking relevant information.
- **Formulation** – focusing on specific ideas in the information found to form a clearer perspective.
- **Collection** – gathering relevant information, including making detailed notes.
- **Presentation** – completing the information seeking and using the results of the task.

The model was initially derived from a study of students and has since been verified with further empirical work, including a work-based study of a Securities Analyst (Kuhlthau, 1997; 1999). In the 'presentation' stage, the search is completed (for example by conducting summary searches where the information obtained had decreased in relevance and increased in redundancy – Kuhlthau, 1991, p. 386). Kuhlthau (1991) states that 'presentation' also involves preparing to *"present or otherwise use the findings"* (p. 368), suggesting that an element of information use is present in the model. Although Kuhlthau explains that 'presentation' involves reporting and using information found, she does not provide further detail about *how* the information that has been collected might be put to use.

2.2.3 Marchionini's process model

Like Kuhlthau's model, Marchionini's (1995) model is primarily a model of the information search process rather than of information use. However, the model touches on how information might be used post-search. According to Marchionini, the information-seeking process involves recognising and accepting an information problem, defining and understanding it, choosing a search system to use to address the problem, formulating a query, executing a search, examining the results and extracting information. This process is iterated as needed as a result of reflecting on the information that has been acquired.

It can be argued that it is at the 'extracting information' stage of Marchionini's model that some information use takes place. At this stage, as highlighted by Bartlett and Toms (2005), *"higher level conceptual skills that indicate how the information is **handled**"* (p.1) are required. Marchonini (1995) explains that these skills related to information extraction include "*reading, scanning, listening, classifying, copying, and storing information"* (p. 57). Marchionini also comments that *"information extraction often includes some physical action such as copying onto paper or another medium and saving those copies in larger structures…"* (p. 58).

2.2.4 Hughes et al.'s reflective online information use model

Hughes et al. (2006) created a 'reflective online information use model' based on their perceived need for a *"reflective and holistic approach to information use based on a deep understanding of the information use experience"* (p. 2). This model considers information seeking and use to be a *"dynamic and cyclical"* (p.4) process comprising of four non-linear phases:

1. **Plan** – *"developing a search strategy"* (p.6) to determine search terms and information sources.
2. **Act** – applying the strategy (i.e. conducting information retrieval).
3. **Record** – *"saving and organising the information found"* (p.6), including using bookmarks, downloading files and printing information.
4. **Reflect** – *"critically assessing the quality and relevance"* (p.6) of the information and the source.

Hughes et al. illustrate their model by describing how a student might tackle an assignment on the 'Republican debate' that surrounded the Australian referendum in 1999 on whether or not the country should become a republic. In the 'plan' stage the student might consider what information is required for the assignment, identify relevant search terms such as 'republic' and 'Australia' and determine an information strategy (e.g. to search Google with those terms, select relevant articles, print them and write-up). This stage involves information seeking rather than information use. In the 'act' stage, the student might conduct the search and scan through the results pages. This stage involves some interpretation of the search results, but still involves finding information rather than making use of it. The 'record' stage is where information use begins. Hughes et al. (2006) suggest that, at this stage, the student might bookmark several sites and print documents they deem to be relevant. In the 'reflect' stage, the student might check the documents found for currency, political bias and specificity (i.e. whether they provide general information or information specifically on the 'republican debate'). Upon reflection, the student might conduct further information seeking in order to find alternative documents that are more current, less politically biased and/or more specific.

2.2.5 Meho and Tibbo and Makri's extensions of Ellis's behavioural model

In the late 1980s and early 1990s, David Ellis proposed a behavioural model of information-seeking based on semi-structured interviews with social scientists, academic researchers and engineers (see Ellis, 1989; Ellis 1993; Ellis and Haugan, 1997). Meho and Tibbo (2003) decided to see whether the model still held in the 21st century now that much information-seeking has shifted from paper-based to electronic. Like Ellis, they conducted semi-structured interviews with social scientists and identified three behaviours that infer information use: 'information managing,' 'analysing' and 'synthesising'. Information managing refers to *"filing, archiving and organising information"* (Meho and Tibbo, 2003, p. 582) for future use. Whilst the authors did not define the 'analysing' and 'synthesising' behaviours, they suggest that both occur when processing information.

Makri et al (2008) and Makri (2009) reported on naturalistic observations of lawyers' information behaviour. We found that lawyers performed many of the information behaviours that Ellis included in his behavioural model of information-seeking (which was created based interview rather than on observational data). We also identified several new behaviours. Many of these behaviours were related to information use and served to broaden the scope of Ellis's behavioural model to include information use as well as information seeking behaviours.

The information use behaviours we identified in Makri (2009) included:

- **Analysing** – *"examining in detail the elements or structure of the content found during information seeking"* (p. 104). Whilst Makri (2009) found that most analysing behaviour was carried out 'in the head,' some lawyers spoke aloud whilst relating the information they had found to the legal problem at hand, whilst others made notes. Often these notes included *"lists of questions to be answered, issues to look out for or points to prove through reading particular content"* (p. 182).
- **Synthesising** – *"combining the elements of content found during information seeking into a coherent whole"* (p. 104). This was achieved by both manual and computer-aided methods, such as printing out documents deemed to be relevant to the task at hand, highlighting parts of the documents that were useful and copying and pasting parts of documents that were useful into a word processor document.
- **Recording** – *"making a record of resources or sources used, of documents or content found or of the query terms used or results returned in a search"* (p. 104). The lawyers often demonstrated recording behaviour by saving or bookmarking regularly used information sources and by saving, printing or e-mailing themselves copies of documents. Some lawyers also kept a 'trail' of the search queries they submitted and, occasionally, the results returned for each submitted query.
- **Collating** – *"the physical act of drawing together documents and/or content for later use"* (p. 104). The lawyers exhibited collating behaviour by printing groups of documents at the same time and by arranging printed versions of documents in paper folders (sometimes adding sticky tabs to denote that a particular page was useful).
- **Editing** – *"preparing and arranging documents and/or content for later use by making revisions or adaptations"* (p. 104). The lawyers usually achieved this behaviour by pasting content from documents they had found and deemed relevant into a word processor document.
- **Distributing** – *"handing or sharing out entire documents, particular content or search queries/results to others"* (p. 104). The lawyers achieved this behaviour by printing and manually distributing documents that had been found and deemed to be useful or, more usually, by e-mailing potentially useful documents to colleagues. Sometimes lawyers also distributed their search queries to colleagues who had asked them to carry out searches on their behalf.

Makri et al. (2008) make suggestions for how some of these behaviours can be better supported by digital information environments. For example, they suggest that digital law libraries might better support 'recording' behaviour by allowing users to add the information source related to the current document being viewed to a list of 'favourite' sources or to save their current search (which could later be re-run or edited). They also suggest that *"there is potential to provide better provision for tasks that border information-seeking and information-use by providing functionality to bridge the gap between the two*" (p. 632) and that this might be achieved by integrating functionality related to information use (such as the ability to select, highlight and annotate text within a document) into the information seeking environment.

2.2.6 Other models that incorporate aspects of information use

There are also other models that incorporate aspects of information use. For example Wilson (2000) developed a general model of information behaviour that includes information processing and use, which consists of *"the physical and mental acts involved in incorporating the information found into the person's existing knowledge base"* (Wilson, 2000, p. 50). Whilst the model is broad in nature, Wilson highlights specific activities as indicative of information use - such as *"marking sections in a text to note their importance or significance"* (p.50).

Similarly, Saracevic & Kantor (1997) developed an interactive model of information retrieval that was underpinned by the assumption that people search for information in order to use it. According to Saracevik & Kantor (1997), information use consists of three stages:

1. **Acquisition** – acquiring information related to some intentions (i.e. there has to be a reason for acquiring it).
2. **Cognition** – absorbing, understanding and integrating the information.
3. **Application** – using the information to address the intentions.

This model highlights that information behaviour does not stop at information-seeking; once we find information, it must be interpreted and applied to the work or problem at hand. Existing digital information environments have mainly focused on support information acquisition (i.e. supporting people in finding information by searching or browsing for it). Current environments currently only provide limited support for information cognition and application. This is a pity as these are cognitively demanding activities. While conventional wisdom might suggest that it is difficult to support activities such as these, which are primarily cognitive, technology has the potential to support cognition – making it easier to understand and apply information that has been found.

2.3 Existing digital information environments that support information use

As there have only been a handful of existing studies that have focused on information use in situ, it is unsurprising that there is not much existing work that has fed an understanding of how information is used into the design of digital information environments aimed at better supporting information use behaviour. There are, however, a handful of studies that have shared our motivation of understanding information use to inform design.

One of these studies was conducted by Komlodi and Soergel (2002). They examined how lawyers used their memory and externally-recorded search histories to support their use and re-use of information (which included future searches). Komlodi and Soergel proposed recommendations for the design of a digital 'search history' tool that records a history of a user's actions (such as search results and documents downloaded) and the relationships between them. Since their study was published, the search history tool has been

incorporated into Westlaw – a large digital law library. Komlodi and Soergel also propose that the search history tool should be integrated with other tools that support writing and and provide automatic linking between source documents and destination documents. They therefore advocate an integrated information seeking and use environment. Komlodi et al. (2007) also make a number of additional recommendations for the design of such an environment. Those related to information use include the provision of functionality to compare and combine result sets and to record relevance judgements to support the later re-finding of information. They suggest that upon deciding to save a document, *"a pop-up window with a relevance template can appear. The template can include such information as what task the document is relevant for, why, and how it will be used, possibly with pull-down menus showing customized pre-established categories"* (p. 27).

Another study, this time focusing on the information behaviour of newspaper journalists, was conducted by Simon Attfield (see Attfield & Dowell, 2003; Attfield, 2005; Attfield et al, 2008). Attfield and Dowell (2003) describe the process of finding, interpreting and using information in journalism as three phases – 'initiation,' 'preparation' and 'production.' These stages are constrained by both product constraints such as newsworthiness and deadlines and resource constraints such as topical knowledge and working memory). The initiation stage involves establishing an angle for a potential story. The preparation stage involves confirming the originality of the angle, developing a personal understanding of the story and both actively gathering and passively discovering potentially useful information for the story. The 'production' stage, where most information use occurs, involves managing multiple information sources. Attfield and Dowell (2003) found that the journalists often stored potentially useful information in personal collections and, whilst writing, needed to engage in extensive cross-referencing using this information. They found that journalists often split the screen between the word processor document of the story they were writing and the information source they were currently drawing on in order to write the story.

Based on his findings, Attfield developed and evaluated a prototype digital information environment for newspaper journalists called NewsHarvester that allowed them to search a news database and extract text from the full-text of documents into an integrated text editor. The resource automatically created a link between the extracted text and the source document it was taken from and clicking on the link took users back to the source document (this functionality was named 'Autolinks'). Attfield et al. (2007) note that Autolinks is similar to drag-and-link, which was later incorporated into the Microsoft OneNote planning and note-taking software. Attfield et al. (2007) explain that *"within the text editor, extracts can be retained and optionally annotated, edited, or incorporated into a new piece of writing"* (p.414). This integrated information seeking and writing interface allows journalists to organise information they have obtained and to work it up into a finished news story within a single interface. Attfield et al. (2007) evaluated the success of the digital resource by conducting a user study that compared the drag-and-link functionality present in NewsHarvester with more conventional methods of gathering information from source documents such as printing paper copies and using standard drag-and-drop. They found that users considered the drag-and-link functionality to be an easier method of gathering information from source documents than printing and that this functionality made it easier for users to re-locate information.

Buchanan et al. (2004) developed a spatial hypertext system called Garnet which presented search results in self-contained windows that could be moved around a virtual space. Within each window, search results (i.e. documents and metadata) were presented as a series of movable labels. Users could choose documents of interest and put them to one side in the space. Then, when further searches were conducted, Garnet would suggest documents that were related both to the current search and to the documents that were put to one side earlier. It can be argued that it is the ability to group documents of interest together in Garnet which supports information use.

Also focused on integrating aspects of information use into the digital search environment, Stelmaszewska et al. (2010) developed a visual search system called INVISQUE. When a search is conducted, results are displayed spatially – as a series of 'index cards.' These cards contain information about documents such as title, keywords, authors, journal and number of citations. The index cards are presented along two axes (which default to publication year along the horizontal axis and citation count on the vertical, but can be customised). The index cards can be moved into user-defined groupings, which can be altered as further searches are conducted. As with Garnet, it is INVISQUE's document grouping functionality which supports information use.

These studies share our ethos of gaining a detailed understanding of information use behaviour to inform design. They also demonstrate that existing digital information environments that support information seeking can be extended to support information use. This can be achieved through the provision of an integrated environment that regards both seeking and use as highly inter-related and therefore does not seek to artificially separate them by supporting one but not the other.

2.4 Summary of existing literature

Although there is existing literature on information use in various domains, there are still surprisingly few studies that focus explicitly on information use in specific work domains. This suggests the continued importance of recognising the use of information as an integral aspect of information behaviour and the need for studies that adopt information use, or aspects of it, as a specific focus. Similarly, few existing information behaviour models incorporate aspects of information use and, when they do, they often provide limited detail about what information use activities might entail. This suggests the need for existing models to adopt a broader scope where possible in order to model information use alongside information seeking. There is also potential for creating additional theoretical and empirically grounded models that focus specifically on information use. Finally, whilst there have been a few existing studies on the information use behaviour of local government policy workers and some in other domains that have sought to understand information use behaviour to inform the design of digital information environments, we are unaware of any work that intersects the two areas (i.e. studies of local government policy workers' information behaviour that aim to inform design). The study we report in this article seeks to address this research gap by providing a detailed understanding of the information use behaviour of local government policy workers and feeding this understanding into recommendations for the design of future digital information environments aimed at better supporting information use.

3. Method

Our study involved conducting semi-structured, face-to-face interviews with eleven local government policy workers. A Grounded Theory approach (see Corbin & Strauss, 2008) was used to collect and analyse the interview data and to identify patterns in how information was used to create detailed documents such as policy papers and scrutiny reports. The rest of this section describes our participants and recruitment process for our interview-based study, the interview structure and how we analysed the resultant data.

3.1 Participants and recruitment

The first author had several years of experience working in local government and identified members of policy and scrutiny teams as good candidates for studying information use in a local government context. These teams have to manage lots of information in order to keep

up to date with the political, economic and social developments that affect a local authority and its citizens. They also regularly use this information to write policy documents.

We recruited members of policy and scrutiny teams through an e-mail invitation which outlined the aims of our research and what the interview would involve. We specifically asked in our recruitment e-mail for people who had recently completed or were currently working on a publicly-available document to consider volunteering to be interviewed. We asked interviewees to provide this document to us beforehand, so we could ask focused questions on areas of information use related to producing their document. Potential interviewees were chosen from the first author's work contacts and contacts from a professional community of practice for local government policy workers. Interviewees were asked to forward the invitation to colleagues from both within and outside their organisation. This led to a snowball effect similar to that reported by Meho and Tibbo (2003), where interviewees suggested colleagues that might also be willing to be interviewed.

All interviewees signed a combined information and consent form prior to the interview. The form reiterated the details about the study included in the e-mail invitation. The form also reaffirmed that all data would be anonymised from the outset and stored/disseminated in accordance with the UK Data Protection Act 1998. The university departmental ethics committee granted permission to carry out the research.

We interviewed six female and five male local government policy workers who all worked in policy or combined policy and scrutiny teams and regularly produced written reports and briefings as part of their work. The nature of their work was to find and assimilate large amounts of information and reuse it in new and original pieces of writing. The interviewees worked in various specialist areas, including children's services, health and unemployment. Interviewees had between 1.5 and 10 years of experience working within the local government domain, and specifically working in policy teams. All interviewees were active information users and wrote several policy and strategy documents each month.

The aim of the study was to examine the range of information use behaviours exhibited across all interviewees and identify patterns that could help inform design. The interviews were carried out at the interviewee's workstation wherever possible (i.e. in order for us to avoid disturbing their colleagues). We considered it important to take a contextual approach to understanding information behaviour because, as noted by Fidel (2012), a study on information use *"that aims to arrive at context-free generelizations, would produce an incomplete understanding of the process, and may even lead to erroneous conclusions"* (p. 4).

3.2 Using previously created documents to facilitate discussion

As part of the recruitment process, each interviewee was asked to send a copy of a document they had recently written to the first author to enable him to ask questions surrounding the creation of the document during the interview. The documents were therefore used as 'springboards' to facilitate discussion of the information use behaviours involved in their creation. Interviewees were asked to send documents that were already in the public domain in order to ensure they were not breaching council confidentiality rules. The interviewees sent several types of document – briefings, strategy and policy papers, action plans, scrutiny committee reports and local profiles. All the documents served a different purpose but shared many common attributes:

- They were lengthy; all were over 30 A4 pages long, some were over 100 pages.
- They were created over an extended period of time (usually over several weeks, often over months).

- They addressed complex issues that rarely have a ‘correct’ answer and often involve many different service areas. For example, it is widely acknowledged that there is no single ‘right’ way to address healthcare as a social issue, and that it cannot be tackled by doctors alone. Local authorities address health through education, leisure and welfare programmes.
- Most of the documents were written with the aim of being persuasive - to influence key decision makers in order to change an existing was of doing things or implement new policy. To meet this aim, the documents included references both to academic research and to good practice from other local authorities. These references provided evidence to support the persuasive arguments.
- They used multiple sources of information, including government documents and national statistics.
- The documents were written to be politically neutral, even though much of the source information came from politically-motivated sources (such as the government). As a result, most of the source documents had to be heavily processed and interpreted.
- Most of the documents were open to public scrutiny and available to download from the council’s website.
- All of the documents followed a long process of review and amendments in order to be formally approved and ‘signed-off.’

Figure 2 provides a series of examples from local authority documents to illustrate the nature of the documents provided by the interviewees.

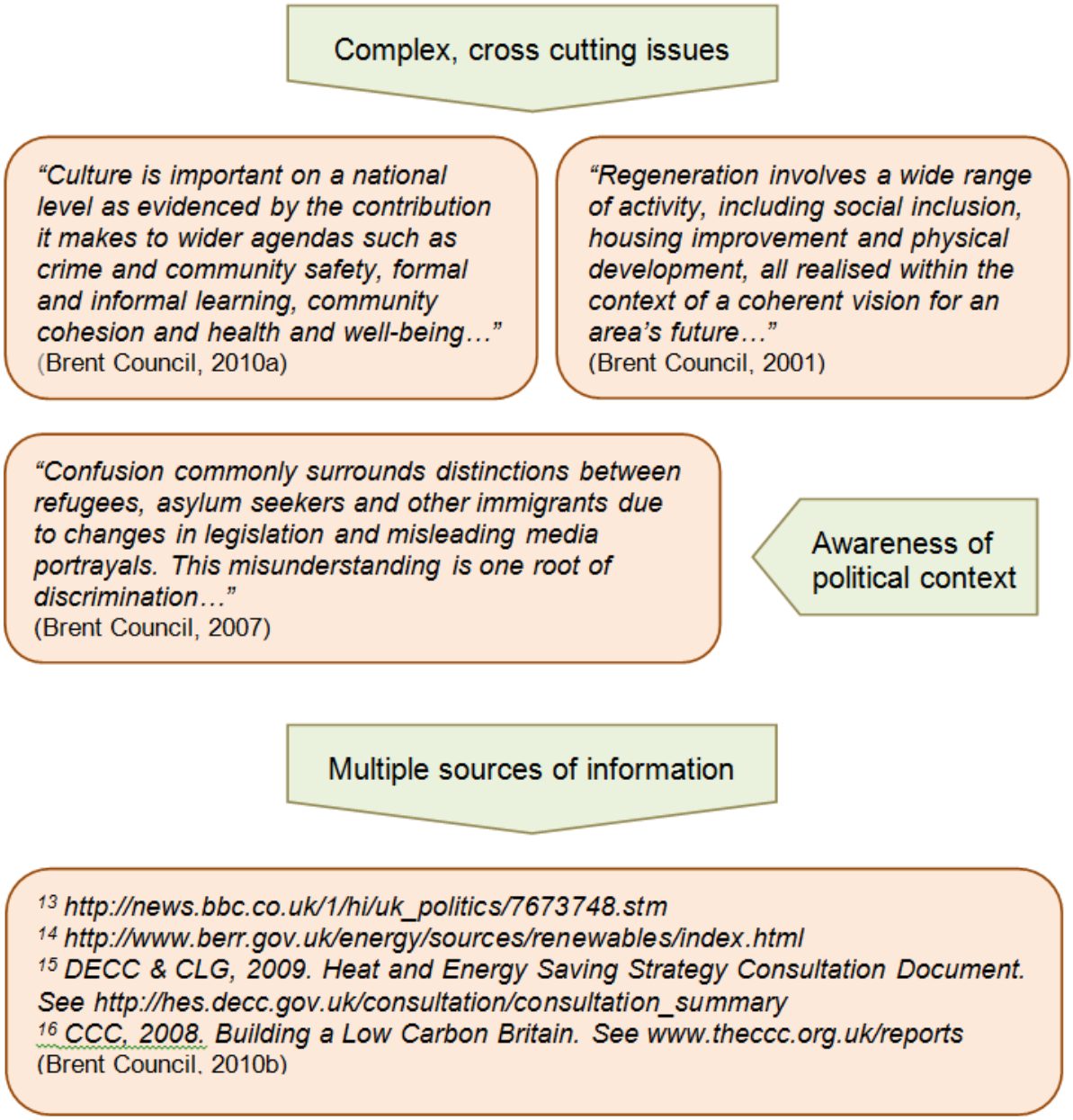

Figure 2: Examples illustrating the content typical of the sample documents used during the interviews. All extracts are taken from publically-available documents on the Brent Council website.

The researcher prepared for the interviews by identifying extracts from each document that suggested interesting aspects of information use, based on the researcher's experience in local government. Using domain expertise as a means to *"understand the significance of some things more quickly"* (p. 33) is an approach advocated by Corbin and Strauss (2008). However, great care was taken not to make assumptions about the source documents or how they were used.

3.3 Interview structure

The interviews were loosely structured and began by asking icebreaker questions about the interviewees' job role and how they divided their time between finding, interpreting and using information. In the remainder of the interview, participants were asked to describe the process of using information they had obtained to write new documents as part of their work.

This was achieved by making reference to the extracts we identified from the example document that the interviewee had sent us prior to the interview and asking questions about how they had extracted the information from source documents and used it in the document they had written. The broad areas of information use investigated through discussion of the example document included:

- How source documents was saved.
- How information was extracted from source documents.
- Whether and how notes were kept during research and writing.
- How documents are constructed.
- How source documents were referenced.
- How created documents were reviewed and approved for publication.
- Typical timescales involved in completing a document – from research through to writing and review.

We decided to ask only a few broad, open-ended questions in order to allow *"unanticipated statements and stories to emerge"* (Charmaz, 2006). We adopted a flexible interview approach, with the primary aim of gaining as rich an understanding as possible of the government workers' information use behaviour. Therefore the wording of questions differed across interviews and interesting or unusual comments by interviewees were followed up with additional questions. The first author's domain expertise meant that interviewees did not have to explain the context of examples being discussed. They could also freely use jargon and policy language, which helped to make them feel comfortable during the interviews. To help identify a broad range of information use behaviour, interviewees were asked to talk about several extracts from the document they had provided, with a focus on eliciting as much detail about their information use behaviour as possible. Where interviewees could not recall how they had extracted and used information related to a particular extract (e.g. when they had worked on the document some time ago), the researcher asked them to discuss a different example that could be readily remembered. This allowed us to strike a balance between identifying a broad range of information use behaviour and eliciting detail about the nature of this behaviour, without 'interrogating' interviewees (Charmaz, 2006). This approach also unearthed some of the motivation behind information use, including time pressure and organisational demands. Each interview lasted between 40 and 65 minutes and was audio recorded for transcription.

Where the interview was conducted at the interviewee's workstation, the interviewee was asked to demonstrate as much of the activities they were describing as possible. This helped to ensure that we understood the nature of their information use activities and that interviewees did not provide a description of their activities that was too abstract. We also obtained informed consent to photograph aspects of their use of digital information environments, including:

- File-naming conventions and the complex folder structures used to store electronic documents.
- How interviewees arranged documents on their screen to refer to source documents during the writing process.
- The types of annotations used during the writing process.

The photographs were used as reference to inform our design recommendations (discussed in section 5). Two of the interviewees who were not interviewed at their workstation were asked after the interview to provide screenshots to illustrate the digital information environments they had described during interview. We also sent e-mail follow-up questions to some interviewees in order to clarify some of the statements made during interview.

3.4 Interview analysis

The interviews were recorded using a digital voice recorder, and transcribed verbatim. Our data collection and analysis process followed many of the core principles of Grounded Theory (see Glaser and Strauss, 1967; Corbin and Strauss, 2008). Our process was 'grounded' in the sense that our findings emerged from 'listening' to the interview data. We also followed a process of 'constant comparison' – where we constantly compared data across interviews. In order to facilitate this process of constant comparison, each interview was transcribed as soon as possible to guide subsequent interviews.

Our coding process involved identifying patterns (or categories) of information use behaviour exhibited by the interviewees and seeing how the categories relate to one another. We did not undertake what Corbin and Strauss (2008) call 'integration' (also known as 'selective' or 'theoretical' coding) – the process of identifying a 'core' theme or element from the data. This was because our aim was not to generate a theory, but to identify patterns of behaviour. A similar data analysis approach has been followed by other researchers who have identified discrete information behaviours from interview and observational data (see Ellis, 1989; 1993; Ellis & Haugan, 1997; Meho & Tibbo, 2003; Makri et al., 2008; Makri, 2009). This approach, which effectively stops short of generating a theory, is recognised by Corbin and Strauss (2008), who highlight that theory development is not essential component of Grounded Theory.

4. Findings

Our interviews resulted in the identification of three broad phases of the process of preparing a local government document:

1. Information management.
2. Writing and editing.
   and
3. Review and sign-off.

Aside from stages in a process, these phases can also be considered as broad categories of information use behaviour. Each broad behaviour was achieved by our participants through a number of more narrowly-focused activities. During the 'information management' phase of document preparation, interviewees highlighted the importance of *personal file management* and of *note-taking*. During the 'writing and editing' phase, activities related to *extracting information from source documents* and *annotating documents* were discussed by interviewees. Finally, during the 'review and sign-off' phase, activities related to *managing feedback* from stakeholders and *managing document versions* were discussed.

During interview, interviewees also touched on activities related to the seeking and processing of information and these often provided a context for interviewees' information use behaviour. Indeed, information processing can be considered to lay on the boundary between information seeking and use. However, as our focus was on understanding information *use* rather than seeking in order to inform design, we do not discuss these activities in this article.

Although the review and sign-off process was often the final phase of creating a document, the behaviours identified were not hierarchical, linear or even discrete. In fact, the boundaries of the behavioural categories were often fluid, with many of the behaviours associated with information management, writing and editing occurring during the sign-off process. This is supported by our earlier work in Makri et al. (2009) where we found during an observational study that information behaviours *"are not entirely discrete (as certain*

behaviours can be facilitated through other behaviours or performed in parallel)" (p. 91). In spite of the fluid boundaries between categories, it was important to create a clear (albeit somewhat artificial) distinction between then in order to aid the presentation and analysis of our findings.

The remainder of this section describes each of the 3 phases of preparing documents in detail. Section 4.1 examines interviewees' information management - how they stored materials to make them easier to re-find when writing. Section 4.2 looks at how the interviews performed writing and editing (i.e. how they extracted information from source documents and used it in their writing). Finally, section 4.3 examines the review and sign-off process - the iterative process of obtaining feedback from stakeholders on documents that have been written.

4.1 Information management

Most of the projects discussed in the interviews took place over many weeks and shared a similar pattern – they involved intensive research at the start and writing only began when interviewees felt they had obtained enough information. Also, all interviewees worked on more than one project at a time. Therefore it was often necessary for local government policy workers to store information that they had found for later use. This was achieved through:

1. Personal file management.
2. Note taking.

Whilst they do not mention note taking, Meho and Tibbo (2003) identified personal file management (which they called 'information managing') as an important aspect of social scientists' information behaviour. The creation of personal information stores was also noted in the observation of social services workers conducted in the 1970s by Tom Wilson (and described in Wilson, 2003). We now discuss both personal file management and note taking and frame our discussion with example quotations from our interviewees.

4.1.1 Personal file management

Large, complicated and cross-cutting projects often resulted in intensive and unstructured information seeking. Interviewees often worked on projects with an unclear brief – with the aim of the project only becoming clear as a result of iterative information seeking and interpretation. This, in turn, necessitated the government workers to manage the project-related information they had found. Some interviewees hoarded information at the start of a project, often by saving local copies onto their computers – as explained by interviewee 8:

> P8: *I tend to stumble across documents in searches, which I don't have time to read at the time, but I will save them to a specific folder on my computer… I'll usually think 'I won't get into it now, I'll get to it while I'm writing the review'.*

One interviewee mentioned forgetting information downloaded during this intensive research phase, indicating a low *"reminding value"* (Jones et al., 2001):

> P10: *I'll bank it in a folder on my computer, in the shared drive, so that I can come back to it at some other point. I've often got loads and loads of things that I save away and actually never go back to it because I've forgotten it was there.*

Most interviewees had access to a shared network drive for storing files. However, they all created their own personal file structure, based around specific projects they were working on and did not expect anyone else to necessarily understand the naming and organisation

conventions used (a finding also noted by Hyams and Sellen, 2003, in their study of how knowledge workers organise their file structures). There was little commonality in the hierarchies or naming conventions used. Some had a deep folder structure (one interviewee had to click through several folders to re-find a document during a demonstration) whilst others had a much flatter folder structure with scores of files in each folder.

Interviewees 8, 9 and 10 worked in the same team but used the shared drive differently:

> P8: *We have a shared drive, but it's fair to say it's an under-used resource… I've got my own filing system, which is probably completely different from my colleagues.*
>
> P9: *We have a shared folder for the team – the idea being that colleagues can look at each other's documents if they need to. Within the shared folder, I have a main folder for each committee with lots of folders within them.*
>
> P10: *I have a committee folder and within that, a folder for formal committee meetings, and then another folder the individual projects, such as the member-led reviews. And within that, there is a series of sub folders which are labelled according to the source of the information. For example there's a folder labelled 'Accenture', because that's where I got one of the reports from.*

Interviewees found it difficult to create and maintain an intuitive file system because the scope of the projects they were working on (and therefore the nature of the information required) evolved over time. A file system that made perfect sense at the start of a project became chaotic as more source documents was added and draft documents and intermediary files were created:

> P2: *Sometimes an intuitive order will emerge after you've started creating documents. At the beginning, it may seem that this is the right structure to have, but towards the end it gets quite messy.*

As a result, long-serving colleagues were often the only people with a solid understanding of the file system:

> P3: *We often have to rely on colleagues that have worked here for a while… The shared drive is not a user-friendly way of accessing archived information, unless you've been here for a while and you know where everything is and what it's called.*

Makri (2009) found similar issues regarding the creation of file hierarchies in the legal domain. For example, a law lecturer mentioned that she found it difficult to manage her file system as her research evolved and that the structure became less and less workable as her research progressed.

Managing their file system during a project and beyond was an issue for most of the interviewees. To avoid interrupting the task they were undertaking, interviewees often 'dumped' source documents onto a shared drive or on their computer without giving much thought to how they might re-find them in the future:

> P2: *It was quite a lot of work to re-find the sources of information used from within my file system. But I think that was my fault for not being structured in the first place.*

Many interviewees wanted to review and clean up their folders on the shared drive but never found the time. When naming files, some interviewees changed the filenames of documents they downloaded so that the filename reflected the title of the document. This was in order to

make them easier to re-find and was particularly important when downloading documents from government websites where the filename had no discernable logical structure:

> P9: *When saving a Department of Health document, quite often you get some horrible bunch of numbers. So I'd rename the file to something simple. Sometimes there may be an interval between finding and saving the document into my files and then working off the saved document, so simple naming makes it easier to find the right file.*

Some interviewees had to manage multiple versions of the same file. For example, interviewee 2 manipulated the data from the same Excel file several times during a project. Each time she manipulated the data, she saved the file with a different name in order to keep the original version intact (naming the file with the current date or simply calling it 'b'). During demonstration, she struggled to find a specific document, opening several ambiguously-named files before locating the correct one.

4.1.2 Note taking

Paper notebooks were used by many of the interviewees to capture thoughts and ideas and to keep a record of new information that might be useful to a current project. For example, interviewee 10 kept a record of project-relevant information that he had seen on TV or heard on the radio. Some of the interviewees also used notebooks to manage their existing information. For example, interviewee 6 recorded the name of a file and where it was saved, along with notes to help her structure and write a document:

> P6: *When I save a file, I'll make a note about where I put it. And when I actually start writing the document, then I'll go back and refer to my notes… I'll use headings to remind me that a reference would be useful for a particular section I'm writing… So when I go back to writing the briefing, I can identify the useful sources right away.*

Recording the details about a source document and how to use it on paper was one of the most frequently used 'keeping' methods identified by Bruce et al. (2004) in a study of how people re-find information on the Web. The lawyers in the observational study by Makri (2009) also made hand-written notes to support their information work.

4.2 Writing and editing

During the writing and editing phase of preparing a document, the local government policy workers extracted information from source documents and applied it to their writing ('extracting' behaviour has been previously noted in several disciplines - see Ellis, 1989; 1993; Ellis & Haugan, 1997; Meho & Tibbo, 2003; Makri et al., 2008; Makri, 2009). There were two main patterns of behaviour within this phase:

1. Extracting information from source documents.
2. Annotating documents.

The behaviours demonstrated throughout this phase were not mutually exclusive and were dependent on the context of what the government workers were writing. The rest of this section will describe these behaviours in detail, including the context in which they occurred. We also briefly highlight situations in which these behaviours were avoided.

4.2.1 Extracting information from source documents

Interviewees extracted information from source documents in four different ways:

1. By copying and pasting information into their document.
2. By referring to printed source documents whilst writing.
3. By referring to electronic source documents whilst writing.
4. By temporarily copying information into a new word processor document.

We now discuss each of these ways that the local government workers used to extract information in turn.

Copying and pasting

Copying and pasting information into the document they were writing was a particularly common way of extracting information from source documents. Most interviewees re-used information that had already been published by their organisation. This information was perceived as trustworthy and was often used without further verification and without providing a reference. Citing external trusted sources was considered to be a way of avoiding contention, particularly when writing about topics of particular importance (such as budget cuts), as explained by this interviewee:

> P10: *I literally cut and pasted from the document because it could have been contentious if I had paraphrased it incorrectly. I wanted to make sure it was absolutely correct.*

Interviewees were more likely to copy and paste information when they were working on a project that was outside their area of expertise. The fast pace of change in all areas of public policy meant that interviewees frequently had to deal with new developments. Interviewee 8 for example, supported a scrutiny committee that reviewed the local authority's child services – a service area that has undergone significant changes over the last few years:

> P8: *What I'm writing about in this report is new ground to me, so I was careful to make sure that I was using the information accurately.*

Time pressure often dictated how much interviewees would copy and paste information. Most of the interviewees extracted large chunks of information by copying and pasting when it would have taken too long to re-type or paraphrase it. However, they generally only did this from sources they perceived as trustworthy. Interviewee 4, for example, extracted large chunks of information from the local authority's Joint Strategic Needs Assessment – a detailed document that describes the health and wellbeing of the local community (Department of Health, 2007).

Copy and paste was avoided when formatting difficulties arose (most interviewees, for example, had difficulty copying information from PDF documents):

> P10: *Formatting is one of the annoyances I face. When you're cutting and pasting information and you slot it into your document, for some reason everything goes all haywire. And you then spend ages trying to figure out why. I often get that with PDF documents.*

Consequently, many interviewees typed the information because it was often quicker than cleaning up the formatting. Some interviewees preferred to re-write text from source documents in their own words, even if it took much longer, as explained by this interviewee:

> P3: *It may be a slightly slower way of doing things, but I do that because I find I get constrained by existing content. Once I copy and paste something, my mind gets set on that sentence structure and I end up tinkering around with bits of detail that don't matter. So I prefer to reconstitute it from scratch.*

Copy and paste was also avoided when the local government workers needed to maintain political neutrality or to ensure their writing was appropriate for their audience. Several local authority officers in our studies commented that they were required to be politically neutral in their work and frequently had to remove political 'spin' from source documents to ensure their writing is unbiased. Interviewee 3, for example, regularly produced briefings for senior managers and councillors and avoided copying and pasting to ensure she interpreted the information before using it. She had seen briefings that had copied information directly from source documents and was wary of doing the same:

> P3: *In examples like that, you're just parroting – becoming a conduit for political messages. You have to know when you might be unconsciously parroting a political viewpoint that we as officers shouldn't be doing.*

Checking for political bias is highlighted as being important during the 'reflect' stage of the information use model by Hughes et al. (2006).

The policy workers also had to ensure their writing was appropriate for their audience. For example, interviewee 5 needed to provide information from containing scientific information about pollutants, but was aware that he was writing for a non-expert audience:

> P5: *The main documents that I'm looking at are aimed at people who are specialised in dealing with air quality management. So, doing big chunks of direct quotes is not necessarily going to be the best approach… I try to interpret the information, re-write it without changing the meaning, but maybe simplify it a bit to make it a bit easier to get through.*

Copy and paste was also avoided by some of the interviewees in order to mitigate the risk of unintended plagiarism. 'Copying' was described by Marchionini (1995) as one of the skills that can support the extraction of information.

Referring to printed source documents whilst writing

Most of the interviewees referred to printed source documents both in preparation for writing and during the writing process. This was especially important if the source document was going to be used heavily in the document currently under preparation:

> P3: *I had to read the entire document and had to know it pretty much inside out. I had to know the bits that were relevant and have an awareness of the bits that weren't relevant… it wasn't about a quick extraction of information – it was something that I needed to know in some detail.*

Some of the interviewees preferred working from paper rather than on-screen because it allowed them to better process the information:

> P8: *I tend to miss things when I'm reading on screen. If I print something off, I pick things up. For some reason, I just can't absorb as much information from the screen, as I can from a printed copy.*

This finding is similar to that of Makri et al. (2008), who found that many lawyers preferred to print documents and annotate the hardcopy because they found reading on screen to be difficult. A preference for reading hardcopy rather than on-screen versions of documents has also been noted in other studies of information behaviour (e.g. Hemminger et al., 2007).

Interviewees also mentioned referring to print sources because it was easier to annotate useful information than with electronic sources. Interviewee 5, for example, preferred making paper annotations even though he acknowledged it was often quicker to re-find information by searching within an electronic document. The importance of making paper annotations in the workplace whilst reading has been highlighted by several previous studies such as O'Hara and Sellen (1997) and Kawase et al. (2009). As the interviewee explains, he had tried to use commenting tools to annotate electronic documents but found them difficult to use:

> P5: *If I think I've found a particularly good document, then I do still sometimes print them off because I find it easier to go through and make notes. I sometimes use the comment feature in PDF and Word to make notes while I'm reading on screen. But I find sometimes that it makes such a mess of the document because you don't have much control about where the comment goes.*

This comment supports the assertion by O'Hara et al. (2002) that existing annotation tools do not have the *"sophisticated level of affordances seen in the fluid free-form markings on paper-based source documents"* (p. 300).

Interviewees annotated printed documents to help them re-find information later, often by highlighting key sections of text, marking paragraphs with asterisks and underlining text. Interviewee 5 indexed key sections of a long document with fluorescent yellow tags and made notes alongside paragraphs to help him quickly scan the document later.

Referring to electronic source documents whilst writing

As well as referring to printed documents, all bar one of our interviewees referred to *electronic* source documents whilst writing, mostly to aid in paraphrasing text. Interviewees referred to documents on-screen in 3 different ways:

1. By splitting the screen so they could see the source document whilst typing.
2. By following an iterative process of switching between the document under preparation and the source document.
3. By copying text from the source document and temporarily pasting it in the document under preparation in order to aid paraphrasing.

The first way of referring to electronic source documents involved dividing the screen between the source document and the word processor document they were creating in order to refer to the source and write at the same time. This approach was generally used when working with complex information that required detailed processing. Interviewee 11, for example, had to extract information about reasons for non-work migration from a detailed UK Office of National Statistics report. The report required a lot of interpretation in order to make sense of the information and apply it to the context of the local authority the interviewee worked for. Consequently, the interviewee wanted to be sure she did not misinterpret the source:

> P11: *I had to be quite careful about how I wrote that and how I worded it. I had the source document open behind and the Word document in a smaller screen in front. So while I was typing, I'd look back to the source document and think.*

Interviewee 3 demonstrated the same behaviour when paraphrasing or re-writing sentences. She maximised the source document and resized and moved her word processor document around the screen to see different parts of the source document without having to scroll again (see figure 3). Interviewee 4 did not like splitting the screen in this way because the Word document often became hidden under the source document and it took time to locate

the correct document in the taskbar. This problem was exacerbated when interviewees had several programs and files open at the same time (also illustrated in figure 3) and resulted in them often having to click on several files on the taskbar in order to locate the desired one, as described in the following quotation:

> P11: *Unless you remember what order the documents are in, you actually have to select each document and make it full screen to see if it's the one that you want.*

This problem was exacerbated when the Windows operating system stacked similar files into a single icon on the taskbar.

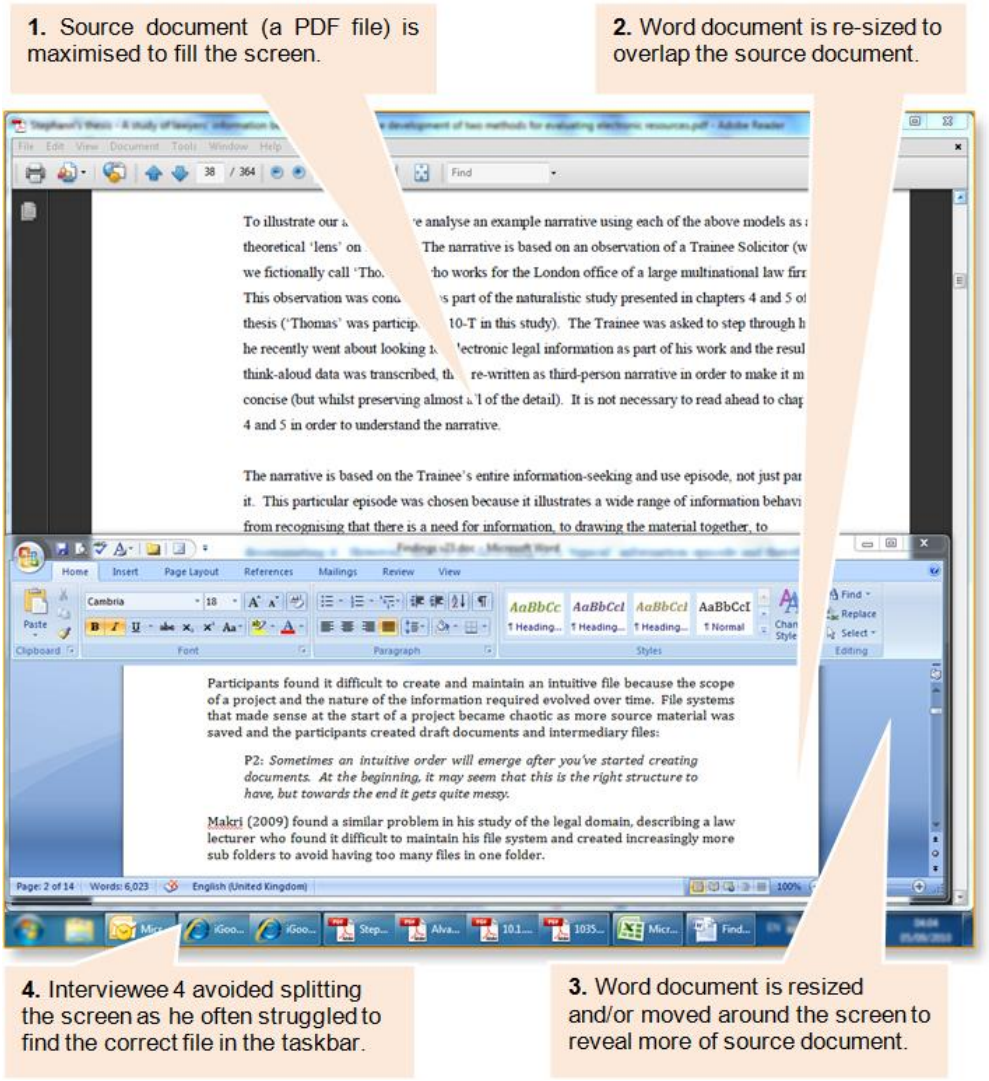

Figure 3: A mock-up illustrating how interviewees split the screen between the source documents and the document they were writing.

Temporarily copying information into a new word processor document

As with the study by Berryman (2008), our interviewees used multiple sources of complex information in their writing. Many adopted the strategy of copying and pasting often large amounts of text into a new, temporary word processor document, as explained by interviewee 3:

P3: *I created this temporary document when I was going through all the different documents on the Licensing Act… I used this document as a way of dumping together all the relevant information in one place.*

After the relevant text from source documents had been pasted into them, temporary documents were usually used as the main source to support the writing process. However, interviewees did not always include references to the documents the text was pasted from. This made it difficult when they wanted to re-find the information. As well as pasting text from source documents into a new word processor document, some interviewees temporarily pasted it directly into their working documents, as explained by interviewee 6:

P6: *I'll cut and paste the original information and then paraphrase underneath it so I can see the source information while I'm writing. So I will write what I think should be on there before I delete the original information from my document.*

4.2.2 Annotating

During the writing process, interviewees not only extracted relevant information from source documents (as described in the previous section) but also annotated documents - mostly as temporary signposts to avoid interrupting the flow of writing. The interviewees' priority was to capture their ideas quickly and efficiently, even if it meant writing incomplete sentences. Many of their annotations served as aide memoires to revisit the content. For example, interviewee 11 started her document with a series of incomplete sentences (which she highlighted using the electronic highlighter tool in Word to ensure she did not overlook them):

P11: *The sentence I'll highlight will be something like "Note: add in data from 2009"… Or I might be literally halfway through a sentence trying to explain something, and I'll highlight what I've written so far because I don't know how to finish that sentence yet and the highlight is a reminder to come back to it.*

Most interviewees created placeholder references to source documents to help them re-find the documents later whilst minimising disruption to the flow of writing. When interviewees did not reference source documents, they often found them difficult to re-find and had to systematically browse their file system or search for them again on Google. However, many of the interviewees had retrieved the source documents several weeks or months prior to writing and could not remember where they had saved them, what the filename was or how they found them on Google in the first place. Interviewee 4 avoided this issue by copying and pasting the title of source documents into his Word document as a placeholder reference so he could easily locate it again:

P4: *I try to make sure that the footnotes are at least good enough for me to find the document again. So with a PDF, I'll copy and paste the title of the document into the footnote so I can find it on Google again if I needed to.*

Each interviewee labelled the annotations they used in a different way. Interviewee 2 heavily annotated an early draft of a document she was working on. She had pasted information from different sources and organised it using broad headings and used annotations to add further structure. Her annotation system was highly systematised. In her annotation system:

- Bold indicated a key point and was used as a reminder to ensure it featured prominently in her write-up.
- Highlighting was used as a reminder to check the information had been used accurately.

- Placeholder text in block capitals indicated missing information that needed to be revisited.

She also inserted and highlighted 'XXXXX' at the end of a sentence she wanted to come back to, performing an internal search for 'xxx' to quickly locate each annotation. Shipman et al.'s (2003) study of law students found a similarly varied and idiosyncratic use of annotations. The law students annotated their documents for several reasons, including to emphasise particular text or to prompt an action.

Whilst most annotations were used as a tool to support-self communication, interviewee 4 also used annotations in an early draft of a document she was writing to communicate directly with stakeholders (who would be reviewing the draft):

> P4: *It's a holding note, letting them know that I'll be putting some more information in. I had a deadline to do the draft of this document by a certain time and both of the areas I've annotated were a major piece of work, which would have taken me well beyond the deadline.*

This interviewee highlighted incomplete sentences in yellow and used block capitals to indicate where he was going to add further detail. He described the meaning and location of the annotations in a covering e-mail, which he sent to the stakeholders.

4.3 Review and sign-off

Almost all of the interviewees followed a rigorous and iterative sign-off process because the documents they were writing would be publically available and any errors could adversely affect the reputation of the local government organisation. As explained by one of our interviewees, a significant error in the document could lead to repercussions for the author and for the organisation as a whole:

> P1: *Everything in the document is checked quite obsessively… When it goes out in the public domain, if somebody finds a mistake in it, they'll tell everybody else. It tends to de-value everything else – they ignore everything else and just focus on the mistake you've made.*

The sign-off process almost always involved several people (including internal and external stakeholders). The interviewee obtained feedback through a combination of face-to-face meetings, telephone discussions and by circulating the document via e-mail. The sign-off process for the scrutiny committee reviews involved consulting councillors with varying levels of expertise on the subject of the review. The interviewees faced two main challenges during the sign-off process:

1. Managing feedback from multiple stakeholders.
2. Managing multiple versions of the document under review.

As with the study by Berryman (2008), our interviewees often obtained feedback from multiple stakeholders. In a study on the use of annotations when performing asynchronous collaborative writing tasks such as those identified in our study, Weng and Gennari (2004) found that writers and editors found communicating and making amendments to documents to often be problematic. Problems arose because communication often took place using multiple communication channels (e-mail, telephone, face-to-face meetings), it was difficult to follow changes through the different versions of the document, there were often conflicting suggestions and electronic annotation tools were often inadequate (resulting in comments often being sent in an e-mail). Our interviewees faced similar problems, which we discuss in this section under the headings of 'feedback management' and 'version management.'

4.3.1 Feedback management

Most interviewees preferred to discuss amendments in face-to-face meetings as they enabled the interviewees to direct stakeholders to comment on specific areas of content:

> P9: *I find when I'm sitting in a group looking at a particular paragraph that somebody feels isn't quite right, quite often in that face-to-face discussion, you'll come up with the right wording. But when you try and do the same thing electronically, it's more likely that you're going to get a vague answer like 'I think this needs to be said better'.*

However, it was rarely possible to get all stakeholders to meet for each iteration of the sign-off process. Consequently, the interviewees had to manage several methods of obtaining feedback:

> P6: D*ifferent stakeholders use different methods because some don't know how to use the different functionality. Some people use track changes. Some people add comments...Some people will send you an e-mail saying 'On page xxx…'. We have lots of different ways of suggesting changes. I did have one person who actually printed it off, wrote their bits on it and sent it in the internal mail.*

Supporting the findings of Weng and Gennari (2004), our interviewees also found electronic commenting and change-tracking tools to be inadequate. Interviewee 9, for example, suggested that some people found it difficult to provide useful comments using existing tools:

P9: The problem with track changes is that some people might come up with a good piece of re-wording – they know what they want to say and how they want to say it. Other people, including me sometimes, are not going to find the right words, but what they do know is that 'this report ought to say something more strongly than it does'.

Some interviewees received feedback through annotations made directly to the body of the document text. Often, stakeholders highlighted sections of text and described the changes to be made in an e-mail. Occasionally, stakeholders made amendments directly to the text. Some of the interviewees also added annotations in the body of the document to prompt stakeholders to comment on specific areas. As part of the iterative review process, interviewee 10 implemented or rejected each round of amendments proposed by stakeholders before circulating an updated version of the document. When he received conflicting or controversial amendments, he included the proposed change alongside the original text in red text and added a commentary about whether or not he thought the proposed change should be accepted. The stakeholders were then asked to provide their comments.

Interviewee 2 used the 'track changes' feature in Microsoft Work and then made manual annotations within the body of the document. In one example, she indicated 'moving' a section of text to a different location on the same page by copying the text into the new position using a green font colour and formatted the original location of the text with a double strikethrough (see figure 4).

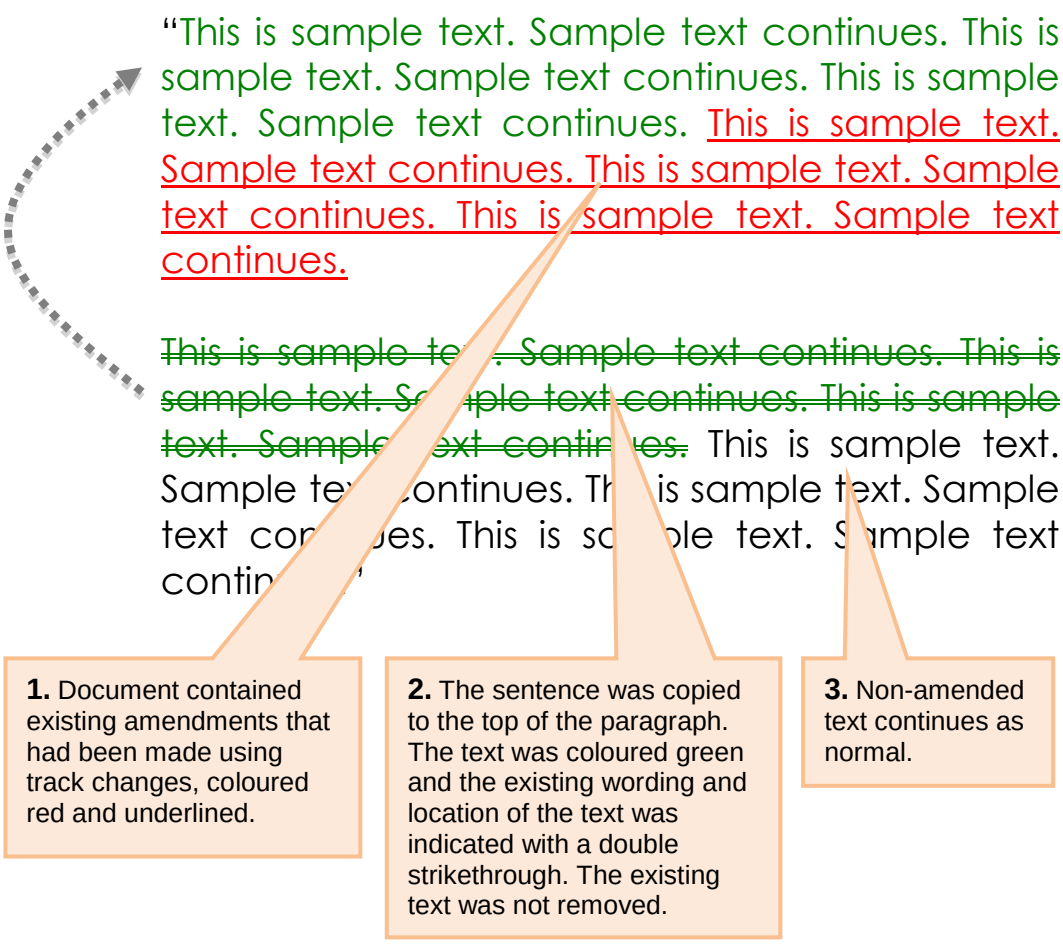

Figure 4: Illustration showing how interviewee 2 used manual annotations in a document that already contained some tracked changes.

4.3.2 Version management

Managing versions of the documents they had created and circulated was also found to be a challenge by interviewees because the review and sign-off process was iterative and often involved numerous stakeholders. Furthermore, it was often necessary to amalgamate amendments that were proposed electronically and handwritten amendments made on paper during face-to-face meetings.

One way of managing version control was discussed by interviewee 6, who wrote documents using a Microsoft Word template with a blank field for the version number. This allowed the version number to be manually inserted following each round of amendments (i.e. before circulating the document for further comments):

> P6: *Because I was controlling this document, it was fine. We want to make sure other teams are putting in the version number when they're writing their own documents. But they won't necessarily do it.*

4.4 Summary of findings

The local government policy workers in our study reported and exhibited a variety of different information use behaviours during the three phases of document preparation that we

identified (information management, writing and editing and review and sign-off). These behaviours ranged from those related to storing and re-finding documents such as personal file-management, to those related to writing documents (e.g. extracting information from source documents, note taking and annotating) to behaviours related to document collaboration (e.g. feedback and version management). These behaviours were motivated by the need to make source documents easier to re-find, to extract information efficiently and accurately from source documents, to avoid breaking the flow of writing and to gather efficient iterative feedback from multiple stakeholders.

In the next section, and based on the findings we have just discussed, we present recommendations for the design of integrated digital information environments that provide holistic support for local government policy workers' information use behaviour.

5. Design recommendations

The information use behaviours we have discussed fall into three broad categories relating to the stages of the document preparation process: file management, writing and editing, and review and sign-off. The behaviours we identified were neither hierarchical nor linear and the boundary between the stages of the document preparation process was fluid. Therefore we propose a holistic approach to the design of digital information environments that aim to better support these behaviours. We follow in the footsteps of Komlodi and Soergel (2002) and Attfield (2005) and propose an 'integrated environment' aimed at supporting a broad range of information use behaviours and allowing users to seamlessly switch between information seeking, processing and use. This type of integrated environment has been advocated by previous information researchers (e.g. Twidale, et al., 2008). Such an environment recognises that information seeking and use are intrinsically linked and therefore should not be artificially separated in the design of digital information environments.

In this section, we make a number of design recommendations for how integrated information seeking and use environments might holistically support the information use behaviour identified in our study. We make design recommendations related to each of the three phases of preparing a document that we identified – managing information, writing and editing and review and sign-off.

5.1 Overview of design recommendations

In order to provide holistic support for the types of information use behaviour identified in our study, we suggest that future digital information environments might provide users with functionality that allows them to:

1. Manage and re-find source documents by linking them to the document being written, by indexing source as well as authored documents and by allowing them to be tagged, highlighted, annotated and searched.
2. Easily refer to source documents to facilitate efficient information extraction by presenting the documents within an integrated information seeking and use interface.
3. Focus on uninterrupted writing by allowing them to view source documents within the integrated interface, automatically or semi-automatically insert citations for source documents used and highlight/annotate sections of text as they write.
4. Access, edit, highlight and annotate shared documents in a common environment in order to simplify the process of collating and making amendments from multiple contributors.

We now discuss each of the above design recommendations in the context of the broad information use behaviours they aim to support (i.e. information management, writing and editing and review and sign-off). As our recommendations related to writing and editing can be neatly split into two categories (supporting the extraction of information from source documents and supporting highlighting and annotation), we discuss these as two separate sections (5.3 and 5.4). Whilst not discussed as a standalone section, many of our suggestions also incorporate the need to support the re-finding of information (which our interviewees often discussed as part of the information management and writing and editing phases of document preparation).

5.2 Supporting information management

Almost all of our interviewees had difficulty with information management. Information was often retrieved long before it was used, which meant some interviewees had forgotten about documents they had previously downloaded (see section 4.1.1). This was exacerbated by interviewees working on several projects simultaneously. Shared network drives were often used as a dumping ground for documents and interviewees did not have time to organise their file systems. As a result, re-finding documents was difficult and time-consuming so the interviewees resorted to re-searching for source documents.

To better support information management, future digital information environments might *automatically record and log all web pages and documents* that are opened, saved and printed. This implicit feedback (see Kelly and Teevan, 2003) could be captured without cost to the user and without interrupting the task at hand. A similar approach might be taken for incorporating search histories into the system, by keeping a record of search queries submitted and results returned. According to Komlodi, et al. (2007), recording the relationship between search terms, pages visited and actions taken can preserve the original context of the search. A tool for recording search histories in a structured way (allowing users to interrogate and re-use individual search queries) was developed by Kaur et al. (2005) and found to be useful by evaluation participants in the medical and legal domains.

Future digital resources could also incorporate a *bookmarking tool* to ensure that both created documents and source documents are accessible and locatable via a single interface. This might be particularly useful for the local government policy workers in our study as most of them saved source documents and bookmarks in a project-centred folder hierarchy. Such a system could allow the author to *associate and disassociate source documents from a project* through an admin screen and allow authors to *tag documents* based on an organisation-wide ontology so that users can use a mixture of search and browse functionality to locate documents (based both on the document tags, meta-data and full-text). Users might also tag documents with custom key words and phrases in order to make it easier to re-find the document. The system could also automatically *bundle temporary and intermediary documents created* during the writing process with the document they are being written to support (and allow users to delete the temporary versions once they have finished using them).

All source documents could be made accessible through an integrated interface so users would not have to minimise the document they are working on locate them. The system could support multiple methods of sorting source documents, including most viewed, most used, last viewed and last used. Such a system could also allow users to ‘pin’ documents to the top of the list to provide quick access to frequently used documents.

Where source documents contain bibliographic information, the system could automatically save that information to allow *auto-citation* when the information is used (auto-citation has already become a feature of existing bibliographic software such as EndNote and Reference Manager). If the document does not contain any bibliographic information, the author could

be prompted to add information when saving the file and even if the prompt is ignored, the system could automatically keep a record of the title and URL of the document (and the author names where easily parsable from the document) in order to make it easy to return to the source in the future. As interviewees were required to cite documents using different styles, a system that supports their information work should be flexible enough to allow users to configure referencing formats.

5.3 Supporting the extraction of information from source documents

Interviewees faced difficulties with all the methods of extracting information from source documents that they described and demonstrated (i.e. switching between the source document and the document they were writing, splitting the screen so that the source document was visible as they typed and copying and pasting text from the source document into a temporary document). Interviewees who switched documents often found it difficult to identify the correct file using the Windows taskbar. Those who split their screen found the process fiddly and cumbersome to arrange and those who copied and pasted text found it problematic because it imported the formatting of the source document.

To better support the extraction of information from source documents, future digital information environments could be designed with an interface to explicitly support each of these methods (whilst aiming to avoid the problems described above). One mode could present a *split-screen environment* with a simple grab handle to allow the user to adjust the proportion of the screen dedicated to the source document. This would avoid problems with resizing source documents and them overlapping the word processor document. Another mode could provide a visible *clipboard area* alongside the working document for the user to view and paraphrase information copied from source documents. The clipboard area could also allow the user to edit the text before pasting it into their document. A similar panel was present in the NewsHarvester system developed by Attfield (2005) to facilitate note-taking. The clipboard could allow the formatting inherited from the source documents to be automatically removed and present a preview of how the text will look. Structural formatting, such as bullet points should be maintained - similar to the functionality provided by Word Cleaner (see www.convertwordtohtml.com). Direct copy and paste could also be supported by the system and could present copied text to match the existing document formatting by default. With each mode, key functionality to support writing, editing and annotation would always remain visible in the interface.

Most interviewees cited their sources after they had finished writing and it was often difficult to re-find documents. In order to avoid interrupting the flow of writing and, in conjunction with the file management functionality described in section 5.2, future digital information environments could include *automatic and semi-automatic referencing tools* that automatically generate a link to source documents. The link could point back to the location within the source documents was extracted from, and not simply to the first page of the document. When the system is in split screen mode, the interface could display a ‘reference’ button to allow the creation of a link to the section of the source document currently displayed on-screen. This recommendation is similar to the ‘autolinks’ functionality of NewsHarvester (Attfield, 2005), described in section 2.3. Komlodi and Soergel (2002) make a similar suggestion for the design of a digital information environment to support information behaviour in the legal domain - which automatically provided a two-way link between a document being written and the legal cases cited in it.

5.4 Supporting highlighting and annotation

Annotations were used extensively by our interviewees, often as an aide memoire to cite a source or to check a section of text. Annotations were also used as a placeholder, where the author could not think of how to finish a sentence or paragraph. Different types of annotation

were used, including highlighting text, writing in block capitals, adding ellipses to the end of a sentence and putting text in square brackets.

Rather than encouraging the use of different annotation methods, digital information environments designed to better support this behaviour could *incorporate dedicated annotation functionality* that aims to streamline the annotation process. For example, the system might provide dedicated functionality to highlight text that the author would like to revisit (and then allow them to cycle through highlighted instances in the document). This would allow authors to ensure that proposed amendments are not overlooked. The system might also represent inserted annotations with a notebook icon in the body of the text and a snippet of the annotation in the margin of the document. Then, when clicked on, the full annotation text could pop up or be presented in a pre-assigned of the interface. Both of these options would allow the text to be viewed, changed or deleted and for the annotation itself to be minimised or deleted. The system could also allow annotations to be moved, copied and pasted.

Such a system should be flexible and allow these annotations to be customised with different colours, icons or symbols. Annotations which have been dealt with can be marked as 'addressed,' which would remove them from the document (but keep them in a log in case the author needs to refer back to them or marked one as 'addressed' in error). The interface could also provide an indication of the number of unaddressed highlightings and annotations that are present in the current document.

It is also possible to provide functionality to enable authors to flag specific annotations or highlightings and *alert individual collaborators or reviewers by e-mail* that their input is required. A summary of the insertion, editing and approval of annotations can be made available to users. So too can details of who is currently working on the document (with the option for collaborators to view edits in real-time if the person editing the document provides permission for this), details of who has been requested to review the document (or particular highlighted/annotated sections) and details of historical changes to the document. Users should be able to hide all annotations in a document when they want to concentrate on the text.

The annotation functionality could be integrated with internal search to allow users *to filter by annotation type or search within annotation text*. The annotation and highlighting functionality could also be extended to allow the annotation/highlighting of *source* as well as authored documents. Source documents could be indexed by the system, making the annotations fully searchable and allowing users to collate, search and/or filter annotations across all or subsets of source and authored documents – helping to unify aspects of information seeking and use. Users could also annotate and highlight source documents as a means of supporting the writing process. Highlighted sections from documents might be automatically extracted into a document, complete with citation information, in order to facilitate the paraphrasing or writing-up of the extracted text. The ATLAS.ti qualitative data analysis tool has similar functionality. Working in this way could help the author to structure their writing, which is one of the benefits of using annotations as identified by O'Hara and Sellen (1997). Users might also annotate source documents to indicate how parts of the document could be used later - reflecting Spurgin's (2006) notion that personal information management can allow the user to communicate to their 'future self'.

5.5 Supporting review and sign-off

Almost all interviewees found it challenging to manage the iterative document review and sign-off process because it often involved multiple stakeholders and the scrupulous checking of document content for accuracy and lack of political bias. Interviewees often had to work with multiple copies or versions of the same document and incorporate vague or conflicting

amendments. We have already mentioned that future digital information environments designed to better support local government workers' information use behaviour might include highlighting and amendment functionality. This functionality could be extended to allow collaboration amongst the author and multiple reviewers. Each reviewer could be assigned a different colour for highlightings and annotations that they make and the system could allow users to filter annotations, highlights or amendments to the current version of the document by contributor. The highlighting and annotation functionality described in the previous section will allow reviewers to comment on particular parts of the document without interfering with the body of the text.

The system could also provide the functionality to allow users to *view (and if necessary revert back to) previous versions* of a document, section or paragraph. Such a system might also *automatically keep track of document versions* (providing an on-screen notification of when the document was last updated and by whom) and automatically alert users if a newer version of the document they are about to work on exists elsewhere in the organisation's document repository. The system could also *alert users if multiple contributors have amended the same section of text* and allow the author to quickly *compare the conflicting amendments* in order to decide on which to accept. Where this requires further approval, the system could allow the author to *notify the contributors of the conflict*, presenting them with the alternative suggestions, the author's decision and (optionally) an explanation of why this particular amendment choice was made. This would avoid the need for the cover e-mails sent by many of our interviewees.

6. Conclusions and future work

Through this study of local government policy workers' information use behaviour, we have highlighted that information use is an important and integral part of knowledge work. The artificial separation of information seeking and use in the past has meant that one has received a disproportionate amount of research attention compared to the other. This is a pity, since the information gathered whilst carrying out knowledge work only acquires value when it is put to good use – usually as the basis for supporting the preparation of new documents. The lack of research attention on how information is used has not only had implications for our understanding of information use behaviour (we do not understand it as well as information seeking behaviour) but has also had implications for the design of digital information environments (existing resources have tended to provide adequate support for information retrieval but little or no support for information use). Our study has provided a much-needed focus on information use behaviour in a specific knowledge work domain. Furthermore, we have illustrated through a series of design recommendations that a detailed understanding of information use behaviour has the potential to result in the design of information environments that provide explicit, holistic support for information use.

Potential future work might involve studying information use in other knowledge work domains. This might entail studying a domain where information is used extensively but where existing studies have primarily focused on information seeking rather than use (e.g. journalism, law, healthcare) or studying a domain whose information behaviour has not received much research attention at all (e.g. crime science, economics, film production). Alternatively, it is possible to examine information use carried out for leisure purposes (e.g. holiday planning, family history checking). It is also possible for future work to examine aspects of local government policy workers' information use behaviour in more detail (such as their strategies for avoiding interruptions to their flow of writing or collaborating with multiple reviewers). Future work might also involve developing and evaluating the success of a prototype digital information environment based on the design recommendations made in this article. Such an evaluation might entail a prototype being introduced in a governmental organisation and government policy workers being asked to use the prototype to support the

document creation process. A mixture of formative and summative feedback can then be elicited from the workers, focusing on important success criteria such as perceived usefulness, usability and likeliness of use.

We believe that it is only possible to design digital information environments that provide good support for information use behaviour by first gaining a detailed understanding of this behaviour. Therefore we need more studies that seek to understand different aspects of information use, in different disciplines, in order to ensure the design of truly user-centred resources. We also need more studies of information behaviour that aim to inform the design of digital information environments – either directly through the design of new resources or improvement of existing ones, or indirectly through the provision of design recommendations and guidelines. Therefore we should not only regard information seeking and use as two sides of the same coin – as inter-dependent aspects of information behaviour that are best considered together rather than in isolation, but we should also regard information research and user-centred design as two sides of the same coin – as disciplines with a symbiotic relationship that ultimately aims to produce digital information environments that meet the needs of their users.

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