Activity Awareness and Social Sensemaking 2.0: Design of a Task Force Workspace

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Abstract. Task forces of expert knowledge workers would benefit from more advanced web tools supporting activity awareness and social sensemaking. This paper proposes the design of a task force workspace, which is under development. It introduces the problem through a scenario, specifies requirements, illustrates a modeling approach and the mockups of the functions in the proposed workspace. Design issues and future work are finally discussed.

Keywords: Awareness, Sensemaking, Task Force, Roles, User Modeling, CSCW Design, RSS or Atom Feeds.

1 Problem

Numerous and diverse task forces of expert knowledge workers would benefit from more advanced web tools supporting awareness and social sensemaking. Examples of task forces are a national scientific committee writing an official report on climate change, a team of professionals writing a proposal for a large contract bid on behalf of their company, a corporate group learning about and identifying opportunities in a new business area, a group of financial analysts or a tiger military team strategizing a solution to a complex problem, an inter-agency task force planning and managing responses to a major natural disaster such as a hurricane.

The tasks of these large work groups tend to be novel in topic, ad hoc in method, and have a number of constraints in time and space (e.g., limited time, asynchronous work, and distributed across different places). The large amount of labor, the broad variety of skills required, and the critical implication of the final product make it necessary that multiple experts contribute to the work. This paper describes an ongoing research that focuses on supporting a specific set of needs of these task forces. Such needs include managing a large amount of noisy data, summarizing data coming from multiple sources, and coordinating among collaborators with diverse roles toward the common goal of delivering a final report (or a solution to a problem) which synthesizes the information content foraged and the judgments made on it.

Two classes of tools help task forces, respectively, to collect information and author a final report. Web tools have expanded knowledge workers' abilities in foraging

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large numbers of tokens or chunks of information, such as web pages, wiki pages, blogs, documents (or portions of them) and share them with others (e.g., through email, search engines, feed readers or aggregators, shared databases). Moreover, workers typically have access to collaborative editing applications for collaboratively writing reports (e.g., wikis, Google Docs, groupware applications). Despite the abundance of tools in these two classes, currently there are very few tools to assist the workers in doing the in-between work of filtering, abstracting, and organizing low-level tokens of information into intermediate representations that progress towards the components of the desired final product (e.g., see preliminary attempts in 10, 10]. That is, in a nutshell, we lack social sensemaking tools.

This paper proposes a workspace design that supports awareness, monitoring, and social sensemaking in a task force. The next sections present a scenario and, in relation to it, illustrate requirements for task forces. Then, we describe the functions of our prototype and briefly discuss the main design issues and future research.

2 Context

Task scenario

Let us consider a real problem scenario for a task force.

The US government establishes a scientific task force on climate change. The task force includes about thirty-five members with very diverse specialties: biologists, economists, climatologists, lawyers, policy analysts, and other professionals. The goal is to identify the science and information needed to assist the government in addressing the consequences of climate change and to suggest possible options for getting the needed science. The concrete task is to produce a progress report in a period of about 6-9 months. The task force needs to forage and summarize large amount of information from various digital sources such as scientific libraries, government databases, the Internet, personal media (e.g., email, private databases). The members need to share and discuss the relevant chunks of information, then write and assemble sub-sections of the progress report in a shared wiki. That is, they generate intermediate summaries that are later used to compose the final proposal.

This problem scenario is modeled after a real task force formed in 2007 to identify the science and information needed to assist the government in addressing the consequences of climate change and to suggest possible options for doing the needed science [1]. It exemplifies aspects of a task force that are useful when specifying design requirements, which are:

1. *Specialized co-workers*: large group of knowledge workers, including a chair and domain experts of very diverse backgrounds as members.
2. *Collaborative task*: progress report writing is a complex knowledge task requiring labor division across experts who share a goal, i.e., delivering a high-quality report.
3. *Setting*: the work is distributed across places, the projects is completed over several months, members collaborate mostly asynchronously with few coordination meetings.
4. *Tools*: Web, various databases, and a wiki for drafting the progress report.

Design Goal

The goal is to engineer tools as part of a web-based workspace that ultimately improve the quality of the task force's final report by *reducing the costs (or increasing the benefits) for the members to*:

- Construct and share intermediate sensemaking products.
- Maintain awareness of relevant content and roles of contributors.

The theory guiding the design is the sensemaking model [2] and research on collaborative tools supporting awareness and sensemaking in teams [e.g., 3]. Pirolli and Card's notional model of sensemaking [2] was initially applied to develop new technologies for intelligence analysts. Here the focus is specifically on tools that support the intermediate stages of extracting information, schematizing, and summarizing within a task force.

3 Requirements

In traditional collaboration settings, a benefit of forming a co-located task force was that the members would learn incrementally about each other and share content by working in close coordination, via face-to-face meetings and intermittent periods of asynchronous collaboration. A free benefit of working together was the effortless increment of mutual awareness and the common ground established, which would make members' coordination and sensemaking more efficient.

With the introduction of groupware applications, first, and web-based collaborative tools, later, collaborations in enterprises have become increasingly distributed in space and asynchronous in time. However, this greater flexibility in the setting and the ability to easily share large amount of data came with a big cost. In distributed, asynchronous collaboration, maintaining awareness and making sense of massive amount of content now requires both an active effort from the collaborators and adequate tools need to be provided within the shared workspace.

Nowadays, many tools (e.g., FriendFeed [4]) support task force members to collect low-level tokens of information such as web pages and Word documents into a shoebox-like repository (see left box in Figure 1). Similarly, several collaborative editing tools support the members at the end of the collaboration, while the report is being finalized (e.g., collaborative editing tools such as Google Docs or some features of Microsoft Office, see right box in Figure 1). But very little support is available for supporting awareness and sensemaking while the task force is engaged in the process

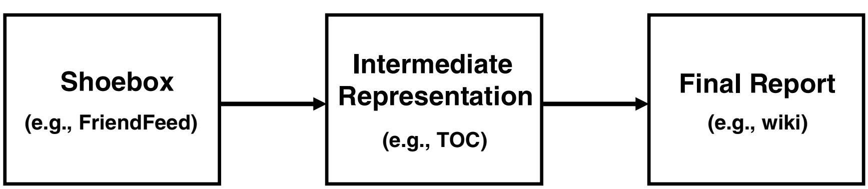

Fig. 1. Sensemaking process and sample tools: adaptation of model in [2]

of filtering out noisy collections of data to arrive at relevant information tokens, creating intermediate representations from the low-level tokens, and communicating the individual contributions to other people.

Proposition 1. Knowledge sharing. *In a task force, where collaborators have different roles, it is not the case that everyone in the team should know everything.*

This proposition emphasizes the need to reduce the things that collaborators need to attend to. This contrasts with the simplistic view of knowledge sharing as the formation of uniform mental models shared across team members (i.e. see this distinction in the literature on the transactive memory models [5]). It is, in fact, endemic to task forces dealing with massive amount of information to manage different skill sets and jobs. It is more efficient if the members divide the labor and attend to only what is relevant to their jobs. In this context, the performance can be improved via tools that support the awareness of each member for relevant content in ways that take into account the role specialization within the task force [e.g., 6].

Proposition 2. Content representation. *Collaborators assimilate shared content at a lower cognitive cost if they organize the large amount of information into higher-order content abstractions rather than low-order tokens or chunks of information (e.g., a few paragraphs of text, a spreadsheet or a table with data).*

This proposition points to a first solution to help with the management of very large amount of shared information (see proposition 1). It is quite common in large hierarchical organizations to generate briefings for the leaders that summarize large amount of data and detailed analyses (e.g., briefings for the US president).

Search engines, feed readers, and plain wikis allow the members of a task force to forage large amounts of detailed and unstructured data but provide little or no help for filtering, categorizing, and organizing the content. On the other hand, research on information processing and information visualization suggests that if a workspace integrates these foraging tools and in addition supports the construction of intermediate content abstractions, then it can significantly improve the quality of knowledge sharing and sensemaking [e.g., 7, 2].

Proposition 3. Role-specificity of representations. *The awareness and coordination of the collaborators improve if the abstractions also reveal about the roles of the authors.*

This proposition follows from the combination of propositions 1 and 2: if the co-workers are more efficient when they selectively attend to only what is relevant to them and if they can easily construct and share high-order representations of information, then it would be also helpful if such high-order representations can be personalized based on the members' roles (i.e., focusing on details relevant to each role) and carry also information about what role has contributed what content (i.e., supporting awareness of roles). Examples of features supporting awareness of different roles are provided in [3, 6].

Proposition 4. Content-argument proximity. *Sensemaking quality and motivation to contribute increase if the workspace presents the content (e.g., raw evidence) close to the rationale for sharing it (e.g., added arguments).*

This proposition points to the fact that the overall process of sharing, summarizing, and judging ideas in work groups has the general form of a dialog (e.g., initial proposal, reply, reply-to-reply, ..., deliberation). Moreover, when sharing a token of information that was already processed individually, collaborators tend to naturally attach their rationale or argument for sharing it [e.g., 8]. However, groupware applications (e.g., Groove) and wikis (e.g., MediaWiki applications) are designed with an unnecessarily marked separation between the content shared (documents or pages) and the discussion on it (i.e., discussion tools in groupware systems or discussion pages in wikis). This imposes extra steps (i.e., clicks) and context switches when users need to match the content with its rationale (and who contributed what).

In contrast, other web tools (i.e., blogs, forums) or groupware prototypes designed to make arguments both visible and visually related to the shared tokens have been successful in enabling high-quality sharing [9] and understanding [12], and high participation (see FriendFeed [4] or web blogs such as TechCrunch and Slashdot).

4 Workspace Design

In relation to the scenario above, this section illustrates the design of a workspace that helps to channel information from the foraging tools to the editing tool (i.e., the wiki) used by the task force. Each member has a personal and a shared space where the numerous pieces of information found can be pre-processed individually and then analyzed collaboratively (see Notebook in SparTag.us tool [15]). The filtered and commented content is then summarized and assembled in the wiki.

To address the requirements synthesized in the propositions above, the design includes support for content abstraction (proposition 2), selective awareness of shared content and contributors (propositions 1, 2, 3), discussion in context (propositions 2, 4) and guided discovery (propositions 1, 2, 3). Providing such support requires an adaptive workspace that models the knowledge, role, and interaction of each member and then provides support that is informed by each user model.

4.1 Modeling the Task Force at Work

Past work on adaptive systems (e.g., handheld guides in museums or online recommender systems) contributed sophisticated approaches to model individual users and guide their exploration of large amount of content [13, 14]. Such models allow tailoring the presentation on user's knowledge, interest, and interaction history and enabling personalized recommendations that guide the discovery of new content.

We adapt the model for individual users proposed in [13] and extend it to the case of a task force (Figure 2). The proposed model has four modules that keep track of four different sets of attributes for each member:

- Static member characteristics: e.g., age, gender, interface preferences
- Three sets of dynamic characteristics:
  1. *Individual knowledge* (i.e., facts s/he knows in the problem domain)
  2. *Role* (i.e., responsibilities in the task force and personal interests)
  3. *Interaction history* (i.e., content searched, content found, annotations, and summaries generated).

All the four modules of the model are initialized with information from users profiles (member-specified or imported from pre-existing task forces) and the roles assigned by the team leader of this task force. Then, the three dynamic modules are incrementally refined as the members work on the task.

A first novel element of this model is the account for the members' roles, which makes it a model for a work group. When considered collectively the different roles represent the strategy of the group. Key interdependencies among the roles can be inferred and used. This relates to recent attempts in collaborative computing to model the structure of collaborative activities or business projects rather than just their actors (activity-centric design [17]). A second novel aspect is that the model tracks no only the behavior of retrieving existing information but also the results of generating syntheses (written summaries), which includes content added ex-novo by members. Finally, in contrast with black-box modeling approaches, we propose a "see-through model": the facts collected by the system on the members are made visible to the members. This aim at enhancing their mutual awareness at a project level.

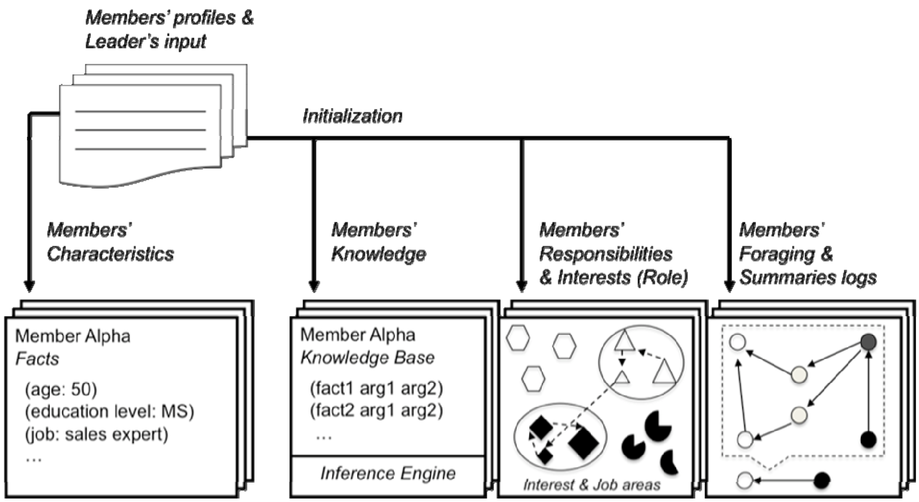

Fig. 2. Task Force Model Components

4.2 User Interface Functions

Let us consider the situation of a scientific task force sharing, discussing, and organizing information for a report on climate change. The leader has given the members different roles based on their expertise. The members pooled in a shared web-based repository a large number of pieces of content from papers, books, and web pages. These are presented in a list, which can be rearranged or filtered. Each piece can be annotated (e.g., highlighted, tagged).

To illustrate the functions of the user interface we use the table of contents (TOC) as our example content abstraction to organize and share information. A TOC is an intermediate representation on the content that is typically exploited in collaborative report-writing tasks. Note however that it is not the only possible embodiment of content abstraction. Alternative kinds of representations are clouds of tags, concept maps, affinity diagrams, flow charts, box-and-arrow (or Entity Relationship) diagrams, etc. The aim of this paper is to present the design ideas underlying the modeling approach and the UI functions, rather than the specific TOC representation.

We propose an augmented version of a TOC where the members can refine the items, access the low-level tokens in the leaf nodes, browse new low-level tokens selected by the system, and look at the contributions of other members, etc.

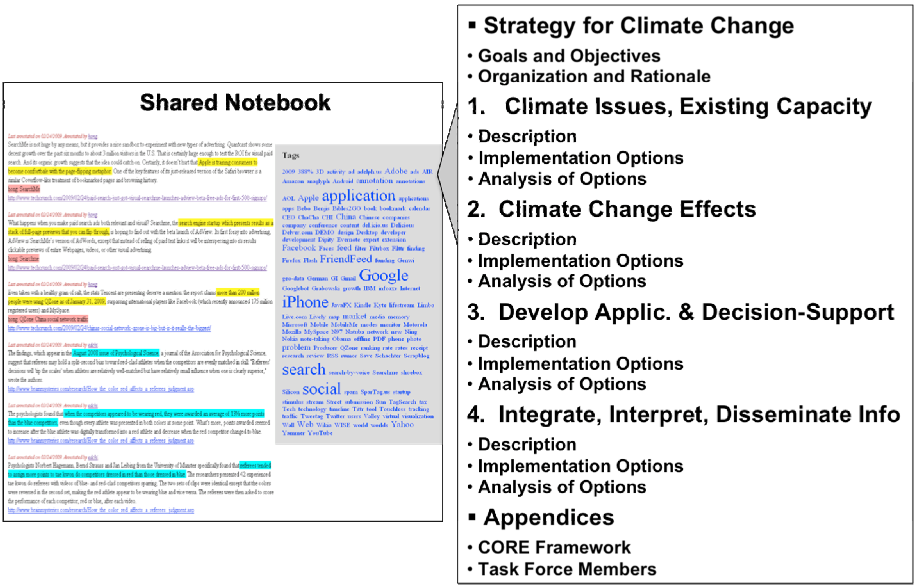

Fig. 3a (left) and 3b (right). 3a shows the shared repository with annotated pieces of content and tag cloud (functions implemented in SparTag.us [15]). 3b shows the proposed intermediate shared representation: a table of contents of the task force report.

4.2.1 Creating Intermediate Representations (Content Abstraction Function)

Group members select and categorize the low-order chunks of content from documents in the repository. Then they create items in the TOC (see proposition 2). Purpose-tagging can be used by the collaborators either while foraging [10] or later when sharing to explain why added tokens are relevant, or why contributed summaries are useful [8]. This enables clustering of content by purpose or argument (see proposition 4).

4.2.2 Selective Awareness of the Knowledge That Was Shared (Awareness Function)

More importantly, the TOC is displayed to each member as a personalized view (point-of-view) that takes into accounts the member's prior knowledge, role, and prior activity in the system (see proposition 3). Visual cues used to personalize the view are: expanding vs. collapsing parts of the table, boldening vs. graying out items, adapting font size of items, and showing visual traces of amount of overall content

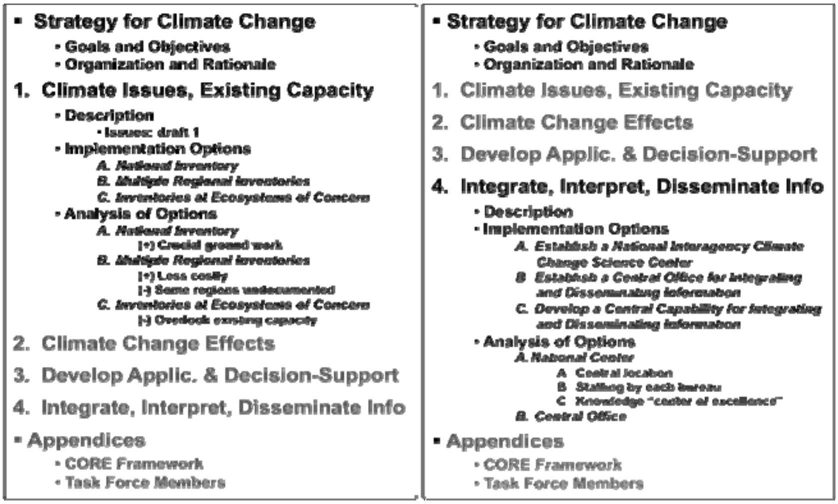

Fig. 4a (left) and 4b (right). Role-specific views of TOC shown in Figure 3a. For two experts who are focusing on, respectively, sections 1 and 4 of the report.

(overview on content) and other members' activity on the different parts of the table (activity progress bar). Figure 4a and 4b present views of the TOC to two members: Climate Issues and Capacity expert and Information Dissemination expert.

4.2.3 Supporting Discussion in Context (Discussion Function) and Scaffolding the Foraging of New Knowledge via Recommendations (Discovery Function)

A dialog or discussion concerning an item of the TOC can be conducted in context as shown in Figure 5a (see proposition 4). The contributor of an item can explain why he chooses to add the item. In addition, as shown in figure 5b, the system leverages the model (i.e., the information about prior activity of each member) to filter recommendations of new content or notification of related contributions. The member can adjust

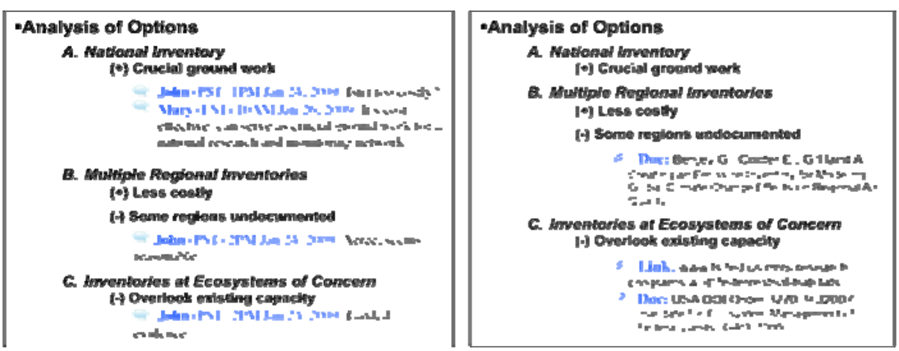

Fig. 5a (left). and 5b (right). 5a shows discussion messages in context. 5b shows three items recommended by the system. The icons indicate that two were rated as relevant.

the weight that the model has accumulated to influence the recommendations and notifications.

5 Discussion and Future Work

The sections above motivated and presented the design of a shared workspace. First, the approach to model knowledge, roles, and past contributions of the members, which are incrementally defined as they continue working together. Then, for the user interface (UI), the design of the workspace includes functions for (1) constructing intermediate representations to abstract and share knowledge efficiently, (2) selective awareness of what relevant knowledge was shared and who contributed it (3) discussion in context on the representation and discovery of new knowledge guided by notification of related contributions. These functions require a workspace that adapts to the needs of each member. This requisite motivates the modeling functions.

We presented design mockups and ideas to illustrate these UI functions. The proposed design builds on prior studies conducted in the Augmented Social Computing Area at the Palo Alto Research Center. Prior work has provided us with a web tool supporting individuals and groups at an early stage of sensemaking while they collect information, share, and learn from collaborators (see SparTag.us prototype [15] and study [16]). A precursor of the adaptive representations (TOCs) in this paper is the ScentIndex UI technique [18], which supports individual information foraging from a book via an enhanced subject index that reorganizes the content to suit the user's information needs. In other research we studied computer-supported teams at their final stage of sensemaking, while a final complex decision was made (see CACHE prototype and study [3]). Currently, we are extracting requirements by observing the work of real task forces. We have been observing expert professionals in an enterprise who take part in task forces, such as corporate teams that write business proposals on behalf of their company for competing in large bids.

As part of our future research, we plan to iteratively develop the design and perform formative evaluations with members of the task forces that are currently being observed for requirement elicitation. Consistently with our two design goals the evaluation measures include measures of process (costs for content abstraction and costs of awareness for content & roles) and measure of performance (quality of the report and total coverage of relevant information).

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