

Knowledge Mapping Aids Discovery of Organizational Information

By Ray D'Amore, Manu Konchady, and Leo Obrst

Guest Editor's Note: Knowledge maps, the cartographic view of "knowledge" within an organization, help in discovering the location, ownership, value, and use of organizational knowledge. Additionally, such maps help us to learn the roles and expertise of people, to identify constraints to the flow of knowledge, and to highlight opportunities to leverage existing knowledge. According to Gartner Group research, this year more than 50 percent of knowledge management programs will implement knowledge maps that are more complex than current public Web sites. This requires an understanding of ways in which knowledge maps can vary and an investment of highly skilled human labor.

MITRE researchers are performing leading research in knowledge mapping. The following are descriptions by three researchers whose goal is to enhance the value of the considerable repository of knowledge available in the MITRE Information Infrastructure (MII), the company intranet. The separate efforts described below are complementary and provide a view of how organizational knowledge may be mined in the future.

(The following section was contributed by Ray D'Amore and Manu Konchady.)

Knowledge Mapping on the MITRE Intranet

Formal views of an enterprise may not always reflect the actual interest areas, roles, and relationships of the people within an organization. For example, organizational hierarchies that define communication between supervisors and subordinates provide, at best, only a partial representation of actual communication or work relationships. The use of topic detection technology to discern actual work relationships (or knowledge networks) across the enterprise has implications for how organizations can assess workflow, areas of expertise, and collaboration. Here topic detection can ferret out interest areas and tasking and characterize how work is being addressed within an actual organization (i.e., who, what, where, and when). Because work groups can form and disperse quickly to meet project demands, we have what can be characterized as emergent networks to complement what sometimes exists in formal organizations. We are investigating how using topic detection technology to create knowledge maps may provide a more effective way of mapping corporate roles and expertise in a fluid work environment.

We have applied topic detection technology to the MII as a basis for generating knowledge maps. In particular, we have used specialized clustering technology to extract information usage patterns from MII transfer folders (folders assigned to individuals to facilitate sharing). Linking derived topics with personnel information provided a basis for assessing affinity groups within an

organization. In the initial experiment, a sample of items from each transfer folder was obtained. Each item (e.g., a Microsoft Word or PowerPoint file) was represented by a weighted vector consisting of keyword and frequency information as well as metadata associated with each transfer folder (e.g., owner, organization). The pairwise similarity is computed across all sampled items and provides the basis for automatically generating topic clusters, using a simulated annealing clustering algorithm. The overall approach supports generating both semantic as well as organizational links among staff members within a topic cluster or across related clusters. In a full-scale application, we would expect to index all items within the transfer folder and incorporate temporal information into the clustering algorithm so as to identify changes in work patterns over time. The initial prototype allows users to navigate through topic clusters and their associated people, as well as search for specific topics using queries. The selected topics allow for easy access to MII personnel information as well as transfer folder items.



Knowledge maps point to key areas of work and user communities.

The derived groups reflect shared interest in some technology, joint work on a project, or other workflow aspects. In some cases we have uncovered staff who are inkey oversight roles, as well as those that serve as information "hubs" -- providing information to the division. How accurate is mapping? In some cases the clustering results have mirrored current division and department structure, especially where departments are rather homogeneous (e.g., a department focused on collaboration). However, it has also identified virtual groups that span multiple departments and a number of these have been validated by informal discussions with staff members. We are currently preparing a more formal assessment, comparing formal organization charts to expertise networks gleaned using clustering, as well as those identified through staff survey inputs. The automatically derived knowledge maps may provide a basis for assessing

ongoing work within an organization to include areas of expertise and, more specifically, the experts themselves. The technology being developed is applicable to a wide range of public information spaces such as document publishing, resumes, and Web pages. This work is being supported by the Smart Yellow Pages MITRE-Sponsored Research.

(The following section was contributed by Leo Obrst.)

The Organizational Model and Its Knowledge Map

What's next in the evolving knowledge management paradigm after an organization links its employees and their documents together so that it is possible to conduct a successful search for everything an employee writes?

One prospective answer takes something old and weds it to something new. The something old is business process reengineering combined with enterprise modeling. The something new is ontological engineering, which has recently emerged as an offshoot of knowledge representation and knowledge engineering. Under one view, an ontology is a specification of a conceptualization (i.e., the terms of a conceptualized domain representing its entities, relationships, attributes and the semantics of the attributes). These combined technologies can begin to enable a usable organizational model, that is, a knowledge map of the organization.

The image shows a software interface with two main windows. The top window, titled 'Topic Labels', contains a list of terms and their associated concepts. The bottom window, titled 'A Cluster: Selected MITRE Staff "Interested" In Video Conferencing...', shows a list of staff members and their file titles.

Topic Label	Concepts
31. 2	strike cell; mission assignment; target pair
32. 1	uses compass; jira chooses; collaboration tool
33. 2	knowledge management; decision support; learning pro
34. 1	collaborative learning; lead goodness; peer interaction
35. 2	asset management; key assets; client initiatives
36. 3	tech insertion; exercise plan; training materials
37. 2	vulnerability data; intrusion detection; editorial board
38. 3	directory service; pete firey; randy marks
39. 4	filtering agent; adaptation infrastructure; lqnl messages
10. 4	collaboration services; video conferencing; shared whiteboard
11. 1	user interface; work support; training services
12. 2	baseline comparisons; alembic workbench; tool intrusiveness
13. 1	named entity; task definition; broadcast news
14. 2	interagency collaboration; demonstration components; guard units
15. 3	client install; document server; installation guide
16. 4	video conferencing; desktop collaboration; chat window
17. 6	story segments; video server; network assessment

Name	Org.	File Title
Small, Cynthia Taylor	G69	Collaboration by Enriching and Filtering COTS Technology; Collaboration by Enriching and Filtering COTS Technology; Collaboration Environment on TeamWare Networking on T.120 &
Dwan, Lucia M.	G61	Collaboration and Security: Christine L. Edgeson Is
Holland, Robert J.	G61	Collaboration Environment: May 1999 Organization: G601
Krutch, Michael C.	G61	Collaboration Of: ronal - Fred@fred.org.uk
McDowell, George J.	G67	Collaboration environment must clearly focus on all
Giofano, Pamela R.	G6a	Collaboration Intelligent Information Agents Distributed

A Technology Center "community of interest" found by examining public information sharing and related project work areas.

Currently, the knowledge about a typical organization's business data, its knowledge sources, and its conceptual interrelationships exists only as informal knowledge residing in the minds of personnel (management and staff) and in their documents, the latter of which must be interpreted by personnel with respect to their internal model of the organization. In the organization of the future, however, knowledge increasingly will be collected, structured, interpreted, and used automatically. This increasing automatization is possible because most knowledge is in fact relatively fixed. On a daily basis, for example, we do not typically have to drastically modify our knowledge of gravity, traffic, eating, performing our work, doing arithmetic, and talking in English, even though particular atomic instances of these kinds of knowledge change: I am eating red beans and rice on October 18, 1999, at 6 p.m. When relatively fixed knowledge about an organization is captured and a process is built to link it to knowledge that changes often (dynamic knowledge), the result is an organizational knowledge repository, growing over time and able to be reasoned over -- as, for example, by software agents performing e-commerce transactions across a supply chain of virtual enterprises. These technologies, especially when coupled with emerging Web technologies such as Extensible Markup Language (XML) and semantic extensions of XML, can help build a usable knowledge-based model of the organization leading to this vision of the future.

Currently, MITRE is working on several knowledge management pilots. One pilot is trying to identify the entities, relationships, and constraints within the operating center. The goal of this particular pilot is to construct an organizational ontology and its supporting knowledge base. The resulting knowledge map will enable additional data and knowledge linkages to be made, facilitate knowledge capture, and promote the construction of knowledge management applications.

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