

Making Sense of Fragmentary Information: Compendium and the Intelligence Community

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1. EXECUTIVE SUMMARY

This paper describes a collaborative approach called Compendium and explores its potential for application in the intelligence analysis process. Are there types of analysis problems or a part of the analysis process that could be enhanced by using the Compendium process? The paper is intended primarily for readers in the Intelligence Community at senior management, management, and analyst levels, and secondarily for the general public.

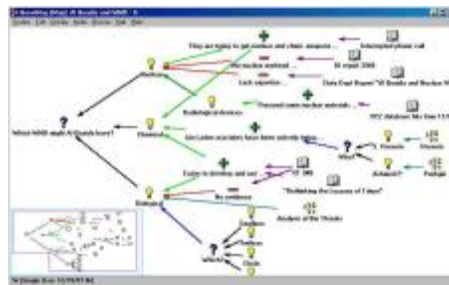
Compendium

Compendium is not a single tool or technique – Compendium is a family of tools and techniques for collaborative work which is designed to optimize the level of shared understanding that a group can achieve, and the speed and efficiency of achieving this shared understanding. Shared understanding is seen as fundamental to effective teamwork and collaboration.

The Compendium approach introduces a novel combination of three familiar elements into group collaboration: a Facilitator, hypertext computer software projected on a screen, and one or several “conceptual frameworks” that determine how information is captured and organized in the computer. This combination draws a group into a rich new mode of interaction, *hypertext-augmented collaborative modeling*, which has potential applications in the Intelligence Community (IC). Compendium’s power and effectiveness in a collaborative session is optimized by a facilitator who is experienced in Compendium-assisted analysis (or a similar process).

One element of Compendium is “*Dialog Mapping*,” which has been applied in various commercial and governmental settings since 1992. Originally developed as a tool and method for “virtual meetings” (different-time, different-place), Dialog Mapping found greater success when applied in a traditional (same-time, same-place) meeting setting. Subsequent research and development at Verizon Communications and NASA have added new tools, new methods, and a new conceptual framework, creating the “family” of technologies now called Compendium.

Compendium focuses on improving the knowledge management and sense making capacity of groups or teams that have a specific goal or objective, i.e. Compendium focuses on projects. The Compendium process is not a linear sequence of steps, it is a flexible and interactive method for organizing data, information, and knowledge. It allows for incomplete and contradictory information, open issues, and novel or unexpected chunks of knowledge that are hard to manage in more traditional information structures. Compendium uses a kind of hypertext software that, like human



cognition, uses multiple hyperlinked structures for complex and evolving knowledge connections.

The primary benefit of using Compendium is the rapid enrichment of ***shared understanding*** among a group of participants (even potentially adversarial ones). The use of shared language and a shared display are key to creating this shared understanding. Compendium also provides ***group memory*** that includes a visual display of the analysis structure to a project team, easing some of the traditional problems of collaboration over time, such as repetition and lost knowledge. Finally, Compendium seeks maximum ***participation and buy-in*** from session participants by morphing its complex internal knowledge structures into conventional document formats for participants to read and absorb.

Non-IC Situations in Which Compendium has Been Used Successfully

Compendium has been used over the past decade in a wide variety of commercial and governmental settings. It has been used in planning, design, and problem solving sessions at the World Bank, the United Nations, the US Army National Guard, other military organizations, and at least one intelligence agency. It was used on a project at NASA (Apollo Lunar Surface Experiments Package Deployment), and a wide variety of projects at Verizon Communications (Demand Forecasting, Capacity Creation Project, Executive Leadership Council, Corporate Year 2000 Contingency Planning, etc.), and the Hyde Park Central School District in New York State. In one installation at an electric utility company (Southern California Edison) it has been in continuous use as a knowledge management tool since 1992. Compendium was heavily used over a two year period on the Corporation for Public Broadcasting's "Reforging the Links: The University Digital Business Partnerships Project" project. It has also been a successful addition in executive development and "Facing Complex Challenges" workshops at the Center for Creative Leadership. In all these cases, participants reported a high level of satisfaction with Compendium, a sense that it had accelerated and facilitated the work, and a desire to extend its use into the future.

Compendium has not, however, been 100% successful – there have been organizations and situations in which it was discontinued, for a variety of reasons. The success factors for situations where Compendium succeeded include:

- The right kind of problem or project goal –the problem requires a collaborative approach for its solution, and is complex enough that there has been some “pain” or perceived need for better collaboration and shared understanding;
- The skill and preparation of the Facilitator;
- Management commitment to better collaboration and openness to new methods;
- Multiple meetings extended over time, and the need for continuity and memory from meeting to meeting;
- Commitment of the group to the project and to getting to a high-quality consensus solution;
- Willingness of group members to learn and experiment;
- Availability of large and bright computer projection on a wall or screen.

Compendium and the Intelligence Community

Intelligence analysis is practiced in a variety of ways in the U.S. Intelligence Community (IC), but a common theme across the board is the focus on delivering a high-quality intelligence product (e.g. a report or briefing) on a complex and dynamic subject, usually in a short amount of time. In some agencies and situations individuals produce the intelligence products, while in others there are several analysts involved and there is some level of collaboration in the analysis and/or the production process.

Because of Compendium's ability to help a group make sense of a complex situation and to efficiently focus on the key issues and actions required to move forward, it seems likely that there are many settings in the IC in which Compendium may be of value. However, to be adopted Compendium, like any new tool or process, will need to demonstrate its value in the IC, and will need to show a positive return on investment (ROI) for projects in which it is used. The return might be saving the valuable time of analysts, and/or enhancing the quality of the intelligence product. Similarly, Compendium will only have a significant impact in settings where there is a pull to use it. Moreover, Compendium Facilitators will usually need to have security clearances and at least some working knowledge of the domain content; having a pool of such people available poses resource issues.

This paper briefly explores two specific IC settings in which Compendium has great potential value: Red Teams and Task Forces. Both are complex problems in which collaboration is essential. Both involve participants with potentially widely ranging backgrounds and types and levels of expertise. Both take place over time frames of weeks or month, involve multiple meetings, and are often under significant time pressure. Both, especially the Red Team, involve situations in which alternate viewpoints and characterizing the problem are encouraged. These are some of the key drivers for Compendium's success outside of the IC.

Next steps

Further pilot studies are needed in order to determine the best fit for Compendium in the IC. There is no cookie-cutter approach to testing and evaluating new collaborative technologies. It will be important in the design of such "experiments" to take into account the success factors mentioned above. It will be important to search for pilot groups and situations in which there is a significant and complex (but solvable) problem, and a willingness to explore new technologies and methods. A skilled Facilitator must be identified and included early on, to allow adequate preparation for Compendium sessions.

A few such studies should be sufficient to identify for a specific organization (i) the benefits of using Compendium in that organization's intelligence analysis, (ii) its limitations and issues in intelligence analysis process assistance, (iii) specific critical success factors for Compendium use in the organization, and (iv) further research issues and opportunities to optimize Compendium's value in specific settings in the IC. An

Making Sense of Fragmentary Information

iterative refinement approach will allow Compendium tools and methods to evolve at the same time as further definition of its specific applications and success factors.

The IC may be well-positioned to exploit Compendium's ability to support creation of an organizing framework that allows for a shared visual audit trail of group discussion, displaying all points made as well as interrelationships among questions and ideas -- nothing is lost. Compendium can also help with workflow, scheduling and resource allocation.

If you have frequent 'wicked' analysis problems where multiple viewpoints and original thinking are required and a collaborative, brainstorming mode will help; where the product evolves over several collaborative sessions; where the structure of all the analytic components is difficult to envision at once; then it may be worth it to develop a relationship with, or to have in-house, a trained Compendium Facilitator.

2. INTRODUCTION

One of the most serious threats facing the United States is terrorism. This threat is characterized by shadowy and loosely organized networks of people. To effectively and efficiently anticipate and counter this threat, technology must be developed that promotes sharing, collaborating and reasoning to convert the nebulous data to knowledge and actionable options. Tools are needed that help the array of subject matter experts make sense of fragmentary information from the various “INTs,” and that help representatives of the superset of departments and agencies working these issues to communicate and achieve shared understanding effectively. At a time when everyone is running full out to keep up with the pace of events and the influx of potentially valuable information, it is essential that people have tools that give them an integrated perspective – that help them achieve an integrated sense of what is known and what it means.

This paper introduces *Compendium*, a tool-and-method approach for visually mapping and linking ideas. Ideas are shown as icons on a screen. Compendium can be used for personal thinking, but it is particularly good in meetings where a Facilitator maps the conversations as they unfold, producing a much richer record than normal minutes. With Compendium you can recover the trace of a discussion from months back, to reconstruct what was decided and why. Moreover, with Compendium the quality of meetings improves, because everyone can see where discussions are going, and a higher level of shared understanding about the issues is achieved.

Compendium is a facilitative approach to collaboration – the power of Compendium draws on the skill and preparation of the Compendium Facilitator². The Compendium approach introduces a novel combination of three familiar elements into group collaboration: a Facilitator, hypertext computer software projected on a screen, and one or several “conceptual frameworks” that determine how information is captured and organized in the computer. This combination draws a group into a rich new mode of interaction, *hypertext-augmented collaborative modeling*, which has potential applications in the Intelligence Community (IC).

Compendium is a “cognitive aid”: a tool *and* a methodology for improving the knowledge management and sense making capacity of groups or teams that have a specific goal or objective. The Compendium process is not a linear sequence of steps, it is a flexible and interactive method for organizing data, information, and knowledge. It allows for incomplete and contradictory information, open issues, and novel or unexpected chunks of knowledge that are hard to manage in more traditional information structures. Compendium uses a kind of hypertext software that, like human cognition, uses multiple hyperlinked structures for complex and evolving knowledge connections.

There is a catch. A recurring issue for Compendium – indeed, of any such cognitive aid – is the overhead of learning to use the system, the time and practice required to gain a high level of proficiency. The Compendium approach seeks to offer two solutions:

² The Compendium “operator” is sometimes also called Compendium Practitioner.

training and support for individual analysts who find the approach fits their own style of cognition, and facilitation (“chauffeured” Compendium modeling) for groups of analysts who need to reach shared understanding and create more coherent collaborative products, but who don’t have the time to master the approach.

Although further investigation is necessary, Compendium appears to offer great promise as an approach that integrates the individual and group aspects of intelligence, as well as the synchronous and asynchronous aspects, in a single framework.

This paper briefly reviews the analyst’s challenge in Section 3, then, in Section 4, describes the Compendium family of tools and methods. Section 5 presents a fictional scenario of Compendium use, and Section 6 an isolated experiment with the analytic use of Compendium. Section 7, the heart of the paper, explores possible applications of Compendium in the analysis process. Section 8 lays out the next steps for exploring Compendium’s use in the IC and longer term research opportunities.

3. THE ANALYST’S CHALLENGE

While intelligence analysis has always been in the business of piecing together what is happening from fragmentary evidence, arguably the new emphasis on the asymmetrical threat of terrorism makes the analyst’s task even more daunting and publicly visible. This threat is characterized by collections of people loosely organized in shadowy networks which are difficult to identify and define. These “**wicked situations**,” which have elsewhere been described as “wicked problems,” (6, 19, 22) have characteristics which make them different from tame problems, which can be solved with more linear³ problem solving approaches:

- There is **no objective problem description**. The situation can be viewed from many perspectives, and each perspective has its own set of interlocking issues. “There is no agreement on the problem or its solution.” (22). For example, the problem of how to provide relief and recovery in Afghanistan has been a wicked problem for the U.N. since 1997. (22)
- No one person has, nor can have, all of the relevant fragments of information. Not only does the information come from a wide variety of sources, each of which has its own biases and reliability factors, but the way in which the information is encoded, represented, and presented is a matter of **interpretation**, and thus is inevitably personal and subjective. For some the Afghan issue was economic, for others, political, and for others, humanitarian and cultural.
- There is no right or final answer. Decisions, solutions, and responses to the wicked situation are always tentative and **interim**. Actions must be taken, but such actions primarily serve to illuminate concealed aspects of the wicked situation, not necessarily to resolve or conclude the problem. For example, actions taken from the economic perspective, such as infrastructure investment,

³ A linear approach, for example, specifies the problem, gathers and analyzes the data, formulates a solution, and implements that solution.

expose the need for parallel actions in the political sphere creating a viable environment for such investments.

- **“Information rot”** is a significant factor. Some kinds of information, such as the location or description of a person or vehicle, may lose validity over time. The faster information fragments can be brought together and synthesized, the more likely the fragments can be fit together into an accurate and coherent theory.

No one person can have all of the information, but – more importantly – no two analyses of the information are likely to come to the same conclusion (14, Chap. 4). Indeed, very few intelligence products are written by just one analyst and then sent to the policy customer (17, p. 84). Therefore, analysis of a wicked situation is, above all, a **collaborative** effort whose success hangs on the “collective intelligence” of a group of analysts and experts (7, 27). Individual analysts will have important insights, and most are likely to have their own theory about how it all hangs together.

Problems are not limited to how analysts perceive and process information. Intelligence analysts often work in small groups and always within the context of a large, bureaucratic organization. Problems are inherent in the processes that occur at all three levels--individual, small group, and organization. (14, Chap. 1)

Moreover, as in any bureaucracy, collective analytic processes, such as the various “estimates,” are complicated by bureaucratic behaviors and strategies, such as “backscratching,” “logrolling,” and lowest common denominator language (17, p. 84). These behaviors, while natural and probably inevitable, politicize the analytic process, taking it beyond the realm of academics and facts. These dynamics create disincentives for engaging in collaborative analytic efforts, even when information sharing is essential, and tend to encourage hierarchical control strategies in collective efforts⁴.

Another challenge of analysis is that much of the “hard evidence” to support an analysis is simply unavailable (17, p. 86). Increasingly sophisticated approaches to analysis are needed which can deal with misinformation and “*unknowables*.” Therefore, a wicked situation can often only be described in terms of a **set of theories**, each of which tells a story or narrative about the past, present, and future. Any one analysis or theory will have faults and shortcomings that some customers judge to be severe or unacceptable. The challenge, for the analyst and for the analytic group, is not settling on the one “right analysis” ... it is synthesizing one or two theories that have the highest level of credibility (i.e. ownership) among the maximum number of customers and presenting these alternative theories as clearly as possible (14, Chap. 4).

⁴ This is not necessarily a criticism of IC culture. Many situations demand the responsiveness of hierarchical command-and-control structures. Collaboration and consensus-based decision making is not always practical.

4. COMPENDIUM AND HYPERTEXT-AUGMENTED COLLABORATIVE MODELING

In this section we review the application of Compendium outside of the IC and describe the major components of the Compendium family of tools and methods.

Non-IC History of Compendium

The “Compendium” approach to sense making, analysis, and knowledge creation has been successfully used over the past decade in a wide variety of commercial and governmental settings (8, 26). It has been used in planning, design, and problem solving sessions at the World Bank, the United Nations, the US Army National Guard, other military organizations, and at least one intelligence agency. It was used on a project at NASA (Apollo Lunar Surface Experiments Package Deployment), and a wide variety of projects at Verizon Communications (Demand Forecasting, Capacity Creation Project, Executive Leadership Council, Corporate Year 2000 Contingency Planning, etc.), and the Hyde Park Central School District in New York State. In one installation at an electric utility company (Southern California Edison) it has been in continuous use as a knowledge management tool since 1992. Compendium was heavily used over a two year period on Corporation for Public Broadcasting’s “Reforging the Links: The University Digital Business Partnerships Project” project. It has also been a successful addition in executive development and “Facing Complex Challenges” workshops at the Center for Creative Leadership. In all these cases, participants reported a high level of satisfaction with Compendium, a sense that it had accelerated and facilitated the work, and a desire to extend its use into the future.

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These factors are reviewed again in considering next steps for evaluating Compendium’s applicability in the IC (Section 8, Next Steps).

The Compendium Family

Compendium is an approach to design and analysis constituted by a family of methods and tools (see Figure 1). The methods of the Compendium approach include the Compendium technique and Dialog Mapping. Compendium software tools include Mifflin and QuestMap™; Mifflin is a superset of QuestMap. IBIS (Issue Based Information System), the foundation for the whole approach, is a rhetorical grammar, a linguistic conceptual framework. This section gives an overview of Compendium and brief descriptions of IBIS, QuestMap, Dialog Mapping, Mifflin, and the Compendium technique.

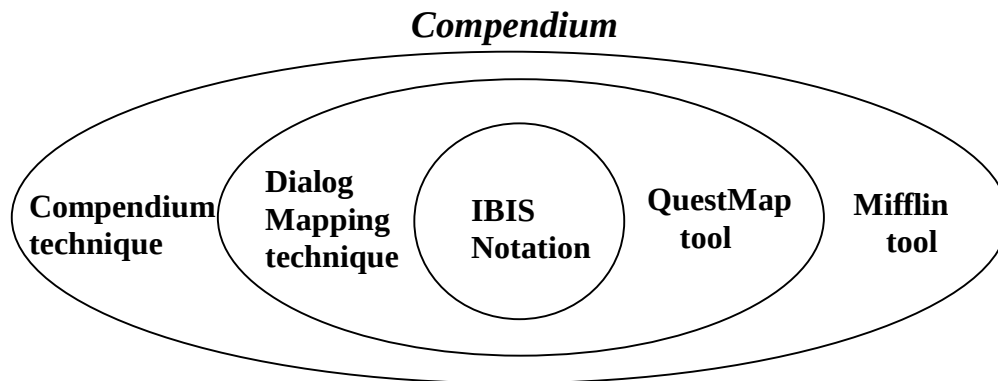


Figure 1: The Compendium family of tools and methods

The IBIS notation is the core. Two techniques (on the left) exploit this notation, and their respective tools (on the right) support the techniques using the notation.

Note that “Compendium,” or the “Compendium approach,” refers to the whole family. The “Compendium technique” refers specifically to a semi-structured modeling method.

Overview of Compendium

Compendium implements a relatively new approach to augmenting human intellect, an approach called “hypertext-augmented collaborative modeling.” This approach seeks to build semi-formal qualitative models of complex situations, usually in real time in a group context, with the help of specific hypertext tools and notations. Compendium unifies three aspects of intellectual work:

- Compendium provides a set of tools for capturing and organizing unstructured information into semi-structured hypertext forms, and for crafting flexible, light-weight diagrams and models.
- Compendium includes a method of collaboration: a facilitation approach to meetings (face-to-face or virtual) that focuses the group on the collaborative construction of multi-dimensional models.
- Compendium also includes asynchronous collaboration, in which knowledge workers or support personnel access the Compendium database off-line to refine

these models and to produce customized reports which are essentially specialized “views” of the database. This knowledge maintenance activity contributes to Compendium’s value as an organizational memory.⁵

One difference between Compendium and other collaborative support systems is an emphasis on *synchronous interactions*, usually face-to-face meetings, as the highest leverage setting for collaborative sense making. The information that is brought to the meeting will come from a variety of experts, tools, and documents. Before the meeting a high level of analysis, theory building, and sense making will naturally have already taken place. It is in a meeting, however, that experts can most rapidly and effectively make sense of fragmented information and theories and converge on a single or a few strong hypotheses about what is going on and what is likely to happen next. Decisions – moments of intellectual commitment to a path of action – can happen most rapidly and with the highest buy-in and ownership in a meeting. In many organizations meetings are a scourge, a necessary evil. Compendium is devoted to making meetings, through the use of facilitation and “shared display” (see Figure 2), highly efficient and effective business events.



Figure 2: Facilitation and shared display in a meeting⁶

As participants discuss an issue their comments are captured by the person sitting at the keyboard (also known as the “technographer”). The Facilitator (standing) uses the shared display to orient and guide the group through the process.

Compendium also aims beyond the meeting room, seeking to integrate the synchronous and asynchronous aspects of collaborative work. In addition to the meeting facilitation

⁵ The integration of synchronous and asynchronous collaborative activity is captured in the Compendium slogan, “Value now and value later.”

⁶ Art by Rocky DeKoven. From *Connected Executives* (available at <http://www.technography.com>).

use of Compendium, another use of Compendium is off-line refinement of these models and semi-automatic production of customized reports which are essentially specialized “views” of the (hypertext) database.

Moreover, the tools and methods of Compendium can help an individual manage a complex set of connections among a large number of information elements. A Compendium model that was originally created by an individual to help organize hundreds of bits of information can be directly used in a group setting as a presentation and collaborative medium, allowing the group to expand on the model, raise new issues, and come to shared understanding about the dimensions of the problem.

Hypertext-augmented Collaborative Modeling

The Compendium approach is an example of an emerging new collaborative technology, *hypertext-augmented collaborative modeling*. From the standpoint of the participant in a Compendium session, the approach looks quite familiar. It takes place in a regular meeting room and has three parts (Figure 3):

- A graphical hypertext⁷ software system designed for real-time modeling (circle A);
- A Facilitator who actively works with the group throughout the session, forming a bridge between the group’s conversation and the representation of it as projected on a computer display screen (circle B);
- Conceptual frameworks which structure the knowledge and shape the group’s process (circle C): two of the most commonly used are IBIS (16) and “World Modeling Framework”.

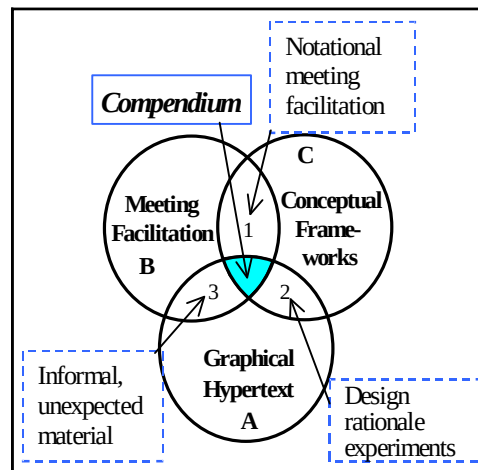


Figure 3: The three elements that constitute the Compendium approach

Compendium is an example of *hypertext-augmented collaborative modeling*, a particular way of combining these three elements.

⁷ “Graphical hypertext” systems are those in which the primary access to and navigation of small, ‘lightweight’ nodes and links is through a graphical map browser, rather than links embedded in nodes/documents exemplified by the Web.

Compendium's uniqueness is the particular way in which it lies at the intersection of these three elements. Each pairing of these elements (numbered in Figure 3) describes a familiar, but less potent, combination:

1. The use of a notation based on a conceptual framework in meetings (intersection of circles B and C) is not new. Even the use of a brainstormed list on a flipchart page is a familiar example of a very simple facilitated conceptual framework. Certainly, Joint Application Design (JAD) (32) and process mapping (23) sessions impose a highly structured framework on a group meeting.
2. Early experiments in capturing design rationale were a blend of a hypertext system with a conceptual framework (circles A and C) that was oriented to the structure of design decisions. Even simple conceptual frameworks, if unfamiliar, can be onerous when one is immersed in and focused on a design or analytic task.
3. Meeting facilitation techniques that use a hypertext system projected on a screen (circles A and B) were some of the earliest collaboration technology experiments (e.g. Xerox PARC's Cognoter (31)). Indeed, this combination is useful in Compendium whenever it is appropriate to dispense with formalism and simply capture informal, unexpected⁸ material.

Compendium's key to knowledge collaboration – to making sense of large amounts of fragmentary information – is to combine a *collaborative approach* with *hypertext tools* via a “shared display” computer projector and a skilled Facilitator.

The ability to deal with unexpected material is significant. Most methods work fine as long as the material being offered by the group fits within the modeling approach; when material doesn't fit, it is often simply ignored or set aside. Compendium's hypertext tools allow the group to stick to the main model while efficiently linking in any potentially relevant information. Nothing is lost, but levels of granularity are preserved.

Hypertext can be an immense aid in the analysis and synthesis process, because it is a technology ideally suited to combining many fragmentary bits of information into models, maps, and diagrams (25). This is not the kind of hypertext represented by the World Wide Web, however; it is a kind “graphical hypertext” (exemplified by such tools as QuestMap and Mifflin, see Figure 4) which has the following properties:

⁸An unexpected information element is one that may be relevant to the problem at hand but has no clear relationships to other known elements.

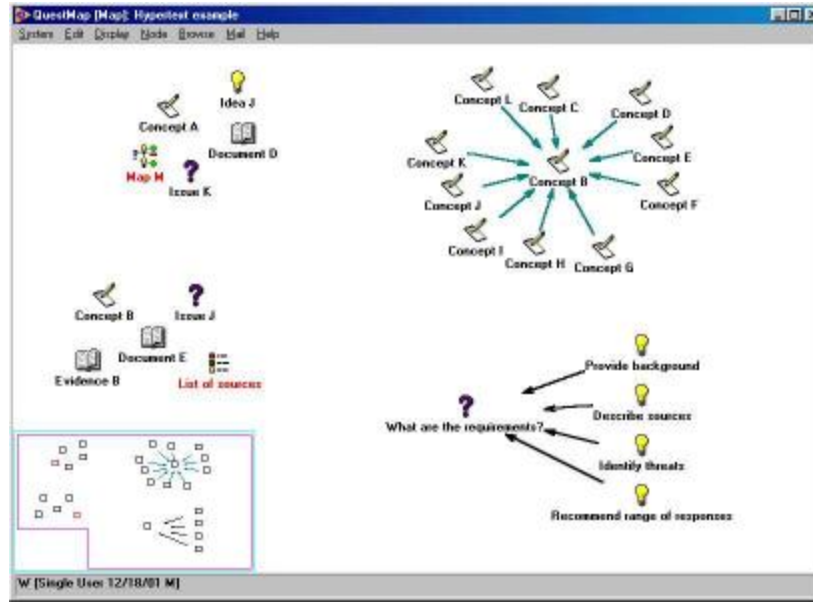


Figure 4: A sample of graphical hypertext

Note the variety of ways of representing relationships among conceptual objects: two “piles” of nodes on the left, a cluster of nodes in the upper right, and a tree in the lower right.

- The primary browser is graphical – it shows the **network** of nodes and links, not the node or page. Nodes may be created and edited, but the main interface presents a visual map or diagram of the hypertext network to the user(s).
- The process of creating, editing, linking, and indexing nodes is extremely **fast** and the interface simple – the system behaves like a word processor for diagrams. As fast as the Facilitator can create possible structures among information elements he or she can create, move and link them.
- The interface makes it easy to make and manage **connections**, both expected and unexpected. Multiple connections between objects are hard to show in a table or a list, or in prose text, but are immediately apparent in a graph.
- The system supports advanced linking capabilities, such as “**transclusive links**,” which allow a single node to be embedded in any number of alternative maps or views. This allows the same concept (node) to be reused in different contexts, and allows users to view the set of contexts in which a concept is relevant.
- In an early state of understanding, one may not know the best category, label, or granularity of a new idea, nor its relations to other ideas. **Unstructured visual space** is the best 'place' to clump such ideas in “piles” until more rigorous, explicit structure can be discerned (note the clumps of nodes on the left side in Figure 4).
- Hypertext supports a **natural cognitive progression** from identifying a concept (a node with a name in the label), to describing the concept (the same node with additional text in the detail), to modeling the concept (a new map containing a model of the concept linked to the original descriptive node).

For further discussion of the principles behind hypertext-augmented collaborative modeling, see Appendix A: Hypertext-Augmented Collaborative Modeling.

Issue Based Information System: IBIS

At the heart of the Compendium approach is the IBIS argumentation system. IBIS is a rhetorical “grammar” which defines the basic elements of all analysis and design dialogs. IBIS consists of three basic elements, Questions, which pose a problem or issue, Ideas, which offer possible solutions or explanations to the Questions, and Arguments, which state evidence, facts, and viewpoints that either support or object to Ideas. Arguments are often linked to evidential documents that back up their claim. IBIS was developed in the early 1970’s as a tool to support planning and policy design processes (16).

For example, Figure 5 shows a small IBIS map concerning possible next steps for Saddam Hussein. Generally these maps are constructed from left to right; thus the “root issue” in this map is “What will Hussein do next?” There are three possible answers (“ideas”) in the map so far, and there are additional questions about the third idea. There is an argument for the first idea, linked to a document with supporting evidence; and an argument against the first two ideas, also linked to evidence. The links may seem to be backward, but they are not: new nodes are *about* existing nodes, and so point back to them⁹.

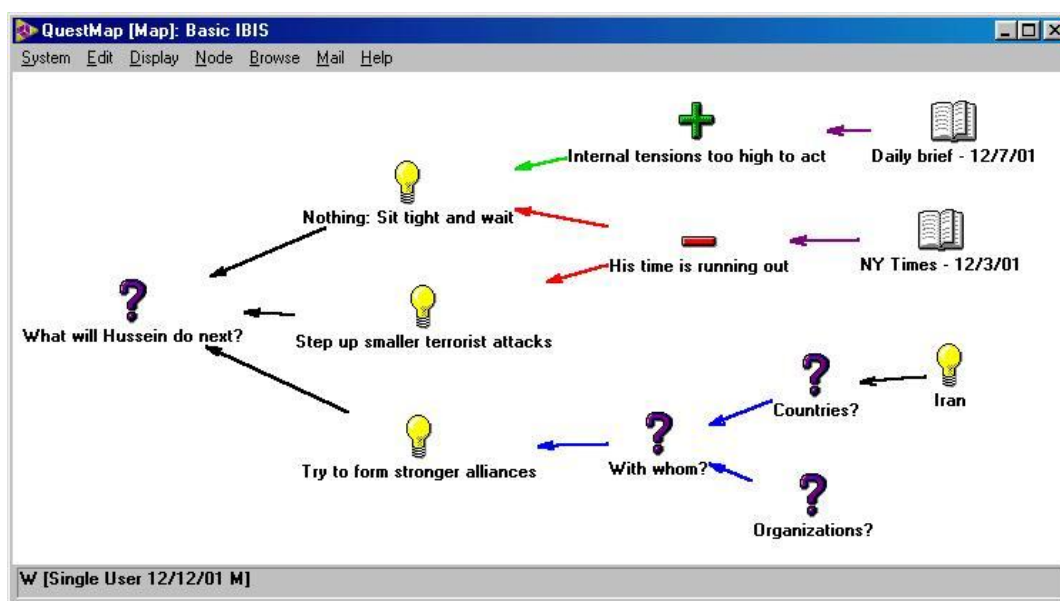


Figure 5: Simple map showing all three IBIS elements¹⁰

Note the “book” icons in the upper right which are hot links to source documents that substantiate the reasoning in the arguments.

The power of IBIS stems from three properties: (i) it maps complex thinking into *structured* analytic maps; (ii) it is based on asking the right *questions*; and (iii) it is simple and intuitive enough to be learned and used with *minimum cognitive overhead*

⁹ Thus the direction of the arrow is connected to the semantics of the link. For example, the idea “Try to form strong alliances” is about – “responds to” – the question “What will Hussein do next?” The impression that the link points backwards generally fades quickly.

¹⁰ Note that this simple example merely meant to show IBIS node types in a map – the contents of the nodes are largely fictional and would in a real map be much more complex and sophisticated.

(making it an good cognitive encoding formalism). Let's consider each of these claims in more detail.

First, IBIS captures complex thinking in structured analytic maps (i.e., diagrams). There is no limit to the size or richness of IBIS maps. A variety of linking and navigation mechanisms provide users with several ways to organize large amounts of information. One of the most basic is that a map can contain other maps (represented as map icons), so that information can be logically chunked. Often, the signal for a new chunk, a new map, is a major new question. For example, in Figure 5, the exploration of possible new alliances might lead to a larger and more detailed argument structure which would be better moved into its own map. This new "sub-map" would be hyperlinked to the top level map.

Moreover, unlike most diagramming and mapping techniques¹¹, IBIS has a grammar, imposing a formal structure (albeit a simple one) on IBIS maps. In English, you cannot say "John ball hit the." In IBIS, maps never start with an Argument node, for example, nor are Arguments allowed to link to Questions. The IBIS grammar imposes a discipline on IBIS maps, with two complementary consequences: it is harder to learn to use IBIS than to use free-form techniques, and IBIS maps are more rigorous, more patterned, and more reproducible. For the analysis of wicked situations, the additional structure and rigor of IBIS creates an important baseline of order and reproducibility.

Second, IBIS invokes a discipline of finding the right *questions*. Recall that "IBIS" stands for "*Issue Based* Information System". Issues, stated as questions, are the heart of this method. One benefit of asking questions in a collaborative situation is that it can help to break up the "answer reflex," in which participants exchange answers without ever agreeing on the question. Also, the IBIS grammar allows a Question to be about *any* other IBIS element, so it is through asking new questions that IBIS maps grow. Finally, there are a small number of *types* of questions in IBIS (approximately five) – each type calls for different kinds of responses, and these types connect together in higher level patterns, or templates. These patterns provide additional order and reproducibility in IBIS maps.

For example, there are Factual questions, such as "What percentage of the population of Afghanistan is Pashtun?" There are Future questions, such as "What is Saddam Hussein going to do next?" There are Evidential questions, such as "What is the evidence that al Quaida has WMD?" Each type of question has certain kinds of answers, and they fit together in regular patterns of reasoning.

The third important property of the IBIS grammar is that it is simple and intuitive. Numerous studies have shown that the potential advantages of rhetorical structuring techniques like IBIS are often offset by the increased "cognitive overhead" of applying them when engaged in a substantive task (2). In part, this overhead imposes a constraint on the expressive power of any formalism that might be adopted in the intelligence

¹¹ For example, the "mind mapping" and a tool that supports it, "MindJet" (for detail see <http://www.mindjet.com/>)

analysis process: candidate notations must be simple and intuitive enough that the “cognitive cost” of using them is very low. Years of practical experience have shown that more sophisticated and expressively powerful notations than IBIS are much more difficult to apply in a transparent way.

There is another way to meet the challenge of “cognitive overhead,” and that is to recognize that lowering the cognitive cost of use is in part a matter of *fluency*. Although English is generally recognized as one of the more difficult languages to learn in the world, fluent speakers are unaware of the “cognitive overhead” of English when they are engaged in discussion. English is transparent to both speakers and listeners who are fluent. Similarly, as with a language or a musical instrument, practice and fluency render IBIS both transparent and powerful.

As simple as IBIS is, it can be broken down even further to increase its simplicity for those in the learning phase. One part of IBIS is Questions and Ideas/Answers, the basic constituents of dialog dating back to Aristotle. Virtually anyone can listen to a debate and quickly discern what the question is (or questions are), and what the positions or possible answers are. Moreover, the majority of comments in an analytic discussion are questions and answers, so you can map much of these interactions using only these two IBIS elements.

More challenging for IBIS students is the proper use of Arguments, the pros and cons for the various Ideas. Of course, the *concept* of Arguments is simple and intuitive. Most people are quite used to thinking in terms of tradeoffs, benefits and disadvantages, strengths and weaknesses, opportunities and a threats, and so on. These are the basic terms of critical analysis. However, there are subtle pitfalls for the unpracticed. For example, some arguments clearly object to an idea, e.g. “X is too expensive.” But sometimes an argument supports an idea, but because it contains “negative words” it gets erroneously linked as an objection, e.g. “X is not unacceptable to party Y.” In applying Arguments clearly and correctly a background in logic can come in handy! In any case, it turns out that only about 10% of the nodes in open-ended and exploratory discussions are Argument nodes, and even less in more structured analyses, so, again, these are the least important of the IBIS elements (27).

In summary, distinguishing the three basic elements of IBIS – Questions, Ideas, and Arguments – can become, with practice, very natural. Indeed, many people report that, having learned IBIS, they find it very frustrating to listen to discussions in which the participants are not making these basic rhetorical distinctions! (We explore some ways of dealing with training costs and the learning curve in Section 8.) Moreover, participants in meetings in which IBIS mapping is done on the fly, either with markers on a white board or with software on a computer projector, find the notation quite natural and obvious. No explanation is necessary, and any sense of mystery about what is going on generally vanishes quickly -- assuming, of course, some level of fluency in the person doing the mapping!

One final note on IBIS: in addition to how simple and natural this notation is, it is also important to convey the *power* of IBIS as a mapping notation for complex analyses. It is

easiest to see this power simply by reflecting on what happens *without* such a notation. Different players have different ideas about what the issue is, especially in a wicked situation. Each player addresses their comments to *their version* of the issue, but it is often unclear how many versions of the issue there are, or what they are. Making the issues explicit in an IBIS map adds a tremendous clarity to the discussion, as does being clear about which of those issues a given comment is addressing. Wicked situations often have dozens of interrelated issues involved, but human short term memory is limited to the familiar 7 ± 2 chunks of information, so unless one is extremely familiar with all of the information related to all of the issues, the unaided exploration of these issues is confusing and error-prone. The power of IBIS as a notation is that it organizes all of the issues, positions, information, and assumptions so that all participants have the issue map as a point of reference, and they can refer to it instead of trying to keep it all in their head. Thus IBIS contributes to Compendium being a “cognitive aid” because it augments human cognition at one of its weakest points: the limits of short term memory.

Open and Closed Questions

Much of the power of IBIS derives from its artful application, and nowhere is that art more evident than in the creation of *questions*. Artful questions must be simple, not compound. (“What are they planning, and how are they going to do it?” is a compound question – in IBIS it should be broken into its two component questions.) Artful questions do not try to “sneak” assumptions into their statement (e.g. “Given that they are a bunch of mad zealots, what are they planning to do?”). And artful questions are open, not closed. (“What are they planning to do?” is open, “Are they planning to attack?” is closed.)

A closed question is one for which the answer is “yes” or “no”, or which lists the possible answers in the question (e.g. “Are they planning to attack or to retreat?”). Closed questions contain the answer and simply ask for verification. Years of experience have shown that IBIS discussions that start with open questions are more creative and rigorous. Closed questions seem to “stack the deck” and close the mind to new possibilities.

And yet, closed questions are very common in everyday speech. Many meetings have closed questions as their agenda, and occasionally analysts are called on by their customers to answer closed questions.

Fortunately, IBIS makes it easy to “open” the question up. Suppose the starting question is “Are they planning to attack?” To open the question, simply locate the answer buried inside the question (in this case, “to attack”) and restate the question with the answer as an Idea: “What are they planning?”, “To attack”. All of the analysis about a possible attack can then be attached to the idea “To attack” (see Figure 6).

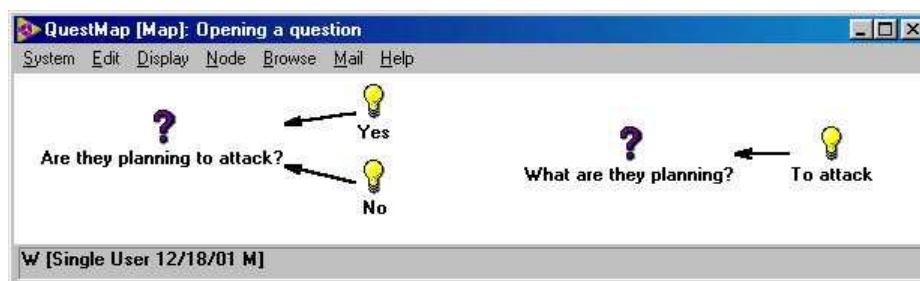


Figure 6: Opening up a question in IBIS

The forms are logically equivalent: the same arguments, issues, and evidence that apply to “Yes” on the left apply to “To attack” on the right.

Opening up questions is one simple example of how IBIS can support a creative and rigorous analysis ... without putting the analyst in a methodological straightjacket. In counter-proliferation, for example, the questions tend to be even more open, such as, "How might we know if Al Quaida has acquired nuclear weapons?" This is actually a meta-question, because it asks for an inquiry about how to do analysis.

*QuestMap*Ô

Another member of the Compendium family is QuestMap™¹², a Microsoft Windows tool for the rapid creation and maintenance of hypertext IBIS maps. Figure 5 (page 15) is a screen shot from QuestMap. IBIS and QuestMap are strongly connected – much of the preceding description of IBIS is based on having a tool such as QuestMap to create and manage IBIS maps.

IBIS-mapping tools such as QuestMap are specialized for fast and flexible information management, including:

- an interface optimized for rapid creation and modification of IBIS maps (for example, a new Question is created with a single keystroke, pressing the “?” key);
- a graphical view of the hypertext node/link network that facilitates orientation and navigation in large maps;
- ease of chunking information (for example, in a few keystrokes a new map can be created and a sub-tree of nodes and links moved into it);
- representing information in the hypertext structure, rather than in node contents – unlike the web, an individual node (i.e. “page”) usually contains only one information element.

In addition to the graphical IBIS links (the arrows connecting icons in Figure 5) there is another, somewhat unusual kind of hypertext link in QuestMap: **transclusions**, or transclusive links. Transclusion is a kind of “power quotation” in which the “quoted” material is not a copy of the original, it *is* the original material. In QuestMap a transclusion is created by copying a node into more than one map. When a node is transclusively linked between several maps, the node can be deleted from any map without affecting its occurrence in the others. If the node is edited in any containing map,

¹² QuestMap is sold by Group Decision Support Systems (GDSS) in Washington, DC. For more information, or to download a trial version, see <http://www.gdss.com/omq/aboutQM.htm>.

it changes in all maps. Finally, the user can easily find out the “Containing Views” (containing maps) of any given node (see Figure 7).

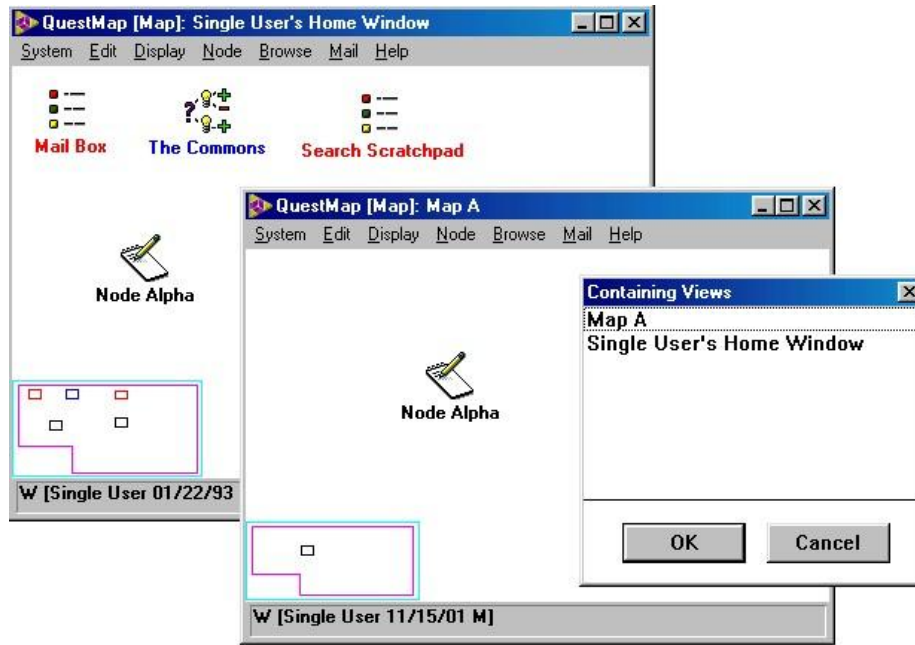


Figure 7: Translucive links between containing views

Node Alpha is in two maps (windows), as shown from the pop-up menu “Containing Views” (which resulted from right-clicking over the node). Selecting one of the Containing Views listed in the menu brings up that view window on the screen, with the transcluded node highlighted.

Translucive links allow the same chunk of information to be shared in multiple contexts. A node representing an important discussion map, for example, can be translucively included in any view where that discussion is relevant, thus adding a kind of “third dimension” to the network structures which can be created. Translucive links are a powerful way to represent a concept in multiple contexts. A node representing the Al Quaida organization, for example, might be translucively placed in several different analytic maps. One benefit of this is that if information about Al Quaida is added or changed in its map, it changes everywhere the map node appears. Another benefit is that, with the click of the mouse the user can see all the contexts in which Al Quaida has been referenced, and with another click can navigate directly to them.

QuestMap was originally created as a groupware tool to support multiple users, in different locations on a LAN, conducting IBIS-based discussions asynchronously (time shifted, as with email and many other groupware tools). Over the decade since its creation, QuestMap has been used by individuals and by groups, both synchronously and asynchronously. One of the most successful ways of using IBIS and QuestMap has proven to be in face-to-face or virtual meetings (synchronous collaboration), to create IBIS maps of the meeting discussion. The art of collaboratively creating an IBIS map with a group in real time, a core Compendium skill, is called “Dialog Mapping.”

Dialog Mapping

Dialog Mapping is simply a facilitation technique in which the Facilitator captures the group's discussion in real time in an IBIS map. Dialog Mapping can be done on a piece of paper or a flipchart pad, on a whiteboard, or using software such as QuestMap¹³. Dialog Mapping is a major aspect of the Compendium technique; all of this discussion about Dialog Mapping applies to Compendium as well.

The role of the Facilitator has two component roles: one role includes engaging with the group in traditional facilitative ways (i.e. watching the clock and keeping the group on task), and the other role, also known as “technographer,” focuses on listening and typing at the computer. Although one person can perform both roles, it is often preferable if two people work together, one as Facilitator and one as Technographer. In this paper we will refer simply to “the Facilitator.”

In Dialog Mapping (formerly known as VIMS, Visual Issue Mapping System) the group actively and collaboratively engages with the creation of the IBIS map. Central to Dialog Mapping is the notion of a “shared display” (see Figure 2, page 11), a projected computer display of hypertext software showing a map of the knowledge and reasoning of the group, unfolding in real time. The shared map focuses the group's energy, encourages creative and rigorous thinking, and creates a group memory of the issues and information discussed.

Dialog Mapping works because of the skill of the Facilitator. The Facilitator is sometimes referred to as a “chauffeur,” because (unlike traditional facilitation) the Facilitator's job is to serve as an unobtrusive link between the group's conversation and the shared map. If group members are only speaking to each other and not looking at the shared map, then the Facilitator is not doing his or her job. Skillful Facilitation means listening to the comments of the group and capturing them in the map in a way that clarifies meaning and adds value to the conversation. The group learns to look at the map because, when it doesn't, it gets lost or goes in circles. The Facilitator is in charge of ***listening***, and thus assures that there is a high quality of communication present in the session.

Of course, sometimes the group doesn't pay much attention to the map, and occasionally the group wants the mapping to go faster or to go in a different direction. As with any group intervention, there are dozens of factors and parameters that contribute to the success or failure of a given Dialog Mapping session. One of the most important skills a Facilitator must learn is keeping the group focused on the map and maintaining the group's ownership of the map. Another critical skill is the ability to listen and type at the same time¹⁴.

¹³ Dialog Mapping is described here in the face-to-face meeting context; the process is similar, but with some differences, in facilitating a virtual meeting.

¹⁴ There are many very good traditional facilitators who do not have great typing skills. It is important to bear in mind that Compendium Facilitation requires an unusual mix of skills, or two people: one to facilitate in the traditional sense and one to be the “technographer.”

Because Dialog Mapping is about the transparent crafting of a high quality map of the group's thinking, sometimes a Facilitator just listens, types, and edits the map. At other times more intervention is called for, including process guidance such as suggesting topics or calling for a break. The Facilitator must sense the needs of the group and make judgments about what kinds of process intervention and guidance, if any, are appropriate.

Dialog Mapping does not work in every kind of meeting or with every kind of group. Sometimes the map ends up being nothing more than fancy meeting minutes. Section 5 sketches a hypothetical scenario in which Compendium is used in several aspects of analysis. In Section 6 we describe a meeting of analysts in which there was an experiment with IBIS and Dialog Mapping. In Section 7 we explore analysis settings in which this approach has promise.

The Compendium Technique and Mifflin

Another component of Compendium is Mifflin. The Mifflin software tool is a superset of QuestMap – it is a mapping tool which has most of the features of QuestMap and significant other features in addition. Similarly, the Compendium technique is a superset of Dialog Mapping – it is Dialog Mapping plus a modeling framework, the World Modeling Framework, and techniques for creating, navigating, and maintaining World Modeling Framework models.

IBIS and Dialog Mapping are good tools when the problem being addressed is moderately structured. For situations when there is more information and it is or can be organized into more regular structures (such as requirements analysis on a technical project), the “Compendium technique” brings a more powerful set of tools to bear. The Compendium technique adds a semi-structured modeling approach to Dialog Mapping, extending the range of facilitation options (29). If Dialog Mapping is suitable for mapping out less structured problems, e.g. a discussion on “What is the problem here,” the Compendium technique is suitable for situations where there is a lot of information and the group needs to make it explicit, organize it, and make sense of it.

Three of the most critical elements added by the Compendium technique are *question-based templates*, *metadata*, and *nested maps*. These elements taken together allow groups to move from informal representations to more formal ones (and back), and from prescribed to spontaneous approaches (and back), as the needs of group and the problem dictate.

Question-based templates. The World Modeling Framework¹⁵ describes recurring patterns of attributes as they structure the subject matter of a particular subject or domain of knowledge – these patterns are reflected in question-based templates (Figure 8). Question types and Answer types may be driven by a specific methodology, but a hallmark of the approach is the ability to break from formal and prescribed representations into 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

¹⁵ Readers interested in the details of the World Modeling Framework can consult (30).

in accordance with templates or in an opportunistic fashion. (Note that the templates are expressed in terms of the IBIS elements Questions and Ideas, but this is a syntactic device, not an argumentative use of IBIS as described above.) The template in Figure 8 is shown instantiated in Figure 10.

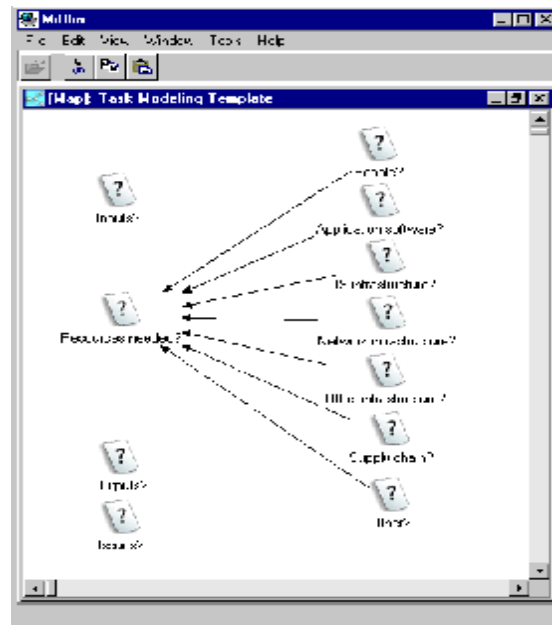


Figure 8: A Compendium question-based template representing a model of tasks¹⁶
The template has four slots at the top level, and seven slots at the second level.

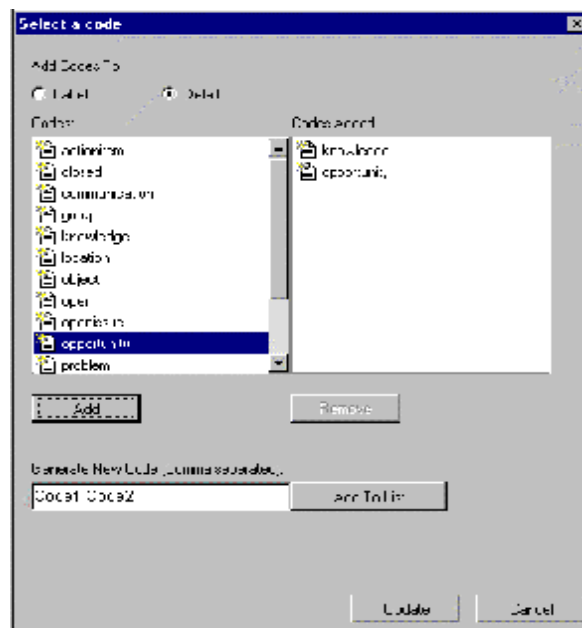


Figure 9: Menu for adding optional metadata codes to a node

Such metadata “tags” added to the content of a node (in this case the tags “knowledge” and “opportunity”) assist subsequent harvesting and analysis of elements.

¹⁶ These screenshots are from the Mifflin hypertext system.

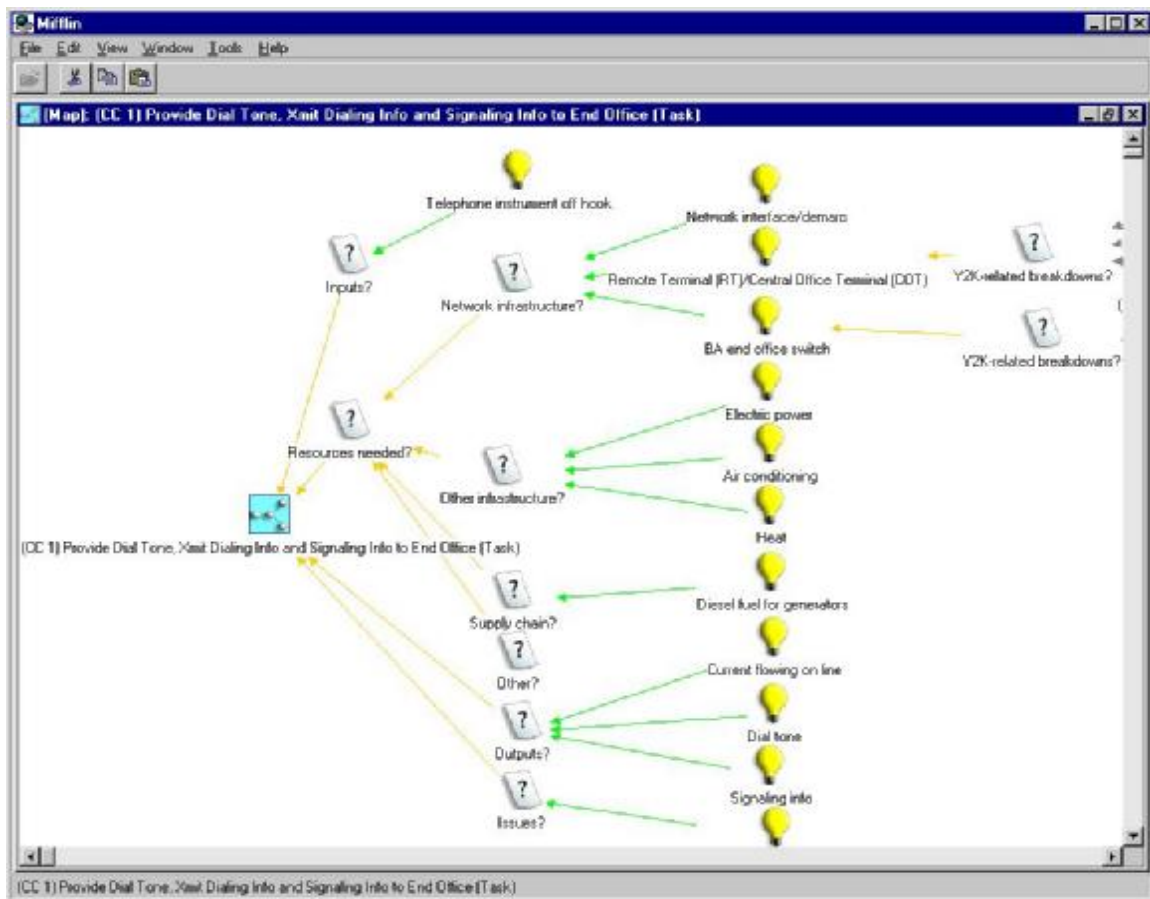


Figure 10: The 'task' template instantiated for a particular task

Note that the Question nodes correspond to those in the template in Figure 8, and that the rest of the nodes provide specific information about a particular task in the model.

Metadata. Metadata codes are keywords that can be assigned to any concept in the database (Figure 9). For example, if an action item comes up during the group's analysis of a concept, that concept's node can be quickly labeled with an "ActionItem" code. At the end of the session all of the nodes so marked can be harvested and printed out. Ad hoc codes can be created on the fly, for example to label all the nodes that relate to a particular organization, person, or country.

Nested maps. Compendium's maps support the granular representation of concepts (as hypertext database objects) so that they can be spatially organized, recombined and reused in multiple contexts. By embedding maps in other maps, a group can "drill down" from a high-level representation of concepts to detailed descriptions and plans. Maps synergize with the conceptual framework to create a fractal¹⁷ representation of the group's knowledge – the model can be deepened and formalized wherever necessary, and left superficial elsewhere.

¹⁷ A fractal is a geometrical structure in which a pattern is repeated at ever smaller scales to produce irregular shapes and surfaces. Upon magnification fractals keep revealing the same pattern of intricate detail without end.

The Mifflin hypertext software, shown in these figures, extends the power of QuestMap by adding features that specifically support Compendium techniques such as question-based templates, metadata tags, and nested maps. Mifflin is a Java software application that, while not a supported product, is available on an experimental basis from Verizon Communications. More details about the features of Mifflin are provided in Appendix B: Mifflin and QuestMap.

What Compendium Does Not Do

At a glance Compendium may appear to be similar to other IT systems for analysis and collection support. It is useful, therefore, to understand what Compendium is *not*.

First, Compendium is not really information technology (IT) in the usual sense – Compendium is a “augmentation” system that only makes sense in the hands of a skilled Facilitator. Compendium – in its current state – does not do any automatic processing of information. It does not do automatic filtering or sorting of information. It does not have artificial intelligence (AI), nor does it do inference or fuzzy logic.

Compendium is as perhaps more method and technique than it is computer tool. Ultimately, the tool part of Compendium is like a cross between a word processor and a hypertext diagram editor. Compendium is not powerful because of what the computer does – it is powerful, in the hands of a skilled Facilitator, because of how it augments the way people communicate and collaborate with each other.

Summary of Compendium

A common problem in collective work is sorting out what level of detail and abstraction the group needs to be focused on at any moment. For example, one of the most challenging collaborative tasks – in any field – is collaborative writing. In part this is because participants are working to create and organize the ideas (content) of the document at the same time that they are working on the expression of those ideas (style, wording, grammar, spelling, etc.). This often leads to unproductive disagreements (e.g. the “happy/glad” debate: whether to use “happy” or “glad” in a sentence) as participants stumble between content and style. Moreover, this kind of disagreement can mask a deeper lack of shared understanding about the issues and concepts, resulting in endless and irresolvable disputes over wording.

Compendium addresses this problem by providing a “pure content” framework – a semi-structured model – for the problem at hand. Participants can stay focused on the content level because it is starkly and graphically represented in the hypertext shared display. Moreover, disagreements over content are not mere verbal jousting matches – the Facilitator works with the group to bring the participants’ best thinking to mapping out the opposing options and their respective arguments, and perhaps even introducing new options. While this emotional “distancing” does not make the debate disappear, it removes its fangs, and allows clearer heads to negotiate new meanings and formulate new options. In many cases, a clear “winner” emerges simply through the process of open

dialog, and even when this doesn't happen, the Compendium model presents the options and tradeoffs clearly to the decision making authority (i.e. the chair of the meeting).

5. A SCENARIO OF COMPENDIUM ANALYTIC USE

The Compendium approach, like sky diving or a great movie, seems to resist clear understanding without experiencing it. This section offers a fanciful "story" about the use of Compendium in an analytic setting to try to get a glimmering of this experience across to the reader, and to highlight various features of the tools and the process of the Compendium approach.

Unfortunately, to keep the level of detail at an approachable level, this scenario is simplistic and naïve about some of the realities of intelligence analysis. The processes of collecting intelligence, tasking, analysis, and presentation are vastly oversimplified here. To be more realistic, this scenario would need to include much more information, attempts to identify and deal with misinformation, coping with pitfalls like mirror-imaging, etc. Moreover, although real names of organizations are used, no attempt has been made to achieve accuracy of the substance. This story is thus meant merely to illustrate Compendium features in ways that are suggestive of possible directions for future development.

This scenario is broken into two scenes. The first depicts an analyst using Compendium to gather and organize information; this scenario illustrates some key features of the mapping software and how it is used. The second scenario depicts a group, such as a Red Team or a Task Force, using Compendium in a facilitated mode; this scenario illustrates the process of creating shared understanding using a shared display.

Scene One. John C. is a recently-hired CIA analyst who is in a group focusing on the Eastern Asia region. One of his first tasks is to begin educating himself and assembling research materials on possible links between the Al Quaida organization and weapons of mass destruction (WMD). Sitting at his desk, John turns to his workstation, and within a few seconds has started organizing this thoughts. He opens the Compendium mapping tool, creates a new map, and types in the question just as the customer posed it, "Does Al Quaida have WMD?" (see Figure 11).

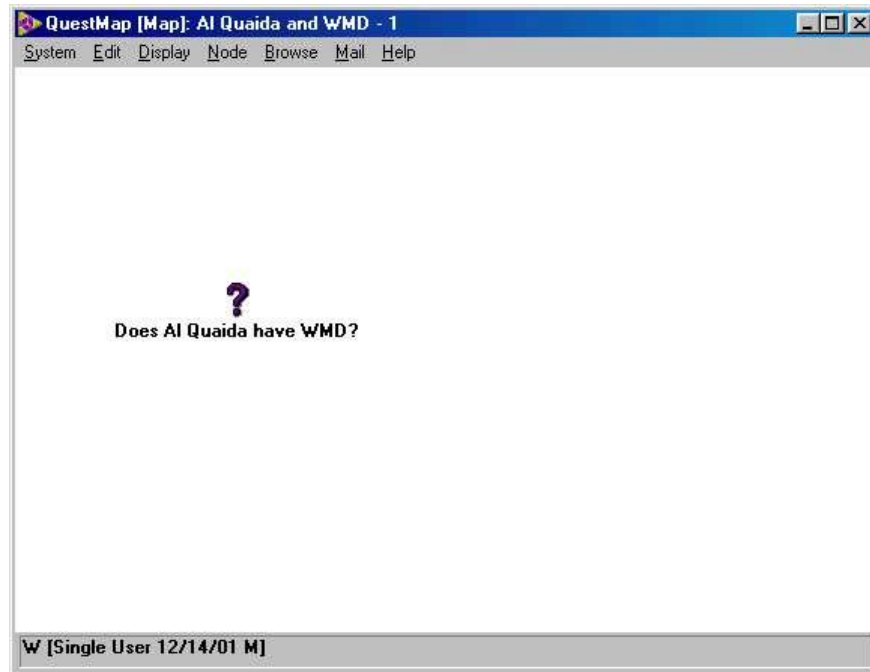


Figure 11: In the beginning ... the Question

This node was created simply by pressing the “?” key and typing in the label.

He then quickly notes some of the terms of reference for this task. First he amplifies the “WMD” term, spelling out the parts (see Figure 12). He also quickly jots down some of related questions as they come to mind.

Realizing that he wants to keep these related issues separate for the moment, John creates a new map, links it, and moves the set of related issues into it. This takes only a second (a few keystrokes) but gives a satisfying clarity to the main map (see Figure 13).

Making Sense of Fragmentary Information

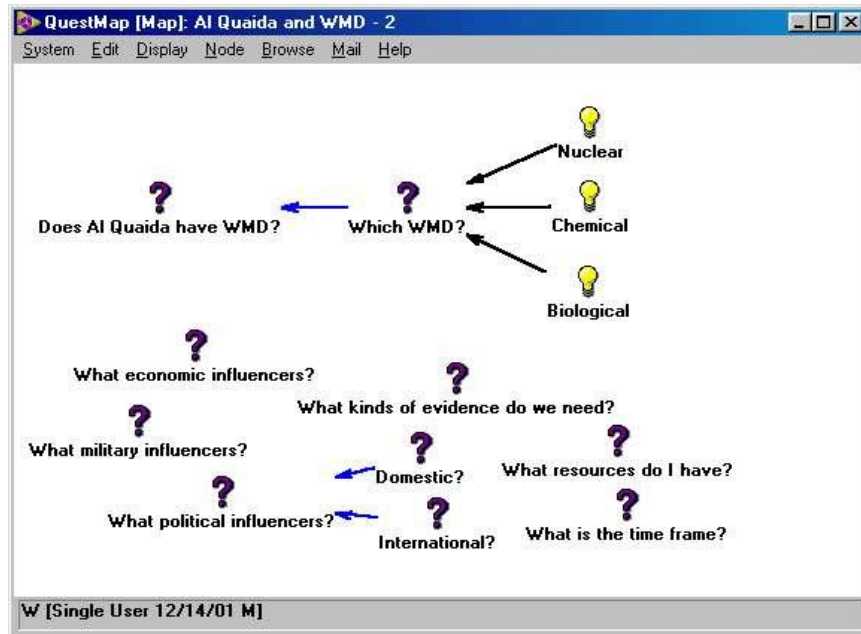


Figure 12: Brainstorming basic issues to address

Nodes can be placed anywhere within maps, and there is no limit to the number of nodes or links.

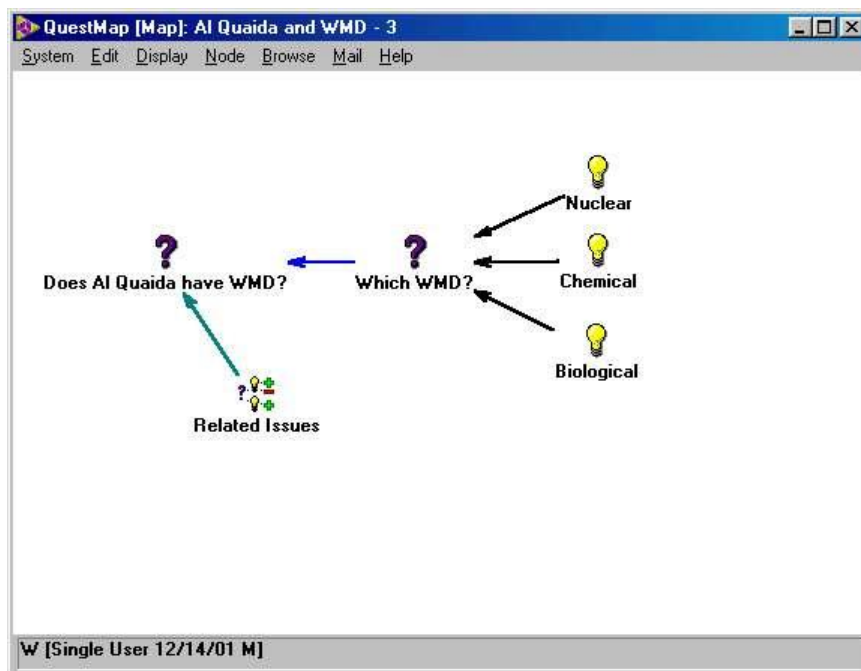


Figure 13: The new issues are chunked into a “submap”

The node “Related Issues” represents a whole new map. Double clicking on this icon opens a new window; there is no limit to the nesting of maps in maps.

But before tackling the main question, there are some points and some links to source documents that he wants to capture, so he opens the related issues map and notes some

basic information and evidence that he already knows (see Figure 14). As the map gets large he clicks on the hot key to open the “Full Map” (shown in the lower left corner), so he can maintain his orientation and can move around the large map more easily.

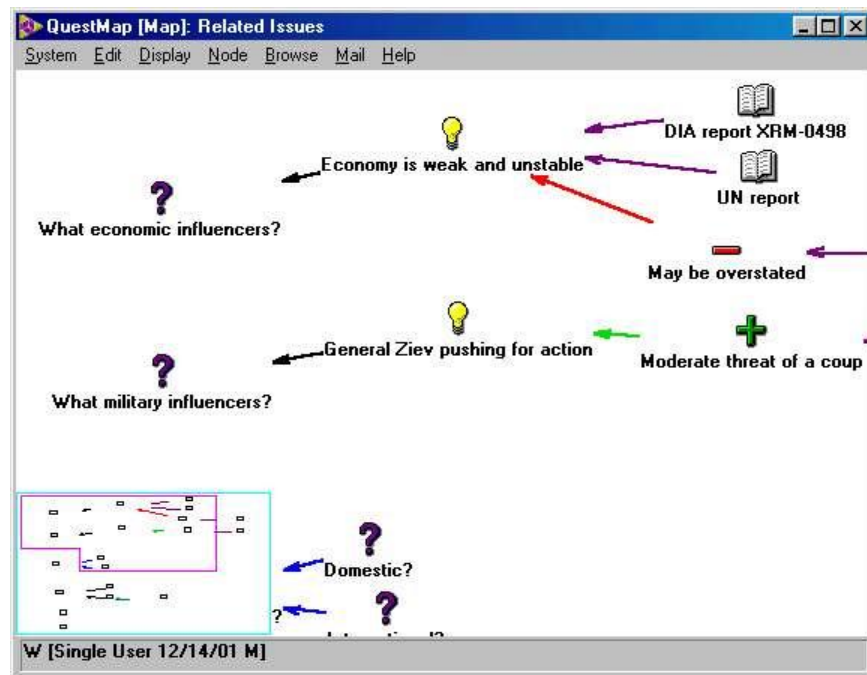


Figure 14: Collecting related sources in the submap

Note the “Full Map” in the lower left that shows the whole map, with the portion visible in window indicated in the purple wire frame.

John then returns to the main map (Figure 15) and lays out the arguments on both sides for Al Quaida’s access to nuclear and chemical weapons, as well as the supporting evidence links which he pulls in from a search engine. The diagram at this point (Figure 15) makes clear what he already sensed: he doesn’t have any current knowledge about the terrorist organization’s access to biological weapons. It happens that he has a good friend from his previous job, a senior analyst named Betty at DIA, who knows a lot about biological weapons, and he decides to give her a call and see if she can help him.

Once they connect on the phone John and Betty are able to quickly open up a shared-desktop connection¹⁸ that allows John to show Betty his Compendium map and brief her on his problem. Betty immediately thinks of several sources that John should know about, and she agrees to email the links of them to John. When he gets the email, John is able to quickly map out the arguments for and against Al Quaida’s access to biological weapons with hotlinks to Betty’s supporting documents. (Of course, if Betty were a Compendium user as well, and she had access to the same database, she could have added the links herself.)

¹⁸ Such as a secure equivalent of desktop conferencing applications such as NetMeeting, Webex, or PlaceWare. These tools would not require Betty to have the Compendium software, only to have the conferencing application.

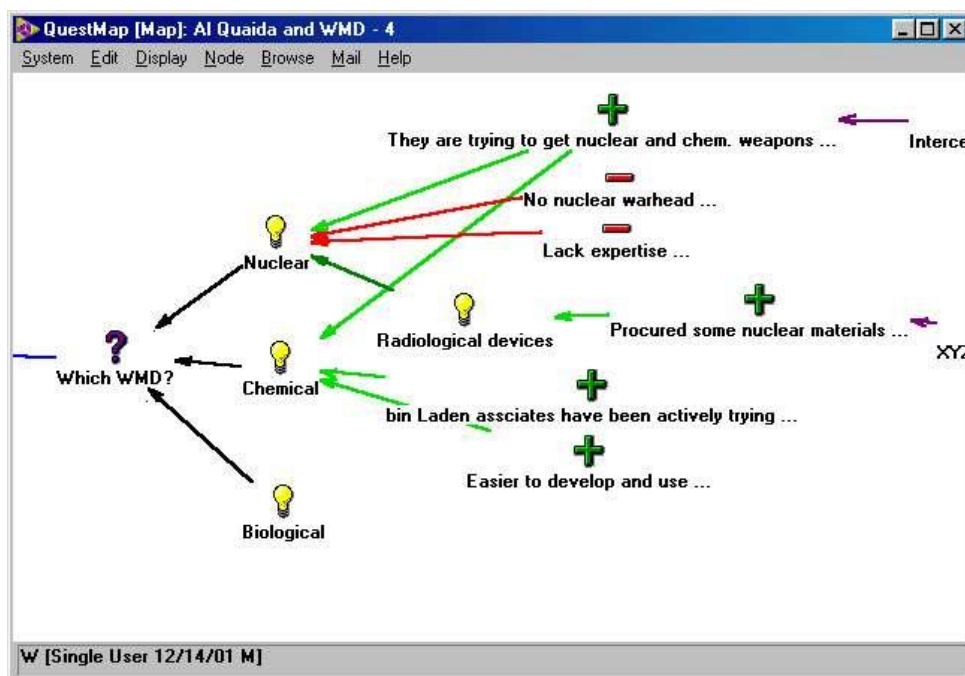


Figure 15: Collecting sources and noting support relations

Although the map structure is usually a tree, it is not required to be strictly hierarchical; for example, arguments can support or object to several ideas at once.

John also knows that there have been some recent signs that Al Quaida members were colluding with other groups, especially in Iraq, to get access to chemical weapons. Buzz, who is at the State Department and who is a Compendium user, has been tracking this one, so John sends an email to Buzz including a link to his main map. In the email he asks Buzz what the status is of connections between Al Quaida and Saddam Hussein's regime.

When John comes in the next day he has new mail waiting from Buzz. The message includes a Compendium map that Buzz has been working on for another report concerning Hussein's activities (Figure 16).

As he reads through the map John realizes that this information is directly relevant to his report, and he is able to quickly create a "translusive" link from Buzz's map to his own analysis, so that as Buzz's map expands and evolves he can always click on it and see the current version (Figure 17).¹⁹

¹⁹ There are some challenging technological problems hidden in this example. Normally John and Buzz would have to share the same Compendium database for them to translusively link maps. How to do this in the more likely case that their organizations maintain separate databases is a thorny hypertext research and development problem. In any case, John could simply link in a copy (a snapshot) of Buzz's map, much as he did with Betty's map, instead of using a translusive link.

Making Sense of Fragmentary Information

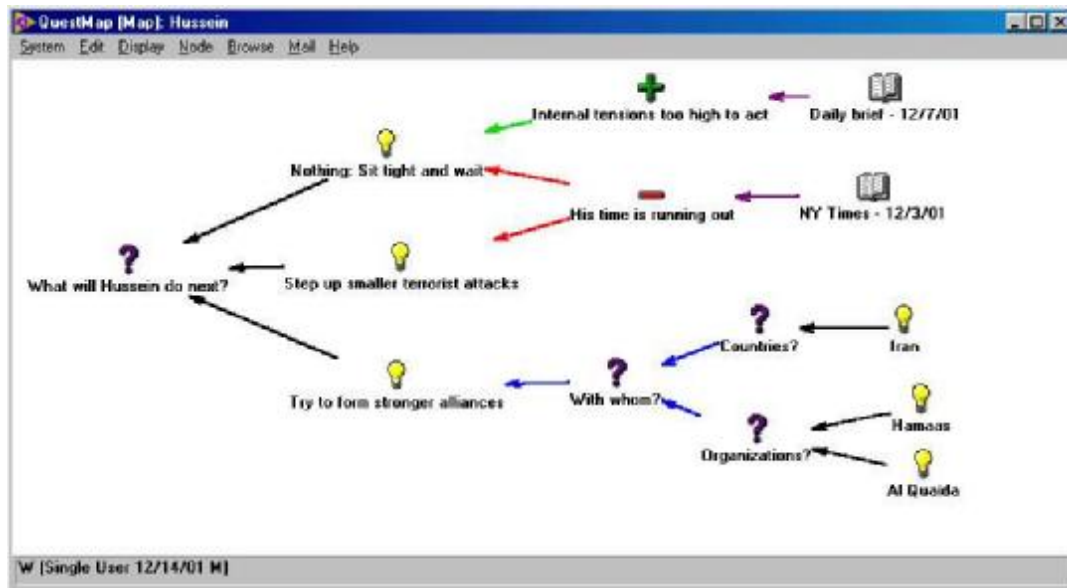


Figure 16: A colleague's related map

This map, labeled "Hussein," is stored in the Compendium database.

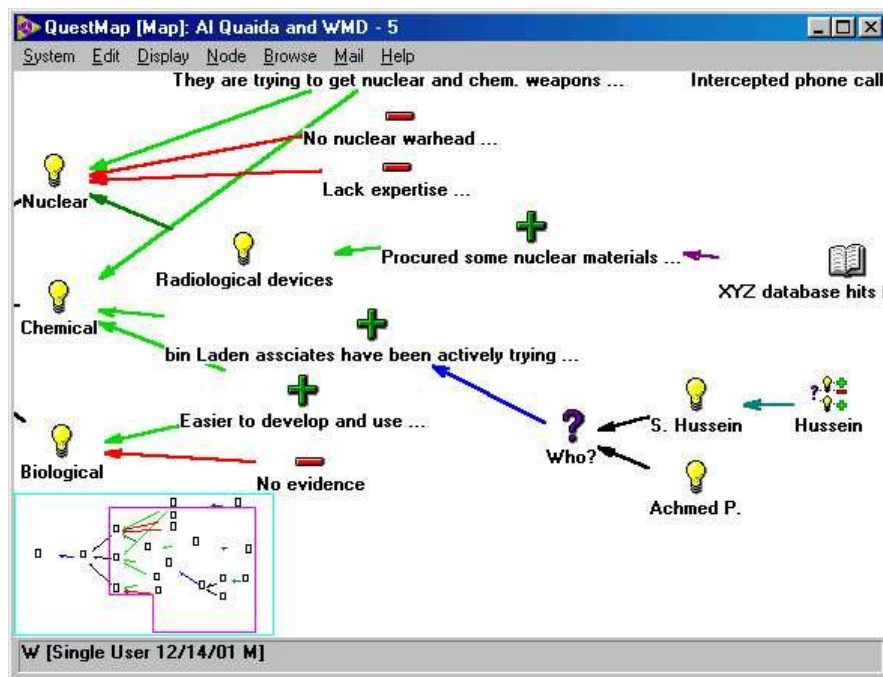


Figure 17: The related map ("Hussein") transclusively linked

Note the "Hussein" map node at the right is graphically linked to the idea node "S. Hussein," as well as transclusively linked into this map. Such transclusive links can be added without limit, and they add a "3-D" aspect to maps.

After some time of doing searches, reading documents, talking to colleagues, and building Compendium maps, John is feeling like he is starting to assemble a solid knowledge base on this subject (Figure 18). Of course, he knows far more in his head

than is captured in the Compendium maps, but the maps serve to help him organize and keep track of the basic categories of evidence.

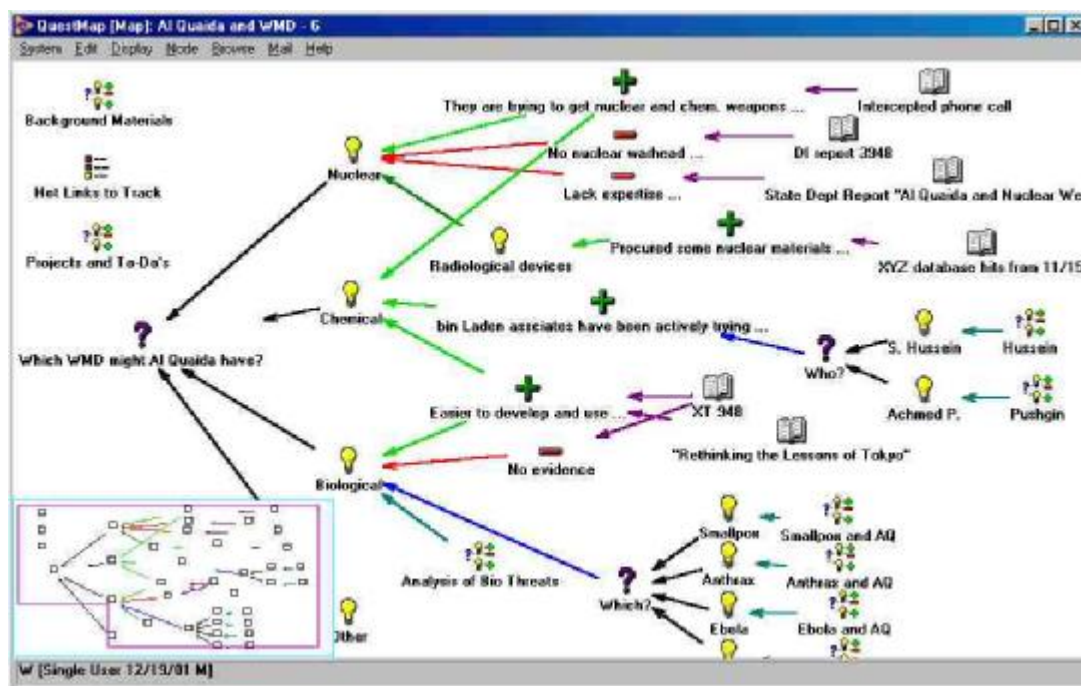


Figure 18: John's main map after further research

Note that this map has grown mainly by having new map nodes added to it. This nesting structure is easy to create and to change, and adds flexibility and clarity to complex collections of information.

One day John's immediate supervisor, Phil, asks John to give an informal briefing on the whole topic area to their group. The idea is to give John a chance to contribute to the group informally, but more importantly to have him benefit from the thinking of some of the more senior members of the group. Also, since Phil's group is exploring using Compendium in presenting complex issues (or extended logic trains) to their intelligence consumers, Phil asks John to use Compendium as his presentation medium.

John is excited about the opportunity to share his research with his colleagues. He starts his preparation by printing out a Compendium report that summarizes all of his maps on Al Quaida and WMD. Compendium automatically creates a Word document containing the contents of several of his main maps, which serves as his outline for his briefing. John gives Phil a copy of the summary report before the briefing, so that Phil, who prefers reading printed documents to reading computer screens, has a chance to make sure John is on track.

For the purpose of this briefing John creates for his audience a high-level map that organizes all of the materials in a simple structure that will be familiar to them (Figure 19). Since the high-level map uses transclusive links into his own detailed maps, John can stay at the overview level until, as needed by the group, he can dive down into his own maps for more precise explanations, or to show specific pieces of evidence.

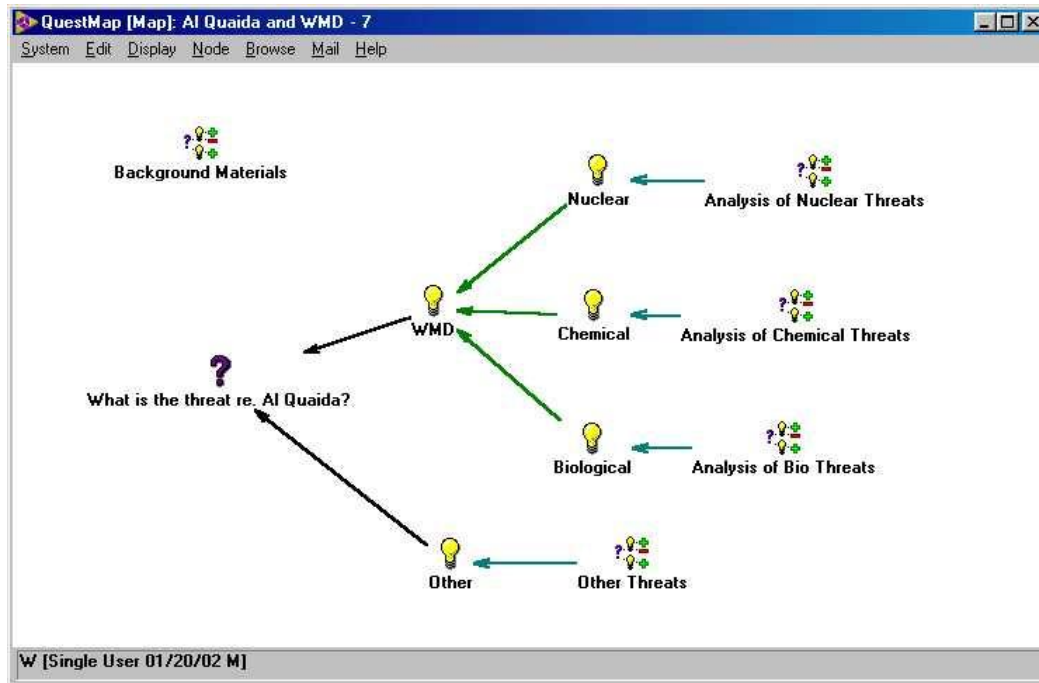


Figure 19: John's simplified presentation map

Compendium maps can be used for analytic research and for presentations, putting the analyst's assumptions, evidence, reasoning, drivers, and linchpins just one step away during a presentation.

On the day of the briefing John arrives a few minutes early to make sure the shared display equipment in the conference room is ready to go. During the briefing John uses the Compendium mapping software, projected on a screen, to walk the group through the key areas of his research. Of course, as members of the group make suggestions for additional references, John can instantly capture new links, or make himself hyperlinked "to-do" notes. Most of the questions that the group asks he has already anticipated in his research, and he simply navigates the hyperlinks to bring up the research that addresses the group members' questions and comments. At other times members of the group make points that he had not anticipated, which he captures and tags as open issues for future research and analysis.

Scene Two. Gretchen is a staff Compendium Facilitator for DIA. She has just been asked to facilitate the sessions for a new Task Force that has been formed on Al Quaida and WMD. Since John has also been assigned to the Task Force, Gretchen has been referred to John for help in preparing for her first Compendium session with the Task Force.

Gretchen has two meetings with John. Initially, Gretchen reviews John's maps on her own, then at their first meeting (which is virtual) John answers Gretchen's questions about the structure and substance of his maps. In their subsequent face-to-face meeting Gretchen goes over the maps she has prepared for the Task Force and John coaches her in getting the right over-all structure and level of detail.

Also, before the first Task Force meeting, Gretchen meets with the George E., the leader of the Task Force, to make sure that they are clear about the ground rules, objectives, pacing, and structure of the meeting. George gives her a diskette with several background documents, including the charter for the Task Force, which she is able to automatically process into Compendium hypertext maps as additional meeting preparation.

On the day of the Task Force meeting, Gretchen arrives early to set up her equipment. Although the conference room is old, Gretchen is able to get the computer projected large and bright enough that everyone in the room will have no problem seeing the Compendium maps. After George and the seven other task force members arrive and take their seats, George welcomes the group and gives a brief orientation about the overall mission of the Task Force. He asks each member to introduce themselves to the group and, when this is done, he turns to Gretchen, introduces her to the group, and asks her to explain her role.

Gretchen stands up and says, “This is Compendium,” gesturing toward the screen (Figure 20).

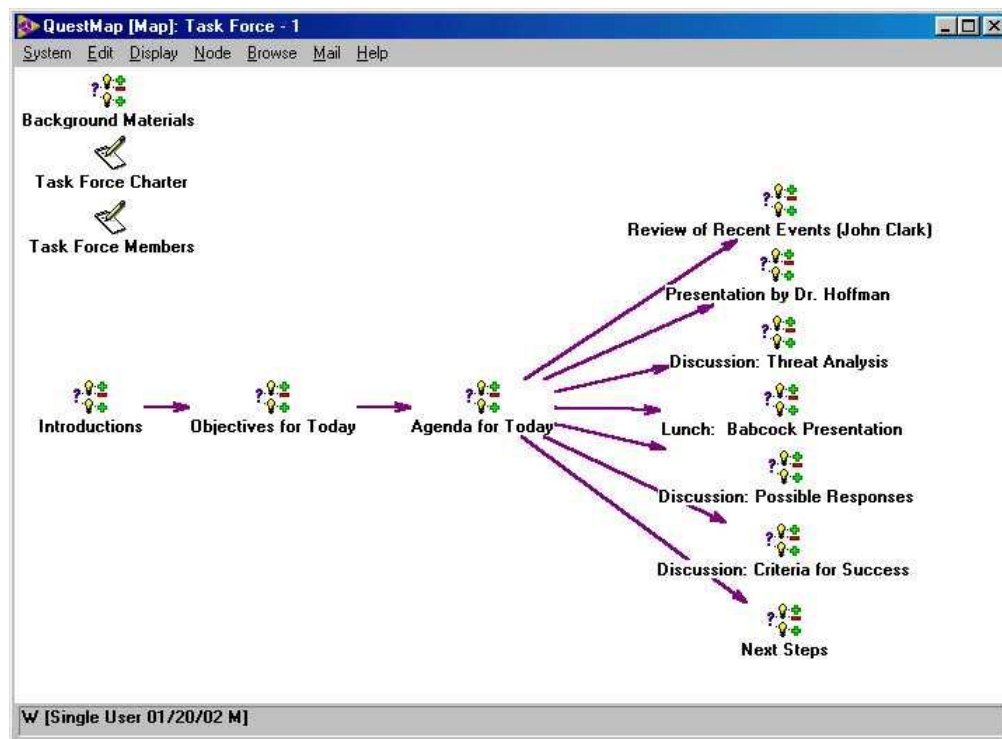


Figure 20: The "Agenda Map" for the first Task Force meeting

This top-level map for the meeting is a “meta-map”: it shows the agenda and provides a literal “roadmap” for proceedings of the day. Any changes or adjustments during the meeting are easily made in a way that everyone can see and understand.

“Think of it as an unlimited electronic flip-chart, and as a mapping tool for conversations. My job in our sessions is two-fold. First, I will be capturing your comments, as much as possible, so that we have a record of the meeting. Second, I will be facilitating the

conversation using the map up here on the screen. The map will show us where we started, where we're going, and, at any given point, where we are. So I will be asking you for three things: one, to read and refer to the map; two, to help me capture your comments accurately; and three; to help me keep our discussion on track and on the issues in the map. Not only will this make today's meeting more efficient, it will allow this Task Force to be much more efficient and effective over the next few months. Please let me know as we go along today anything you need to have this process work better for you."

After George says a few more words of orientation about the day, Gretchen takes over and displays the main map (Figure 20). She reviews the flow of the agenda in the map, and briefly opens the "Background Materials" map so that everyone is aware of the materials that are linked in there. Then, opening the first map in the agenda, she turns to John and asks him to brief the group on background and recent developments.

John's brief presentation is similar to the one he gave to his group, except this time he has a Facilitator to navigate the maps for him and to capture the group's comments. After a few minutes of discussion to clarify some of John's comments, Gretchen says, "Does anyone have any additional points that we should add to this map?"

After a pause, one Task Force member, Mary, says, "Well, biological WMD is not my strong point, but I saw a reference yesterday to a new report just released by the CDC that I think should be included." She promises to send a link to the CDC report to Gretchen immediately after the meeting, and Gretchen sends Mary an email reminder with a link to the map to remind her to follow up.

Louis, another analyst, then says, "You've got a couple of good sources on the nuclear weapons angle, John, but I'm not convinced that you can dismiss that option yet. In my work with the nonproliferation folks we're very concerned about nuclear materials that Al Quaida may have acquired." Gretchen captures Louis' comment as a new supporting argument for the idea "Nuclear", and encourages him to provide more details that she can put in the map. As Louis speaks, Gretchen types, creating new nodes and putting the facts and examples he is using in the node details.

As Louis is speaking it is clear that John wants to respond, and several times he starts to speak. But Gretchen signals him to wait, and when Louis seems satisfied that his ideas have been heard, she turns to John. John says he wasn't aware of several of Louis' sources, but he still feels that the nuclear option is a long shot. At this point George George steps in, and asks Gretchen to simply put a note in the map indicating that the Task Force report should reflect that it is unclear at this point what the likelihood is of Al Quaida having nuclear weapons, but that it is an issue that needs more collection and analysis.

Over the course of the session, many other concerns are raised, discussed, and mapped. Some of the issues deal with major options and points, while others deal with details covered in some of the submaps. Each time, moments of apparent conflict between two Task Force members are resolved by capturing the key elements of the discussion, and

finding new ways to organize the discussion map so that the underlying unity of purpose of the Task Force is clear and preserved.

At the lunch break, Gretchen prints out Compendium reports of the morning's discussions and hands them out to the group, asking everyone to review the notes and let her know if there are any corrections. Similarly, at the end of the day, she prints out an automatically-generated Word document that summarizes the discussions of the day, including new sections listing the open issues, the action items with individual assignments, and the next steps for the group. As the Task Force members receive their copy of the notes on their way out they acknowledge Gretchen for her notes and for the sense of coherence of the day's collective work.

Summary. Each of these two scenes illustrates a different aspect of Compendium as it might apply in different settings in the IC. The features of Compendium highlighted here are:

- Ability to organize loosely-related research materials into a variety of structures;
- Ability to categorize knowledge objects for later search and analysis;
- Ability to capture the argumentation logic and line of reasoning for judgments and conclusions;
- Ability to create and manage hyperlinks to evidence and other supporting documentation, weaving these into argumentation structures with a few key strokes;
- Ability to create "meta-maps" providing specialized views of the knowledge base, such as "presentation" and "agenda" maps;
- Ability to incorporate novel and unexpected new material into the knowledge base;
- Ability to automatically process existing documents into Compendium hypertext format, and conversely to automatically create traditionally formatted documents from the hypertext knowledge base.

Despite these promising capabilities, Compendium is still in its adolescence as collaborative technology. All of these capabilities exist in the current generation of software, and all are currently used in real world non-IC settings. More research is needed, however, to identify the specific uses of Compendium in IC settings.

6. ONE STORY OF COMPENDIUM USE IN THE IC

One way to assess the potential value of Compendium in the IC could be by reviewing previous attempts to use it in analysis. Unfortunately, the experience base here is extremely slim. Sometime in late 1999 or early 2000 Compendium was used in a single substantive analysis meeting in the CIA. The meeting dealt with a serious and pressing issue related to conflicting information about the possibility of a coup. The meeting was called by a senior analyst in the DI and was attended by representatives from NSA, DIA, and the State Department, among others. A Facilitator mapped the conversation in IBIS

on a large white board, and another analyst captured the notes electronically (in QuestMap).

According to several analysts who were present at the meeting, the results of the experiment were mixed. The map was helpful once the meeting was underway, and it had great promise to help increase rigor, create a memory trace of the reasoning process, and support data-based decisions. However, no attempt was made to document the strengths and weaknesses of Compendium in this setting: it was done on the basis of a single analyst's impromptu interest in trying out something new. The main value of reviewing this "experiment," then, is to learn from it some potential pitfalls to watch for in the design of future research. These lessons are noted below in Section 8, Next Steps.

Here are some of the issues that some of the attendees of this meeting, relying on memory, recall being in play during the meeting:

- Using Compendium at the meeting was a big change from the status quo. One reason was because it sought to level the playing field among meeting participants that traditionally had a command and control relationship. Another reason was the introduction of facilitation into a forum in which the meetings were typically chaired.
- There was apparently some issue about capturing concerns as "cons" (IBIS objecting arguments). Capturing a comment as a "con" in the map makes it an unambiguous objection to an idea, and this was evidently construed as disagreeing with the *person* who offered the idea. Ideally, the IBIS formalism should be used in ways to help clarify what kind of evidence will confirm a theory (an "outcome"), and to support the reasoning about how evidence supports and refutes various theories.
- There was some sense that some arguments may have been too politically and/or organizationally sensitive to be explicitly stated²⁰. This will generally be a factor in meetings in a political environment, but it may be heightened by the Compendium feature of capturing comments in writing.²¹
- The topic of the meeting was an esoteric and intractable issue. It was an issue which, at that time of the meeting (1999), had not been settled in twelve years.
- Only a few attendees took the meeting seriously, while the rest "sat on their hands", which impaired the quality of the discussion and the result. It is unknown why some attendees did not participate.

The Compendium Facilitator for this meeting recalled that it was hard to get the right people and the necessary amount of time to do a proper experiment with Compendium

²⁰ As a hypothetical example, an intelligence report and the reasoning behind it might be skewed by a policy-maker's known but undiscussable biases.

²¹ Most Compendium notes are unattributed; in rare cases, with group approval, the Facilitator will add the speaker's name to the recorded comment.

and QuestMap. He also recalled that it seemed that the mapping process initially slowed things down – and that it would have helped the meeting if there had been more preparation: if some critical content could have been captured and mapped before the meeting.

These notes on this single meeting are offered here simply because it is the only such “experiment” of which the author is aware. It was not a true experiment, in that there was no hypothesis about the Compendium intervention, no method of evaluation, and no analysis of the impact. Nor was it a pilot study. It simply was an ad hoc attempt to try out a novel facilitation technique. There is no way to know to what extent the issues listed above were connected to the use of Compendium, or to the Facilitator, or to the group of attendees, or to the topic.

More deliberate experiments with more carefully controlled parameters (see Section 8, Next Steps) will be necessary to determine what if any value Compendium has to offer in analytic meetings, and which particular settings (perhaps beyond analytic meetings) in the IC are the best fit for the Compendium approach.

7. POTENTIAL APPLICATIONS OF COMPENDIUM IN INTELLIGENCE ANALYSIS

Intelligence analysis is practiced in a variety of ways in the U.S. Intelligence Community (IC), but a common theme across the board is the focus on delivering a high-quality intelligence product (e.g. a report or briefing) on a complex and dynamic subject in a short amount of time. In some agencies and situations individuals produce the intelligence products, while in others there are several analysts involved and there is some level of collaboration in the analysis and/or the production process. Compendium’s record keeping function may also be useful in some cases.

In intelligence analysis Compendium has potential value in several contexts:

- As a new way to encourage and support inquiry, especially in new teams, such as the Process Action Team (PAT), multidisciplinary analytic production team²², Red Teams, and Task Forces;
- As an aid to collection (especially HUMINT collectors) as well as analytic efforts, to the extent that the clarification and prioritization of key questions occurs well and early;
- As a presentational aid and graphical technique for use in presenting complex issues or extended logic trains to intelligence consumers;

²² Analytic production teams “are characterized by collaboration among members representing multiple analytic specialties and are structured to ensure high performance in meeting particularly demanding needs of US policymakers and action takers.” From (3).

Making Sense of Fragmentary Information

- As a way to support management (non-analytic) meetings, such as strategic planning and resource allocation, where complex process and operational issues are at stake;
- As a tool for the individual analyst (especially for junior analysts or for projects that are early in the analytic process) to collect and organize loosely structured information, ideas, issues, and assumptions in ways that preserve and support the argumentation logic of the analysis;
- As a process that supports IT planning and oversight, because this is a technical domain in which Compendium has a natural setting and a strong track record; because of the strong technology component in Compendium-facilitated meetings, often IT staff easily accept this approach.

Because of Compendium's ability to help a group make sense of a complex situation and to efficiently focus on the key issues and actions required to move forward, it seems possible that there are many settings in the IC in which Compendium may be of value. However, to be adopted Compendium, like any new tool or process, will need to demonstrate its value in the IC, and will need to show a positive return on investment (ROI) for projects in which it is used. The return might be saving the valuable time of analysts, and/or enhancing the quality of the intelligence product. The question is, Where in the IC to focus for further testing and evaluation of the Compendium approach to hypertext-augmented collaborative modeling?

Compendium is far from a "silver bullet" or general solution for many issues facing the IC. Situations and work settings which are not collaboration-intensive are not good targets for testing and evaluating Compendium. Most of the analytic products of the IC and especially the CIA are not created in group fashion. Individuals take the lead on an analytic problem and solicit help from other information sources and other analysts. But this is rarely a group process, even if an occasional meeting might be called. Similarly, Compendium will only have a significant impact in settings where there is a pull to use it.

Also, the cost and time investment of getting used to a new collaborative tool must be less than the benefits to be attained. Good candidate settings would involve problems requiring a group to work together on a conceptually difficult, information rich problem where a brainstorming-like approach can be of benefit, or at least where multiple, potentially quite different ideas must be considered and weighed. Also, there should be a great deal of uncertainty and also a great deal of (potentially ambiguous) information. Groups attacking such problems historically have encountered organizational problems that are typical of group sessions involving high level people from multiple organizations, each with potentially different agendas. In such cases a facilitated meeting using a non-obtrusive tool that provides a group memory and a shared visual map of the analytic discussion could provide the extra benefit that makes any perceived costs acceptable.

Thus, while there are many possible niches in the IC for Compendium, this section offers two specific IC settings in which Compendium has great potential value: Red Teams and

Task Forces. Both are complex situations in which collaboration is essential. Both involve participants who have potentially wide ranging backgrounds and types and levels of expertise. Both take place over time frames of weeks or months, involve multiple meetings, and are often under significant time pressure. These are some of the key drivers for Compendium's existing success outside of the IC.

Red Teams

The purpose of a Red Team is to look at things in an alternative way – to challenge the conventional wisdom or the current thinking in a specific area of threat or potential threat. Gates defines a Red Team as “a group of technically innovative men and women ... challenged to explore alternative approaches” (12). Kent defines a Red Team more specifically as a group of individuals who are set apart and instructed “to think of themselves as the enemy's general staff. Their task as a red team is to ponder and act out the way the enemy will respond to situations as they develop.” (15).

Of course, in intelligence analysis a basic premise of “estimating the probable behavior of the other man is to try to cast yourself in his image and see the world through his eyes” (15). However, a Red Team takes this shift of viewpoint one step further, to an organized and collaborative effort to challenge the previous thinking about a problem.

In this way Red Teams are potentially a good environment to introduce Compendium to the IC because the team is purposefully starting with a lack of common views and shared understanding, and must discuss scope, various ideas, data relevance, and new issues. As a team they are committed to creating a shared understanding (or multiple understandings) for their report, and they are encouraged to raise questions and issues more than in the normal analytic process.

Typically Red Teams address very important issues and are established for a short duration. The team may be colocated, or its members may have to travel for meetings. In any case, Red Teams involve the commitment of scarce resources: they usually involve senior level staff (i.e. key Senior Analysts) and outside experts.

The value of Compendium to a Red Team will depend upon the charter of the Red Team, the Analysts selected (their backgrounds, personalities, etc.), and the Facilitator's skills. The value of Compendium to a Red Team could be its ability to support creation of an organizing framework that allows for a shared visual audit trail of the group discussion displaying all points made as well as interrelationships among questions and ideas. Nothing is lost. A good Facilitator makes sure that all analyst inputs find their appropriate places in the visual map. This framework could potentially also help with workflow, scheduling and resource allocation. A good intelligence framework could help in reporting recommendations and findings.

Red Teams may meet multiple times and may want to use Compendium to improve their group memory over multiple meetings. This might be especially valuable if, for example, there were a major change of thinking that should be considered, because the group could choose to modify the existing shared Compendium map or create a new one.

Compendium also might expedite the work that could be done between meetings, by allowing Red Team members to leave sessions with up-to-date printed views of key maps and review them individually as time permitted. In the past this has allowed participants of commercial projects to come to subsequent meetings more prepared to re-engage with the material.

As discussed, the rewards of using Compendium must be worth the investment, and this would need to be validated, ideally by a pilot use of Compendium with a Red Team. There are trade-offs. For one thing, because of its emphasis on rigor and memory, Compendium can sometimes slow down the discussion process. Conversely, many groups have found that the total work process actually went faster by using the structures of Compendium. Another potential consideration is that the members of Red Teams have successfully used less elaborate tools in the past (e.g. flip charts and markers), and may not feel the need or have the time to embrace a new process. Thus there must be a willingness to try the new tool with anticipated benefits. It may be the case that Teams find that although they thought they did well in the past, the group memory and indeed the whole analytic process is much improved due to the shared visual map as the guiding analytic framework.

Task Forces

Task Forces are different from Red Teams in that they are typically created for emergencies, surges, or significant changes. Task Forces usually have a military component, they are usually temporary, and typically they are adding resources to an existing area or effort. They can be single agency or represent multiple agencies. The need for creative non-conventional viewpoints that challenge conventional wisdom is not the focus, as it is with Red Teams. However, the other aspects – people from multiple agencies, information richness, uncertainty, and ambiguity – are present. The potential usefulness of Compendium here will likely depend on the conceptual difficulty of the task faced. If exploring lots of different questions with multiple viewpoints on each is necessary, then the Compendium approach might help.

Compendium may be useful to clarify the scope of the Task Force effort, and to clarify roles and responsibilities. As with Red Teams, the group memory aspect of Compendium may contribute to the overall efficiency of the Task Force.

One common challenge for a Task Force is bringing the participants up to speed with what is known, what has been done, what has been tried or explored, and what the issues are ... i.e. with basic key knowledge of the history of the problem preceding the formation of the Task Force. Although there are traditional ways of capturing and transferring this knowledge, this kind of “collaborative learning” is a particular strength of the Compendium approach, because the Compendium Facilitator has the responsibility for capturing, condensing, and conveying this knowledge from the “old hands” to the new ones. Compendium sessions can effectively blend “briefing mode” with “problem solving mode,” and thus may expedite the process of bringing the Task Force up to speed.

As with Red Teams, to be successful in this setting Compendium can not slow down the process. Thus in the Task Force setting it is particularly important that the Compendium Facilitator be well trained and fully prepared for each Task Force session. Also, the Compendium shared visual map must add something that the standard displays used by such teams do not provide. This again points to the specific nature of the task force problem.

The use of Compendium in either of these IC settings will demand a highly skilled Facilitator. Once the tool's value is apparent to the community, it will not be as difficult to get the commitment to Facilitator training or to bringing in highly skilled help. In the initial tryout, this will require a willingness to try the process using cleared, experienced Facilitator help. Otherwise, the perceived value of the tool will be lessened due to the standard problems encountered in group meetings.

8. NEXT STEPS

Tools to support the intelligence analysis process have a somewhat checkered history²³. As computer science advances there are more and more IT applications that might aid the intelligence analyst and the analysis process. In recent years numerous collaborative tools have also been explored within the community, with mixed results. Collaborative tools pose two dimensions of challenge: as tools, they require analysts to learn new ways of collecting and organizing information and producing analytic products. In addition, collaborative tools offer to mediate communication, which is in any case a delicate human process, easily subject to disruption.

Compendium takes the approach of *augmenting* – as opposed to automating – the intellectual skills of the individual analyst and the collaborative capacity of the analytic team. However, any such augmentation, to be accepted, must be “ecological”: it must offer a high degree of “fit” with existing tools and practices, and must ease its way through manifold cultural and organizational barriers. Tuning the Compendium software and methods, and identifying the right situations for its success, will be an incremental and experimental process.

Thus, further pilot studies are needed in order to determine the best fit for Compendium in the IC. There is no cookie-cutter approach to testing and evaluating new collaborative technologies. A well-designed study is needed to:

- refine the understanding of IC user requirements,
- test the feasibility of the Compendium approach in different IC settings,
- understand the environmental drivers and constraints on Compendium use,
- identify the expected costs and benefits,
- identify needed links to other capabilities, and
- identify research and development issues.

²³ According to some sources, the list of advanced tools that have been developed to support the analyst, yet which were never adopted or were quickly abandoned, could fill a catalog. As in most demanding intellectual activities, the norm for computer tools is, unfortunately, failure.

An iterative refinement approach would allow Compendium tools and methods to evolve at the same time as further definition of its specific applications and success factors.

Tactical Next Steps

One of the most important and accessible next steps is to try experiments which are designed to identify and evaluate Compendium's costs and benefits in the IC. Based on years of experience outside of the IC, and having learned something from a single IC trial use of Compendium (Section 6), we can suggest some criteria to make substantial proof of concept studies and pilot tests more meaningful:

1. The problem should be "medium wicked." The issue or topic that the pilot group is working on should not be a "tame problem," one so simple that observers would say that it could have been solved by using *any* problem solving approach. Nor should the issue be so wicked that (like the topic of the first trial) progress on it is virtually impossible due to entrenched positions and political implications. (Note: it is not that Compendium can't be used for such issues, it is just that they don't offer a fair initial evaluation of a new and unfamiliar methodology.)
2. There should be a perceived need to increase the level of *shared understanding* among a group of players. That is, the ideal issue or topic is one in which there is some history, a wide range of positions and opinions, and some time in which to search for common ground on the topic. This eliminates presentational meetings (one person giving information to a group), and immediate decision meetings (a short time in which a final decision must be taken).
3. The Facilitator should be experienced and well-prepared. Much of Compendium's value rests on the Facilitator; it is important that the person (or persons) filling this role be qualified, experienced, and skillful in all of the aspects of Compendium.
4. The pilot study should have organizational and management support. While there is much to be said for "bottom up" experiments and technology "pull," the ideal situation for a fair evaluation is that the pilot group's management is open to and seeking new ways to do business, and new opportunities for improved collaboration.
5. The experiment should involve a series of meetings. One of the greatest strengths of Compendium is *group memory*, the ability to capture and summarize a complex discussion and to carry it forward to future meetings, and for stakeholders who need to be briefed about the meeting. Thus, an ideal evaluation pilot would involve a series of three to six meetings over a period several weeks or months. This would allow the efficiencies of group memory to be demonstrated and evaluated.
6. The participants should care about resolving the issue, and be willing to share information. If the pilot session or sessions are attended by analysts who are only there because they were told to be, and who have no intention to

collaborate, this is (again) an environment from which little new can be learned.

7. The participants should be open to new approaches and tools.
8. The meeting room should have good quality computer projection, and the seating should be arranged in a “U” that is open to the shared display screen.

A corollary next step is to address the shortage of Compendium Facilitators who have clearances. This could be done by getting security clearances for existing Compendium Facilitators, or by creating Compendium training and practice opportunities for traditional facilitators who already have (or are close to getting) a security clearance.

Another potential is to study the linkages between Compendium and the structured argumentation capabilities in other tools under development and/or being used in the IC. Project Genoa, for example, includes a system for structured argumentation called SEAS (Structured Evidential Argumentation System)(18), which has significant parallels – and interesting differences – with the Compendium approach. How might these two approaches be connected?

Finally, there may be opportunities to foster “grass roots” interest in hypertext-augmented collaborative modeling approaches such as Compendium if the current software that supports it, such as QuestMap and Mifflin, is made more directly available within the IC to those who have an interest in exploring its possibilities. This might include creating specialized support services, IC-directed documentation, and/or a self-running demo to introduce the software to new potential users. Cost should not be an issue, since both systems are essentially free.

The Facilitator Issue

A principal distinguishing feature of the Compendium approach to collaborative technology is that it does not require analysts to learn new tools and methods. Instead, Compendium introduces a new player – the Facilitator – into the process, to act as the knowledge mediator, leaving analysts free to focus on sharing their knowledge and completing the analytic task at hand.

One natural concern about Compendium’s facilitation approach is, “Where do the Facilitators come from?” One solution would be to include Compendium facilitation as one of the skills of the staffs of the various collaborative centers (such as the DCI Counterterrorism Center, or CTC) in the various intelligence agencies and departments. One way to think of the Compendium Facilitator in this setting is as a standard support function – just as you would always have IT staff to set up and maintain the IT and multi-media platform in a modern, high-tech “fusion” center, you might also have a cadre of agency facilitators equipped to facilitate using Compendium and the current agency tool suite. Alternatively, a cleared contracting organization might be a source of Facilitators on an as-needed basis. Another option would be to offer Compendium training to analysts and let those for whom it is a good fit emerge as natural Facilitators.

Research Opportunities

Research and development efforts on Compendium to date have focused on optimizing effectiveness and the *transparency* of Compendium augmentation during and between meetings; that is, toward improving the interface between the group and the Compendium model. While there is still room for improvement in this interface there are at least two additional categories of research and development that are needed: semi-automated tools to boost Facilitator effectiveness, and automated reasoning tools to detect violated constraints, inconsistencies, and possible new links.

In the first category, “power tools for Facilitators”, are semi-automated tools for frequent database maintenance and refinement tasks, such as the detection and instantiation of templates, maintaining consistency between meta-tags and views, and review of coding consistency in lists of knowledge elements. Moreover, in the asynchronous mode, in which group participants are directly accessing and adding to the Compendium database, research is needed into tools to support the “group moderator” function in maintaining consistency and relevance (8). (For further discussion of asynchronous collaborative tools, and issues of extending Compendium into the asynchronous mode, see Appendix C: Asynchronous Teamwork.)

In the second category, automated processing, are automatic search and inference engines for detection of patterns of interest in the database. This work builds on research on “structural computing” (20). In particular, future research might extend Compendium toward the academically-oriented “ScholOnto” approach (1): “Current metadata initiatives are focused on the encoding of *primary content attributes* to improve retrieval and interoperability. ... In contrast, these are precisely the features that a system needs to support the *interpreted knowledge level*, as researchers contest the significance of data, and the concepts which it underpins.” (1) This work takes the current metadata tags of Compendium and builds them into a full semantic description of the contents of the node. Thus the ScholOnto approach might lead to new capabilities for automatically detecting patterns of interest in the Compendium database, such as missing evidence, faulty reasoning, violated constraints, inconsistencies, and possible new links. Another approach to reasoning over hypertext structures is “Brahms,” (30) which focuses on “executing” collaboratively constructed models (i.e. running them as simulations) as an aid in model refinement.

9. SUMMARY

This paper presents the Compendium approach and explores its possible applications in the IC. The Compendium approach is an example of an emerging new collaborative technology, *hypertext-augmented collaborative modeling*, which brings together a Facilitator, hypertext software, methods for collective crafting of semi-formal models. Compendium has been successful in a wide variety of non-IC settings, and shows promise of being able to help in certain well-defined IC settings, such as Red Teams and Task Forces.

Individual efforts predominate in a traditional IC production unit, but on occasion analytic teams are formed. According to the CIA's *Analytic Toolkit*:

As the team begins to perform at a level that creates dependency on the part of key policymakers, negotiators, warfighters, and sanctions and law enforcement officials, the likelihood that they will rely and take risks based on the teams analysis increases. Under these circumstances, there is no professional substitute for precise depiction of what the analysts know, how they know it, and their line of argumentation for dealing with what they do not know. (4)

Compendium was created to improve the process of establishing what knowledge workers know, how they know it, and their line of argumentation for what they know and what they do not. Compendium has shown itself as a powerful tool to help focus a group on collaboratively capturing and modeling their collective knowledge about a situation, and in helping them work through differences of opinion and belief. For example, using Compendium debates still happen over issues, but the energy of the debate can be rechanneled into group construction of a rigorous argument structure which shows the logic but strips away rhetoric, repetition, and hand-waving.

Moreover, Compendium creates group memory – a database document that preserves the key points of the discussion, including open issues, action items, the decisions that were made and the rationale for them. This kind of hypertext document preserves much more of the context and sense of the session than “meeting minutes,” which are usually the product of a single note taker and which are rarely long remembered.

Finally, it is useful to keep in mind that Compendium facilitation can range from unobtrusive capture to up-front group facilitation, depending on the circumstances. In any case, synchronous collaboration, whether face-to-face or virtual or a mixture of both, is Compendium's greatest strength. More study is needed to determine the best settings and the right balance and approach for using Compendium in the IC.

10. APPENDIX A: HYPERTEXT-AUGMENTED COLLABORATIVE MODELING

A powerful new tool for knowledge collaboration – for making sense of large amounts of fragmentary information – is hypertext-augmented collaborative modeling: combining a *collaborative approach* with *hypertext tools* via a “shared display” computer projector and a skilled *Facilitator*.

This approach owes its power to several familiar elements:

- Over 60% of human cortex is **visual cortex**. A high proportion of human cognition is visual/spatial, and dynamic maps and diagrams projected on a display screen naturally exploit this dimension of human intelligence in way that monolithic documents and presentations simply cannot.

- The **linkages** are as important as the chunks of information (23). Constraints, dependencies, hierarchical connections, and causal links must be recorded in a variety of contexts, e.g. reflecting different theories or models about how the chunks relate to each other.
- The process is highly **interactive**. As the group discusses the information and possible theories in a meeting, the operator captures key elements of their interaction, putting them into the dynamic hypertext map, and validating and elaborating points with the group (7, 27). The group is discussing and analyzing the data with each other and simultaneously collaboratively building a semi-formal representation of their information, issues, questions, assumptions, and theories. The process itself is productive – a map always results, even if no consensus is reached.

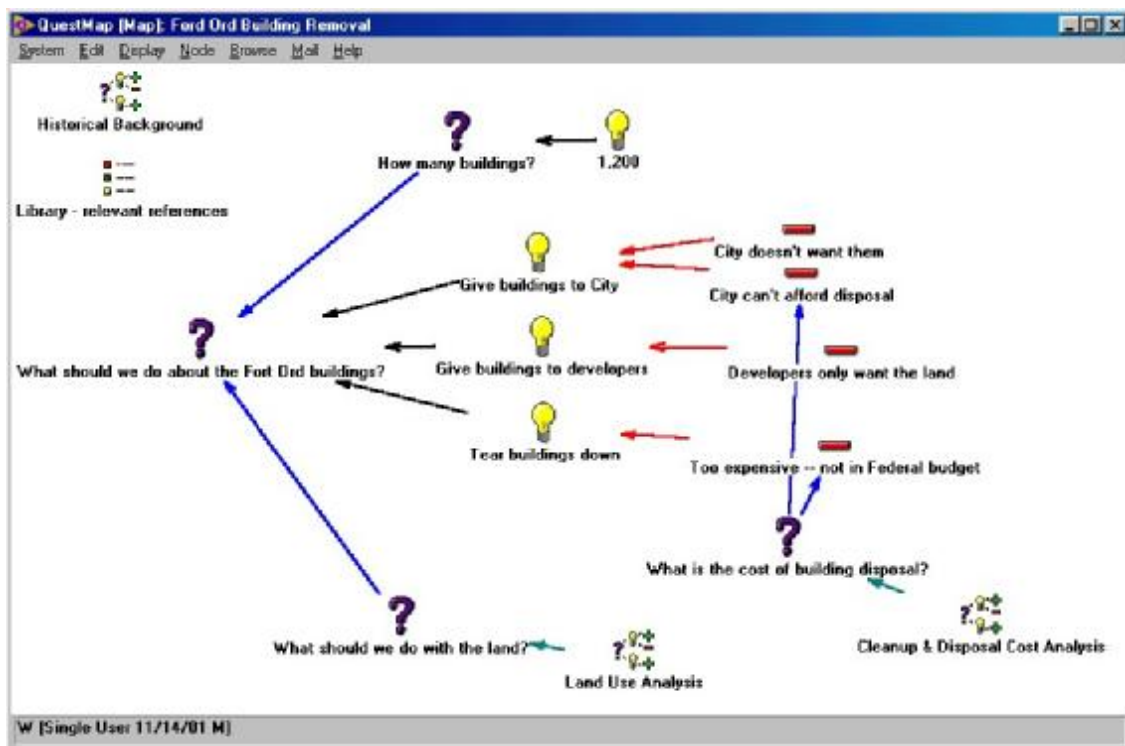


Figure 21: Screen shot of a graphical hypertext system (QuestMap)

- The approach creates an effective **group memory** for the group of analysts and experts (10). Because any given session or meeting results in a *map* of the issues and information explored in the session, the following session (often with new or different participants) can start where the last session ended, adding and expanding on the map, creating new theories, and setting aside theories or information that have fallen in confidence.
- The approach exploits several light-weight **formalisms** which provide flexible structure for the linkages and models. One formalism, IBIS, gives structure to open discussions (11, 16). Another, the World Modeling Framework (30), organizes ill-structured information into a multi-dimensional, flexible model or set of models.

- The use of a skilled Facilitator **removes the burden** of learning new methodologies and interfaces from analysts and other expert participants, leaving their energies focused on applying their skills and expertise to the intelligence problem at hand. Over time participants naturally learn about the tools and formalisms. One of the “killer” problems with current knowledge collaboration approaches is the high overhead of learning that they impose on the users. Attempts to minimize training result in failure of the collaborative system to be used (13). The use of Compendium Facilitator services shifts the training burden to a more practical and economical use of resources.

Hypertext-augmented collaborative modeling is neither simple to do nor easy to learn. It is a craft skill, much like other kinds of facilitation, or (more fancifully) like being a musician. Much practice is required, and mastery can take months or years to achieve.

However, those who have experienced this kind of collaborative technology in action generally agree that it is a powerful new tool in the collaborative toolkit, and well worth the challenge of climbing the learning curve in the value it adds to groups tackling wicked situations.

For more details on Compendium’s use of the elements of conceptual frameworks, hypertext, and facilitation, see (7).

11. APPENDIX B: MIFFLIN AND QUESTMAP

QuestMap is a Windows 3.1-vintage tool that is being sold but no longer being supported. Mifflin is a modern software equivalent that is more of a functional prototype than a product, and it is also unsupported. Thus, there is currently no ideal Compendium software tool. QuestMap offers faster response times and is arguably more stable, but Mifflin offers several graphical user interface (GUI) enhancements over QuestMap, such as a glyph marking that a node is transcluded. Mifflin is written in Java, including the ability to run as an applet through the browser. Mifflin is also Y2K compliant, which QM is not (date search no longer works).

Here is a (somewhat technical) list of the key enhancements that Mifflin offers over QuestMap:

Open architecture: The architecture is based on open standards (Sun Java, RMI, XML, SQL, GIF/JPG, HTML, etc.). This is to enable a variety of interfaces and connections to external applications, data stores, etc. Interfaces can be made at the application, database, and network levels.

Extensibility. Mifflin was designed to be extensible in several ways. Through constructs such as “extended node types”, behaviors can be added to creation/modification of certain nodes. Java programs can also be written to act on trappable events within the system. Forms and wizards can be added to automate certain functions.

Multi-featured web export. Even in its current form (version 1.1.9), Mifflin allows a variety of HTML exports to be created through the GUI. With a few clicks, users can specify any number of views and produce web pages (or whole “sites”) with options such as graphics, links to external URLs, left navigation bars, clickable containing views at the node level, clickable metadata/tags/codes on the node level, etc.

Customizability. Mifflin allows a variety of customizations. Individual icons or whole “skins” can be selected and replaced. Coming releases will extend the level of customization (e.g. map backgrounds).

Database access and queryability. Mifflin currently uses the Microsoft Access database. All data is directly accessible via either the Mifflin application, the database itself, or external JDBC or ODBC queries.

Support for metadata. Mifflin provides direct support for several kinds of metadata. Nodes can have “codes” (tags), for which Mifflin provides an editor. Links have properties which are viewable on double-click. The UI provides viewers and editors for Containing Views, and displays what relationships have been made to nodes in different views.

Enhanced search. Mifflin adds “tag” search to QuestMap’s set of search options. For example, Mifflin users can search for nodes of certain type, created in certain date ranges, with certain keywords, tagged with certain attributes (or any combination of these).

Support for images and graphics. Users can replace the Reference node icon with any GIF or JPG graphic, including animated GIFs, photos, drawings, etc.

Direct import from Word/Excel. Mifflin and Compendium incorporate the VBA tools for importing from Word and Excel, adding metadata on the fly.

XML support. Mifflin reads and writes XML files. (This in a relatively primitive state at present, but the parsers and converters are already in the code).

12. APPENDIX C: ASYNCHRONOUS TEAMWORK

In the scenario in Section 5 (“Scene one”) two analysts (John and Buzz) collaborate asynchronously, through email and through shared access to the Compendium database. The asynchronous mode allows knowledge workers to contribute to a collaborative effort when they have time, for as long as they have time, and avoids all of the scheduling problems associated with meetings. Asynchronous work is also ideal when collaborators are geographically distributed, especially when they are scattered across time zones. A common pattern for project groups is to link up synchronously on a regular basis, for example a weekly conference call, and to interact the rest of the time through email and electronic discussion and document sharing tools.

Asynchronous work, however, also involves new challenges for collaborative intelligence work. Experience shows that asynchronous collaboration is, in general, harder to get

started and harder to keep going than its synchronous counterpart. Some of the barriers are (13):

- a weak commitment to sharing information, perhaps due to a history of competition between agencies, makes asynchronous interagency collaboration even harder than interagency meetings;
- similarly, lack of trust about how other groups deal with security regulations on their networks can make some groups reluctant to put classified information into a system;
- collaborations must provide mutual benefit to all participants to be successful – if one group is doing most of the work and other is getting most of the benefit, the group doing the work will stop;
- recognition and reward systems in the IC tend to not to reinforce collaborative behaviors; and
- low system use and insufficient data can reinforce each other in a downward spiral, preventing a collaborative effort from ever achieving “critical mass.”

These are issues that apply to all IC uses of collaborative technology, and this is not the place to address or solve these general issues²⁴. Let us assume that these baseline collaboration issues are being addressed, and explore the possible asynchronous use of Compendium.

First, it should be noted that, like any shared resource, there are some important organizational issues that must be addressed: Who “owns” the Compendium database? Who maintains it? How is it kept current? These are issues that would need to be worked out on a case-by-case basis.

Second, there are technical limitations in asynchronous mode of the current software platforms that are used for Compendium. QuestMap was originally designed for asynchronous multi-user collaboration, but only on a LAN (not on the Internet or its secure equivalents); while a LAN can be simulated on the Internet²⁵, it is an awkward way to achieve wide-area connectivity with QuestMap. QuestMap also has other asynchronous limitations that might prevent its use as a secure multi-user system. Mifflin, on the other hand, has no implemented support for multi-user asynchronous work²⁶. In short, asynchronous Compendium work is currently unsupported, and would require time and software development resources to be sufficiently developed for real world use. (Note, however, that for use as a facilitation tool (i.e. in single-user mode) none of these limitations are relevant – QuestMap and Mifflin are perfectly suitable as a Compendium facilitation tools.)

Finally, the complexity and skill level for Compendium places extraordinary design demands on the tools and practices of asynchronous Compendium use. In general, the more complex the task, the more highly practiced and disciplined the participants must be in order to preserve coherence and order in a shared space. For example, an on-line

²⁴ For an excellent treatment of these and other issues, see (13).

²⁵ For example, with Virtual Private Network (VPN) capability such as is available in Microsoft Windows.

²⁶ Mifflin’s architecture and code base contain support for multi-user asynchronous work, based on Sun’s RMI architecture, but it is neither finished nor turned on in the current implementation.

discussion (i.e. threaded discussion or email discussion group) is a relatively robust asynchronous medium because the range of actions available to participants is limited and well defined. Virtual group writing and drawing tools are more difficult to design and implement and are more restrictive to users, however, because the system must prevent “collisions” when two users want to edit the same paragraph or object at the same time.

Similarly, the process of creating a hypertext model of a complex situation has some of the properties of group writing. In 1992 QuestMap won the Best-of-Show award in the Group Information Sharing category at the First International Groupware Conference in San Jose, California. Despite this auspicious beginning, the next few years revealed a host of challenges for groups seeking to collaborate asynchronously in QuestMap. Here are a few examples of breakdowns that happened, and for which either additional tool features or additional user training would have to be provided:

- Users occasionally rearranged a group’s map so that the group members couldn’t recognize their map or find anything in it;
- Users occasionally made mistakes in IBIS, such as asking questions in Idea nodes or lumping several arguments together in one node – these errors made it much harder for other users to add well-formed IBIS structures to the map;
- Users inadvertently deleted parts of a map that other users were working on, or changed them, and there was no version control facility in the system;
- Some users wrote with so many abbreviations and wrote so tersely that few of their colleagues could understand what they were saying, nor contribute intelligently to the map.

None of these incidents are peculiar to QuestMap, and they can be largely ameliorated with appropriate software design and/or user training. For example, a system can implement more restrictive access policies to data objects, or impose a “check-in and check-out” protocol on users. There is always a tradeoff between ease of access and multi-user data safety and protection.

With QuestMap’s relatively open access policy, experience and research found that there was a high risk that, during the initial rollout of such a system, errors and problems could quickly erode a group’s intention and energy to learn and use such a system. An important lesson, therefore, is the importance of the role of “Moderator” or Facilitator in such asynchronous shared spaces, to encourage and model good behaviors and (privately or publicly) discourage disruptive ones, as well as a responsive Help Desk to quickly help users over technical problems. This role, though expensive, is essential to the successful rollout of complex shared spaces such as Compendium’s.

In summary, the need for asynchronous multi-user access to Compendium’s database is clear, but the mechanisms for implementing it require further research and development.

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