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Rapid Knowledge Construction: A Case Study in Corporate Contingency Planning Using Collaborative Hypermedia

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Rapid Knowledge Construction: A Case Study in Corporate Contingency Planning Using Collaborative Hypermedia

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Abstract

Many knowledge management (KM) efforts revolve around managing documents in a repository or enabling better real-time communication. An ideal approach would combine these with the ability to create knowledge content that can be either formal or informal in nature, in a rapid, real-time manner. We will call this Rapid Knowledge Construction (RKC). This paper describes the concepts underpinning our approach to RKC, and provides a case study of the approach in an industry context. The *Compendium* approach, which has been applied in projects in both industry and academic settings, facilitates the rapid creation of the *content* of a KM repository, by combining collaborative hypermedia, group facilitation techniques, and an analytical methodology rooted in knowledge acquisition and structured analysis. Compendium addresses key challenges for the successful introduction of KM technologies into work practice: (i) customization for different use contexts; (ii) integration of formal and informal communication; (iii) integration of both prescribed and ad-hoc representations; (iv) validation and cross-referencing of the repository 'on the fly' at the point of entry; (v) conversion of organizational documents/emails into a hypertext database, and (vi) conversion of hypertext databases into organizational document formats.

Introduction

The Knowledge Management (KM) field is saturated with digital technology, with every conceivable system being rebadged and marketed as a 'KM solution.' However, while we all recognise the marketing pitch of hardware and software vendors, given the breadth and fuzziness of the KM concept we should not be surprised if almost all technologies can carve a niche somewhere in the 'knowledge chain' from raw data to meaningful knowledge resource. The question of KM's significance as a new field will doubtless arise at this conference. This paper's contribution to that debate is twofold: we draw attention to a number of concepts which we find help to sharpen the idea of *knowledge-level* technologies, as distinct from the traditional concerns of data processing and information systems; secondly, we show their relevance to a field-tested methodology and software tool. We begin with the concept of Rapid Knowledge Construction, followed by the key perspectives that motivate the approach and case study that we present.

Rapid Knowledge Construction

Many knowledge management efforts revolve around managing documents in a repository or enabling better real-time communication. An ideal approach would combine these with the ability to create knowledge content that can be either formal or informal in nature, in a rapid, real-time manner. We will call this Rapid Knowledge Construction (RKC). In order for an RKC approach to be effective, it must be *flexible* enough to respond to particular situations and people, but in addition, both *disciplined* and *capacious* enough to capture and link

material on the fly. Artifacts always shape the social and material context of use; in an RKC approach, the *methodology and support tools* must facilitate rapid reconfiguration for different *contexts* (Figure 1). The context in turn informs the application (tools+methodology), in a continuous cycle.

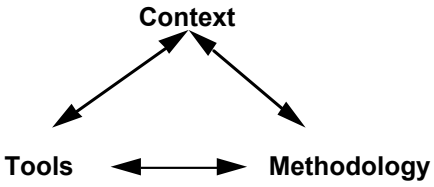

Figure 1: Tools and methods are shaped by, and in turn shape, their context of use

An RKC project can have many goals, timeframes, and audiences. For example, a project may involve a few people in a single workgroup, or many people distributed across a number of groups. Sometimes the target group and task benefit from a highly structured approach, because of external or contextual factors, whereas some target groups and tasks require a more exploratory, less constrained approach. Some RKC projects hold developing a body of content for subsequent use as their primary goal, while other projects may have as much to do with developing better understanding, communication, or other skills among the project group in the process of developing the content. An RKC approach should be flexible enough to accommodate goals anywhere along these continuums, and to move back and forth between emphases as needed. The knowledge captured and stored in an RKC repository should be available for reuse by new project teams or efforts, in such a way that individual knowledge elements can be easily discovered, accessed, and recombined for new purposes—in other words, *recontextualized*. To summarise, RKC as just defined is exploring one of the most difficult parts of the KM technology design space—representations and user interfaces which are 'lightweight' enough to enable *situated, real-time capture*, but which also sustain *reuse*—two goals which are often in tension with each other (Buckingham Shum, *et al.*, 1997).

We now introduce several empirical and conceptual strands of work which inform our approach:

- cognitive overheads of capturing structured information
- perspective making and taking
- boundary objects between communities of practice
- memory as narrative (re)construction

Cognitive overheads of capturing structured information

All systems seeking to store information must confront the *capture* and *reuse bottlenecks:* who is going to enter the material and in what form to assist reuse? In our case, we need to capture and structure ideas emerging from discussions in meetings; this is extremely hard to do automatically, so human structuring of material is required. Structure is a double-edged sword: while it can usefully focus attention on important concepts, sharpen thinking, and yield computable representations, there is ample evidence that many systems for storing and sharing human-structured information fail because the envisaged beneficiaries of the system simply do not have the motivation or time to invest in codifying resources to reach a critical mass. We draw sobering lessons from analysing design rationale systems (Buckingham Shum and Hammond, 1994; Buckingham Shum, *et al.*, 1997), plus evidence relating to groupware (Grudin, 1994) and hypertext more generally (Conklin and Begeman, 1988). The lesson for KM (summarised recently by Shipman and Marshall, 1999), is that systems requiring human-encoded, formalized, sharable information often expect too much of their users. A detailed account of how the Compendium RKC approach in this paper addresses this issue is presented in Selvin's (1999) analysis, which we now extend with a number of additional concepts.

Perspective making and taking

Boland and Tenkasi (1995) highlight the importance of what they term *perspective making* and *perspective taking* in "communities of knowing". "Perspective making is the process whereby a community of knowing develops and strengthens its own knowledge and practices" (p.356). It is this process that underpins the building of a community's identity: their basic assumptions, goals, terminology, stereotypes and modes of discourse. "Perspective taking" refers to the process of trying to engage with another community's perspective. This can be difficult when their respective "ways of knowing" assume radically different, strongly held agendas. An implication of Boland and Tenkasi's analysis is the need for tools to assist in perspective management.

Boundary objects between communities of practice

Wenger (1998) presents a detailed account of the concept of the *community of practice*, of which Boland and Tenkasi's "communities of knowing" may be considered a specialization. Of particular interest to us is the role that technologies could play in helping knowledge capture and reuse within and across communities. Wenger reflects on two ways in which boundaries between communities can be bridged. Firstly, *brokers* are individuals capable of speaking the languages of multiple communities, and coordinating and aligning activities within each sufficient to achieve a useful degree of mutual understanding. Secondly, material or conceptual representations may serve as *boundary objects* (Star and Greisemer, 1989). "Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity acoss sites" (Star and Greisemer, p. 393). Examples of material boundary objects that are used to coordinate and mediate between diverse communities include geographical maps, architectural plans, and software specifications. To this, Wenger would add language and practices as social/conceptual forms that both divide and bond groups.

Memory as narrative (re)construction

There are two related threads that we wish to highlight: conceptions of memory, and narrative modes of sharing and sensemaking. Firstly, Bannon and Kuutti (1996) argue that the term *organizational memory* is often used implicitly to mean a repository based on a 'memory as bin' metaphor, whereby material is unproblematically added and extracted. They point out that the cognitive and social sciences show that 'memory as reconstruction' is a better model—material is not simply retrieved from a 'bin', but is *reconstructed* in the context of our understanding of the world, who is asking, and for what purpose. The task for organizational memory design is thus better conceived as the provision of resources for the *construction, reconstruction* and *negotiation* of information (e.g. over 'what happened', and 'what this now means').

Taking us to the second theme, Bannon and Kuutti emphasise the important role that 'talk' and 'narrative' seem to play in the construction of meaning. There are two senses in which narrative seems to have a role to play in the construction of meaning. Firstly, there is 'the story as artifact'—a constructed account of past incidents in the life of the group, or of its members. Through stories, members share the latest news, show off expertise, seek advice and compare notes, in the process maintaining their standing and claim to membership within that group (Orr, 1990). Secondly (although clearly not distinct from 'stories as artifacts'), there is narrative as a mode of cognition in contrast to logical/analytical cognition. Narrative in this sense is used to make sense of the world by casting and recasting the past in relation to present situations. Narrative theory is being drawn upon in KM-related research into 'sense-making' (e.g. Dervin, 1983; Weick, 1995). The discourse-oriented representations used in

Compendium are resources for (re)constructing the 'story' of a project: what questions were asked, what answers considered, with what kinds of rationale?

Compendium as an RKC approach

The set of techniques which represent the *Compendium* approach are designed to be adaptive to a specific context, and mobile along the tool/method continuums of Figure 1. They revolve around a graphical hypermedia system[1] for the development and application of (i)Question-oriented *templates* which serve as semiformal ontologies to structure the subject matter of a particular project (Figure 2), and (ii)a set of *metadata tags* that can be assigned to any concept in the database (Figure 3). A hallmark of the approach is the ability to move between formal and prescribed representations and informal, ad hoc communication, incorporating both in the same view if that is helpful to the participants. Hypertext nodes and links can be added either in accordance with templates or in an opportunistic fashion.

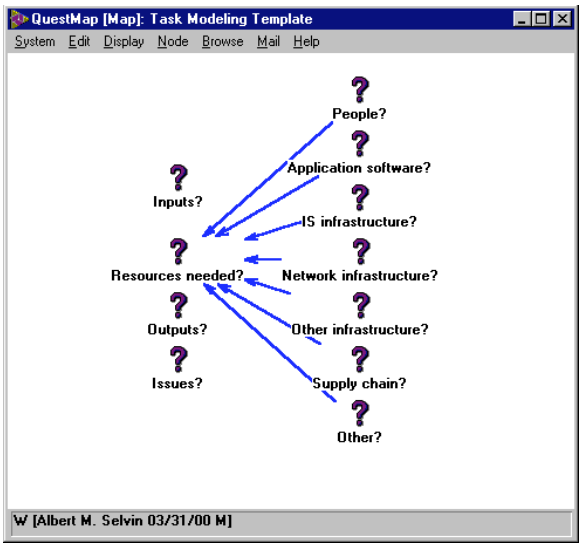

Figure 2: A Compendium question template representing the concerns of a particular stakeholder group (application in Figure 4).

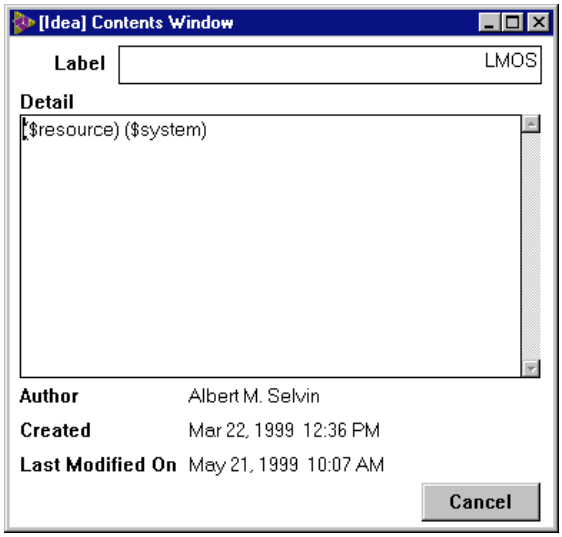

Figure 3: Optional metadata tags added to the content of a node, assisting subsequent harvesting and analysis of elements

Compendium, first developed in 1993 as an approach to aid cross-functional business process redesign (BPR) teams, has been applied in several dozen projects in both industry and academic settings (Selvin, 1996; 1998a; Selvin and Sierhuis, 1999). Its origins lie in the problems attending teams working over weeks or months to design business processes: keeping track of the plethora of ideas, issues, and conceptual interrelationships without needing to sift through piles of easel sheets, surfacing and tracking design rationale, and staying on track and "bought-in" to the project's overall structure and goals. The key feature of the early approach was the combination of an Issue-Based Information System (IBIS) concept-mapping tool (Conklin and Burgess Yakemovic, 1991), which supported informal and exploratory conversation and facilitation, with a structured modeling approach (Selvin, 1999). This allowed teams to move along the spectrum of formal to informal communication as well as prescribed to spontaneous approaches, as their needs dictated. It also let them incrementally formalize data (Shipman and McCall, 1994) over the life of the project.

[1] In the examples presented in this paper, the tool is GDSS Inc.'s QuestMap™ product <www.gdss.com>. Bell Atlantic is currently developing a Java-based product with more comprehensive support for the Compendium methodology.

As the approach was tested and refined over the course of several years, additional tools and methods were added that facilitated RKC. The early use of the IBIS tool, while powerful, had a number of limitations. First, often content already existed in the form of documents or other textual materials (email messages, web pages, etc.), and it was not efficient to manually retype the material in order to transform it to hypertext nodes and links. A tool was developed that analyzed document content and metadata, such as paragraph styles, and automatically generated typed nodes and links in the hypertext database. Participating teams wanted output in customized document forms, not just the outline format that the hypertext tool provided, so a tool was written to generate multiple document formats suited to the representational preferences of the audience (Selvin and Buckingham Shum, 1999). This was expanded to pictorial/graphic representations, such as data flow diagrams and even ad hoc user defined representations. Further extensions met teams' desire for the rapid publication of Compendium meeting minutes, analyses, textual versions of models, etc. on the corporate intranet.

Bell Atlantic Y2KCP case study

The following case study illustrates how Compendium has worked as an RKC approach. The context was a highly time constrained, organizationally pressurized effort to conduct an enterprise-wide risk assessment for a Year 2000 Contingency Plan (Y2KCP). The Y2KCP project comprised an intensive analysis effort to identify those Bell Atlantic resources that would cause the highest degree of risk if they were to fail. The effort was to look at the five "core business processes" of the telephone company as the outside world – customers, regulators, investors – perceived them. These processes were Call Completion, Ordering and Provisioning, Maintenance and Repair, 911 (emergency calls), and Billing. Cross-functional analysis teams were to be formed consisting of members from many departments. The output was to be used both as the content of a Corporate Contingency Plan document that could be given to external stakeholders, and as a validation check against the departmental-level contingency plans generated in an earlier phase of the project.

Prior to the start of the work described in this paper, a team of external consultants had spent several weeks canvassing various executives for participants and holding meetings attempting to kick off the analysis process. When these kickoff meetings proved difficult and contentious as to purpose and process, the Compendium team was asked to help facilitate and provide a structure and database for the rest of the effort. Sessions were held in meeting rooms at Bell Atlantic locations throughout the northeast USA as well as over the Bell Atlantic network using a virtual team approach. This included the use of Microsoft NetMeeting™[2] and phone conferencing. About 60% of the meetings were face-to-face and 40% used the virtual team approach. The project was conducted in Spring 1999, with approximately 60 participants.

[2] NetMeeting is a trademark of the Microsoft Corporation.

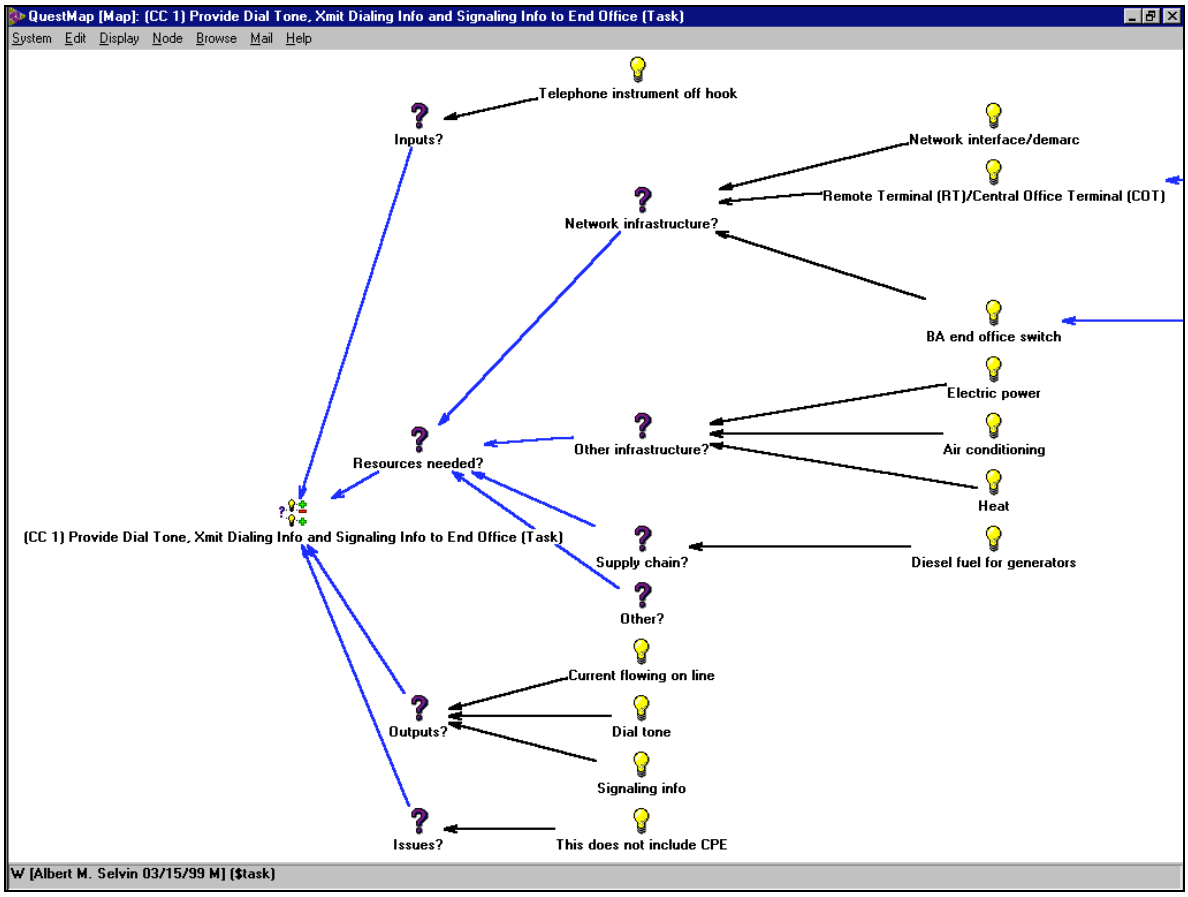

Figure 4: Early session with Call Completion team (using the template in Figure 1)

Initiating the Compendium process

Use of Compendium began with facilitated collaborative sessions with project staff to clarify what the aims of the risk assessment were. Goals, expectations, and specific analysis outcomes were discussed and modeled in real time. Out of those sessions came preliminary templates (e.g. Figure 1) for the process analysis and risk assessment components of the analysis effort. The templates were then applied in an opening session with the Call Completion team (Figure 4). Feedback from the team and reflections after the session prompted refinement of the templates, which continued in subsequent sessions with the remaining groups. As the templates improved, the effort picked up speed. After three or four sessions, the process moved into a consistent mode: introduce the project, problem, and approach; do a high-level process flow on paper or whiteboard; enshrine the agreed-on high-level flow in Compendium software tools; apply the process template to identify which resources (people, computer systems, network equipment, buildings) pertained to each subtask; when all the resources had been identified attach the risk assessment template to each resource so that the team could assess the operational, competitive, and legal risks attendant to that resource for that task.

Rapid construction of the contingency planning analysis

As the teams got deeper into the analysis, they were able to leverage each other's work. For example, several of the teams identified the same systems, roles, and tasks, often adding more description or definition in the process. Compendium supported teams in systematically using only one node to represent a resource (people, systems, equipment, locations, etc.), for example, "the WFA system" (as illustrated in Figure 5). Thus, teams could leverage the work

that other teams had done by re-using the same node in multiple contexts. 'Transclusive hyperlinking' (Nelson, 1987) meant that each team could add corrections or descriptive information to a resource, and know that it was immediately updated in every process map and risk assessment where it appeared. In addition, since the software tool displayed 'libraries' of the resources, the teams could save time by simply copying icons into their current analysis map. The result was that one could find all the maps in which a resource appeared, helping to answer key questions such as, "in what contexts is this factor relevant?", and "who are the stakeholders?"

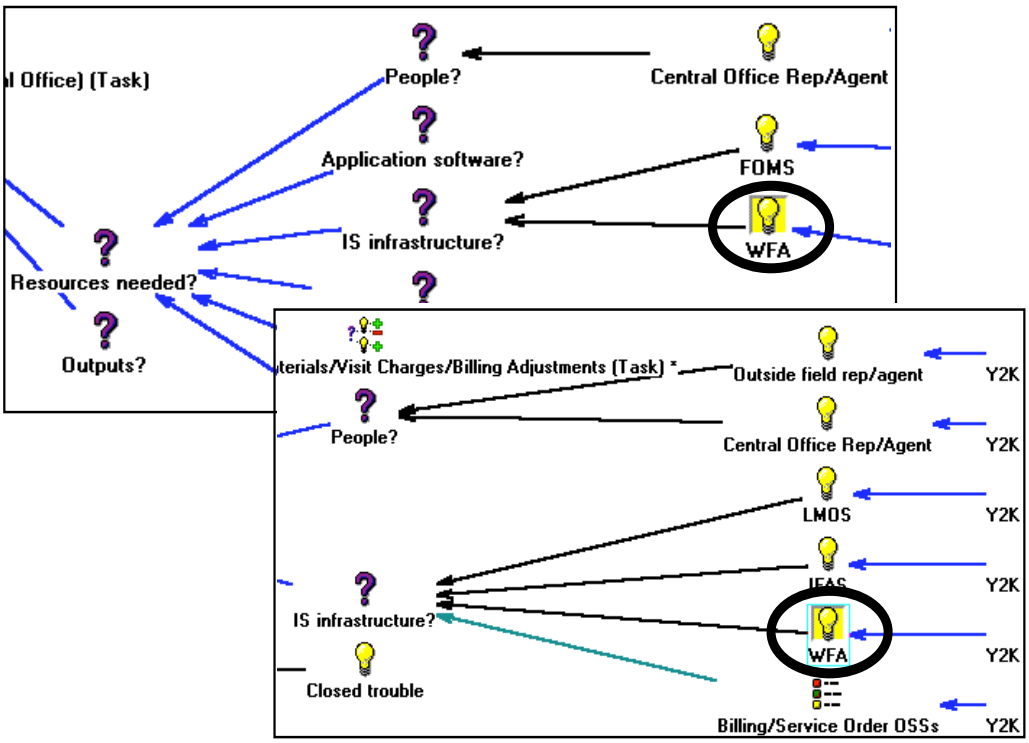

Figure 5: Use of the *WFA* node in two different teams' maps. One can display a menu of all contexts in which a node has been used; selecting a context highlights the relevant node in its context of use.

Participants identified which resources were used in each work step of the business processes. Following this, the resources were rated in terms of the competitive, legal, and operational risk should that resource fail. Resource/task combinations rated as "high risk" were then subjected to a separate contingency planning effort. Due to the tight timeframes and high priority for the project, there was no time available for the more exploratory discussion of the many issues involved that Compendium has supported in other contexts (Selvin and Sierhuis, 1999a); the facilitator focused the discourse on completing the analysis tasks associated with the visual maps displayed in meetings.

By using a visual map continuously created in real time by the facilitators, with all the content provided by team members, validation of the knowledge database's content could occur as it was being created. Participants saw the maps of hypertext nodes and links being created, and informed the facilitator if there were inaccuracies or omissions. A second "round" of validation occurred when documents and diagrams were circulated. The project's sponsors required that the output be customized for different audiences in various document and diagrammatic forms. Compendium software was used to generate twenty-five different textual documents and more than 500 process diagrams for immediate feedback and review.

Knowledge reuse

A critical indicator of the efficacy of an RKC approach is the ease with which knowledge elements can be retrieved and recombined in new ways, for new purposes. The case study discussed in this paper has featured two subsequent reuse instances in the months following the original Y2KCP work. Following the completion of the Contingency Planning effort, a new team, composed of people who had not been involved in the Y2KCP effort, began overlaying the Y2KCP content with an analysis of which resources and tasks had been covered by Y2K-related Business Process Testing. The Business Process Testing team made use of a variety of reuse mechanisms (Selvin, 1998b) to accomplish this work. Later, an eBusiness Strategy team used the process analysis to overlay internal eBusiness initiatives and associated templates onto the core business processes (Figure 6).

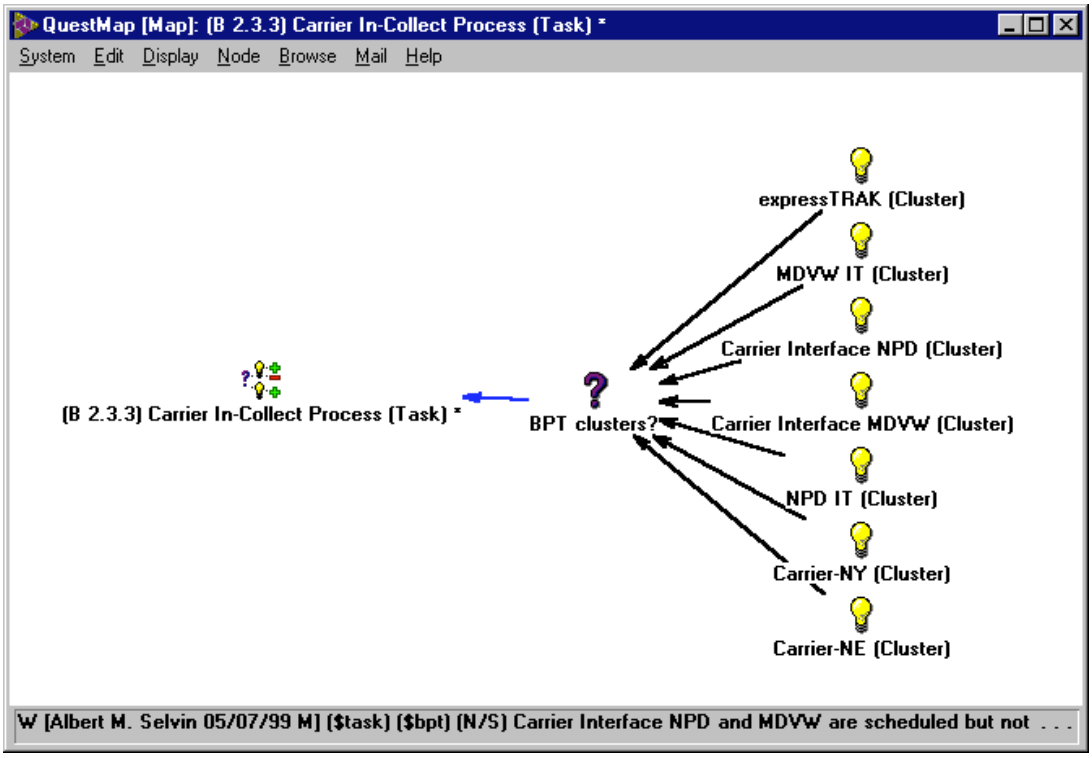

Figure 6: An eBusiness process testing analysis (*"BPT clusters?"*) overlaid onto the original Y2KCP process model (*"B2.3.3 Carrier In-Collect Process"*)

Discussion

Effective, on-the-fly construction of knowledge resources does not come 'for free'—the lower the effort invested at the capture stage (e.g. simply video recording all meetings, or taking conventional minutes), the more work is required for collective reuse and computational support. Naturally, we want quality knowledge resources for minimal effort, and while smart analysis technologies will continue to push the boundaries, there are pragmatic factors to consider: what is possible *now*? Compendium tackles the cost-benefit tradeoff by investing effort in quality capture by a facilitator expert in the approach. Individuals exposed to Compendium learn to use it themselves, or may go on to be trained as facilitators.

The approach draws on several conceptual frameworks introduced earlier, illustrating their potential for framing KM technologies. Compendium assists the *making and taking of perspectives* by making perspectives tangible (through reusable templates that set an agenda),

which then enable "taking" dialogues to occur (stakeholder communities encounter, and can understand each others' perspectives within a common environment and language). Compendium makes heavy use of visual *boundary objects* to help stakeholder groups and analyst/facilitators (the *brokers*) see how other groups view a problem, and emphasises the participatory evolution of modelling schema and content from the language of a given *community of practice*. In Star and Greisemer's terms, Compendium's representations are *robust* enough to meaningfully capture discussions for subsequent reuse, yet *plastic* enough to allow negotiation over the meaning of elements of common interest (using graphical argumentation structures if desired, or just visually mediated talk). The maps represent multiple perspectives at a granularity and level of abstraction that is acceptable to all stakeholders (preserving local control over detail), and can also transform one community's perspective into more appropriate formats (*boundary objects*) for others, thus assisting their *sense-making* (see Selvin and Buckingham Shum, 1999, for details of 'representational morphing'). Incremental formalization of nodes is possible on a "just in time/just as needed" basis in order to tackle the capture challenge of *cognitive overhead*. Finally, the ability to move smoothly between highly disciplined modelling, semi-structured argumentation, and informal notes/discourse makes provision for the co-existence of conflicting views or uncertainty, consistent with a view of organizational memory as *negotiated, constructed and situated* with respect to the codification and interpretational context.

To conclude, this paper has described Compendium, which addresses a number of key issues for the successful introduction of RKC KM technologies into work practice.

(i) customization for different use contexts— Y2KCP templates and metadata;
(ii) integration of formal and informal communication, and
(iii) integration of prescribed and ad□hoc representations—due to the well understood highly constrained nature of Y2KCP, there was less informal communication and representation than in other case studies (Selvin and Sierhuis, 1999a);
(iv) validation and cross-referencing of the repository 'on the fly' at the point of entry (by the Y2KCP facilitator and the teams' monitoring of his work);
(v) conversion of organizational documents/emails into a hypertext database—see Selvin and Buckingham Shum (1999) for examples;
(vi) conversion of hypertext databases into organizational document formats—textual documents and process diagrams generated from Y2KCP maps

The Y2KCP project and subsequent reuses of the knowledge gathered for new purposes illustrate how the Compendium approach can serve as an effective Rapid Knowledge Construction approach. The teams described were able to get up to speed quickly and conduct a complex analysis in a tight timeframe, gather and validate a large body of knowledge, produce documents and artifacts in a variety of forms for different audiences, build on each other's work, and adapt the content for new purposes. Compendium's reusable templates and hypermedia map elements demonstrate the power of visualizations for establishing a common language. In addition, granular, hypertextual linking of important concepts in a project enables the recontextualization of concepts, while maintaining links back to source documents.

The Compendium approach is currently being used and explored for similar purposes by a variety of organizations, including the NASA Ames Research Center, Wisconsin Public Television, The Open University's Knowledge Media Institute, and the Center for Creative Leadership. Future work will report on these efforts.

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