

2005

# DISCOMAP: A System to Support Distributed Cognition in Inquiring Organizations

Sandra M. Richardson

*University of Central Florida, srichardson@bus.ucf.edu*

James F. Courtney

*University of Central Florida, jcourtney@bus.ucf.edu*

Gerald R. Wagner

*University of Nebraska at Omaha, grwagner@mail.unomaha.edu*

Follow this and additional works at: <http://aisel.aisnet.org/amcis2005>

---

## Recommended Citation

Richardson, Sandra M.; Courtney, James F.; and Wagner, Gerald R., "DISCOMAP: A System to Support Distributed Cognition in Inquiring Organizations" (2005). *AMCIS 2005 Proceedings*. 57.

<http://aisel.aisnet.org/amcis2005/57>

This material is brought to you by the Americas Conference on Information Systems (AMCIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in AMCIS 2005 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact [elibrary@aisnet.org](mailto:elibrary@aisnet.org).

# DISCOMAP: A System to Support Distributed Cognition in Inquiring Organizations

**Sandra M. Richardson**  
University of Central Florida  
srichardson@bus.ucf.edu

**James F. Courtney**  
University of Central Florida  
jcourtney@bus.ucf.edu

**Gerald R. Wagner**  
University of Nebraska, Omaha  
grwagner@mail.unomaha.edu

## ABSTRACT

Inquiring systems theory (Churchman, 1971), cognitive mapping (Lee, et al., 1992) and hermeneutics (Boland, et al., 1994) have provided the basis for systems to support organizational learning, distributed cognition, and knowledge management. Boland, et al. (1994) describe three entities in such systems and six principles for their design. Richardson (2005) argues that communication is neglected element in these systems and integrates Habermas's (1984, 1985) theory of communicative action, specifically discursive action, to develop revised design principles. This paper describes DISCOMAP, a system that instantiates and tests the revised design principles using discussion forums and The Planners Laboratory<sup>®</sup>, a new software package that provides advanced modeling, graphical and network capabilities to provide shareable models with engaging visual interfaces for decision makers.

## Keywords

Knowledge management, organizational learning, distributed cognition, inquiring systems, communicative action, decision support systems, visualization.

## INTRODUCTION

Boland, et al. (1994, p. 457) define distributed cognition as "the process whereby individuals, who act autonomously within a decision domain, make interpretations of their situation and exchange them with others with whom they have interdependencies so that each may act with an understanding of their own situation and of others." They describe objects in a distributed cognition process as consisting of actors, interpretations, and actions. They develop six design principles for distributed cognition systems, and a system called Spider based on those principles. Spider integrates hermeneutics, inquiring systems (Churchman, 1971) and cognitive mapping to support distributed cognition.

Distributed cognition is similar to organizational learning (March and Olson, 1976), except that distributed cognition places more emphasis on the individual as opposed to the organization. The similarity of the concepts is illustrated by Lee, et al. (1992, p. 23) who state that "learning occurs as organizational actions lead to environmental responses, which are interpreted by individuals who share their interpretations and form a collective organizational action-response map based on cause-effect relationships." They develop a system called COCOMAP which also uses cognitive mapping and Churchman's (1971) Hegelian inquiring system to represent individual worldviews, and describe formal join operations for integrating individual maps into a collective map.

Richardson (2005) argues that communication is a vital part of organizational learning and distributed cognition. She integrates Habermas's (1984, 1985) theory of communicative action, ideal speech situation and discursive communication with Boland, et al.'s design, adding communication as an element and revising the six design principles.

This paper describes a system called DISCOMAP that instantiates Richardson's design principles within the context of inquiring organizations, a kind of learning organization based on Churchman's (1971) inquiring systems theory. DISCOMAP is being developed in a new modeling system called The Planners Lab (PL) (Wagner, et al., 2005) that integrates spreadsheet models with Macromedia FlashMX<sup>™</sup> so that maps may contain animations and sophisticated graphics

and can be shared in a network environment. Along with the PL, is an Opinions Lab that supports threaded discussion forums that are used to implement discursive action related to the validity of models and results.

### **DISCURSIVE COMMUNICATION**

Habermas (1984) identifies four types of action: instrumental, communicative, discursive and strategic (Ngwenyama and Lyytinen, 1997). Instrumental action involves transform or manipulating objects or concepts in the external, “objective” world. It involves the use of technical knowledge and tools, such as when the PL is used to model and analyze a managerial problem.

Communicative action is a type of rational discourse that assesses the arguments proposed for or against a message in terms of its clarity, truthfulness, correctness, and appropriateness. These four criteria define “validity claims” and communicative action is aimed at justifying any or all of these claims (Lyytinen and Hirschheim, 1988; Ngwenyama and Lyytinen, 1997). Anyone at anytime can “cash in” on these validity claims, each speaker is free to investigate the claims of another (Benoit, 2002). The redemption of validity claims makes discourse a vehicle for reflective learning and criticism which helps free the participants from inner compulsions, biases, prejudices, and false beliefs (Lyytinen and Hirschheim, 1998).

Communicative action is social and oriented toward maintaining understanding and involves social norms that define the expectations of the communicative partners, as when managers are interpreting the results of PL models and sharing and discussing those interpretations with others, perhaps using the Opinions Lab.

It is when the norms or the interpretation of model results can no longer be agreed upon or recognized that discursive or strategic action begins (Ngwenyama and Lyytinen, 1997). Habermas describes the ground rules for an environment he calls the “ideal speech situation” which sets the context for discursive action. The ground rules are that each participant agrees to seek after the “truth,” each person has an equal opportunity to participate, and participants must accept the force of the better argument, coercion and lying are prohibited. It involves an open discussion forum, such as in the OL, where users are genuinely seeking to come to an unbiased understanding.

Strategic action involves attempts to persuade others that a particular viewpoint is correct. If organizational norms and lines of authority are followed and policies are adhered to, this is considered acceptable. If facts are distorted, untruths are deliberately used, or other “dirty tricks” are employed, then obviously this is unacceptable.

Acceptance of the ground rules of communicative action permits criticism of organizational processes that do not conform to these rules (Lyytinen and Hirschheim, 1998). This process lends itself to verification of the information communicated by individuals within the distributed cognition process. The verification of individual perceptions provided to the system under the hermeneutic process in order to develop new organizational knowledge lends itself to the creation of a system guarantor called for in Churchman’s (1971) inquiring systems, and in “inquiring organizations” based on those systems (Courtney, et al., 1998; Courtney, 2001; Richardson, et al., 2001).

### **DESIGN ELEMENTS AND PRINCIPLES FOR DISTRIBUTED COGNITION SYSTEMS**

Boland, et al. (1994) describe three core elements of distributed cognition: actors, interpretations, and actions. To this, Richardson (2005) adds a fourth, *communication*, based on the theory of communicative action. Boland, et al. state that a system is oriented toward an individual person, and not a group, because only an individual can have a hermeneutic understanding and meaning to represent. However, Richardson (2005) points out that it is the individual in dialog with others that is the locus of an inquiring organization. The addition of Habermas’ theory provides the communication link between the individual and others in the organization, bringing the individual into a social process through discursive communication. Her revised description of core elements is given in Table 1 and the revised design principles are in Table 2.

### **IMPLEMENTING THE REVISED DESIGN PRINCIPLES**

Major features of DISCOMAP include the graphical representation of models, a network architecture to enable model sharing, and OL discussion forums to support communicative action. A forum is established for each model supported by the system. Participants involved in building and using the model are instructed by the forum moderator that all postings should be designed to lead to models, parameters and analyses that accurately reflect reality (“truth”). In addition, flaming, threats and personal attacks are not allowed. Validity claims and refutations are maintained in the forum postings.

The integration with Macromedia FlashMX™ provides a ready ability for managers to “play” with assumptions that reflect alternative views of the future in an engaging, visual manner (Figure 1). The model is in the left window. Goal variables in

this scenario and What If variables are shown as trend lines in the windows on the right. The user may grab a Goal variable trend line with the mouse and drag it to a desired point, and the lines for the What If variables will change accordingly.

**Table 1: Original and revised elements of distributed cognition systems**

Core Element	Original Element Description	Revised Element Description
Actors	The system is oriented toward an individual because only an individual can have a hermeneutic understanding and meaning to represent.	<i>The system is oriented toward an individual operating within a social context through discursive communication. The result is merging individual interpretations into organizational knowledge.</i>
Interpretations	The system is oriented toward an actors' interpretation of his or her situation taken as an integral part of a whole.	<i>The system is oriented toward an individual operating within a social context through discursive communication, which provides a mechanism that validates each individual's interpretations.</i>
Action	The system is oriented toward the actions that punctuate the ongoing process of distributed cognition.	<i>Through discursive communication understanding between group members can provide the knowledge for the inquiring system, which has the goal of using knowledge as "potential" for action.</i>
<i>New element: Communication</i>		<i>Through discursive communication the system provides the means for fusing together the interpretations producing collective organizational knowledge.</i>

**Table 2: Original and revised design principles for distributed cognition systems**

Design Principle	Original Principle	Revised Principle
Ownership	An interpretation is always owned by an actor who is responsible for creating and maintaining it.	<i>Discursive communication provides the mechanism for moving interpretations owned by individuals into a social context, this is necessary for creating organizational knowledge.</i>
Easy Travel	An individual's interpretation should display a hypertext like structure in which any element can be linked together and followed quickly and easily.	<i>Discursive communication provides a mechanism to provide direction, and validate the volumes of information that result from easy travel within the knowledge system.</i>
Multiplicity	Each actor should make his or her own interpretations and participate in the exchange or critique of these representations.	<i>Discursive communication provides a forum for open and validated communication to occur – a requirement for exchange and fusion of the representation of individuals in order to form organizational knowledge.</i>
Indeterminacy	Interpretations are not required to be	<i>Indeterminacy explicitly leaves room for</i>

	complete, comprehensive, or precise. They are not a final understanding.	<i>conversation from separate views and discursive action provides the mechanism for open and validated communication.</i>
Emergence	Abstract concepts will be developed during the process of interpretation as ideas are fused together.	<i>Discursive communication provides the forum for bringing together the interpretations of individuals and validates them, as a result interpretations are fused together and new organizational knowledge emerges.</i>
Mixed Form	Actors have radically different forms of expressing their understandings, ranging from text to pictures and graphs.	<i>Discursive communication provides a mechanism, through validity claims, to ensure that actors are communicating accurately with each other, this is especially important if they are using different forms of expressing their understanding.</i>

The PL accesses SQL databases containing models that reside either on the client, intranet, or internet. The latest version of Flash is especially powerful at creating rich Internet applications and occasionally connected applications that can run on mobile phones and PDAs as well as standard desktop computers. Further enhancing easy travel. Combined these features support local ownership, easy travel, multiplicity, and mixed forms. New knowledge emerges in the forums.

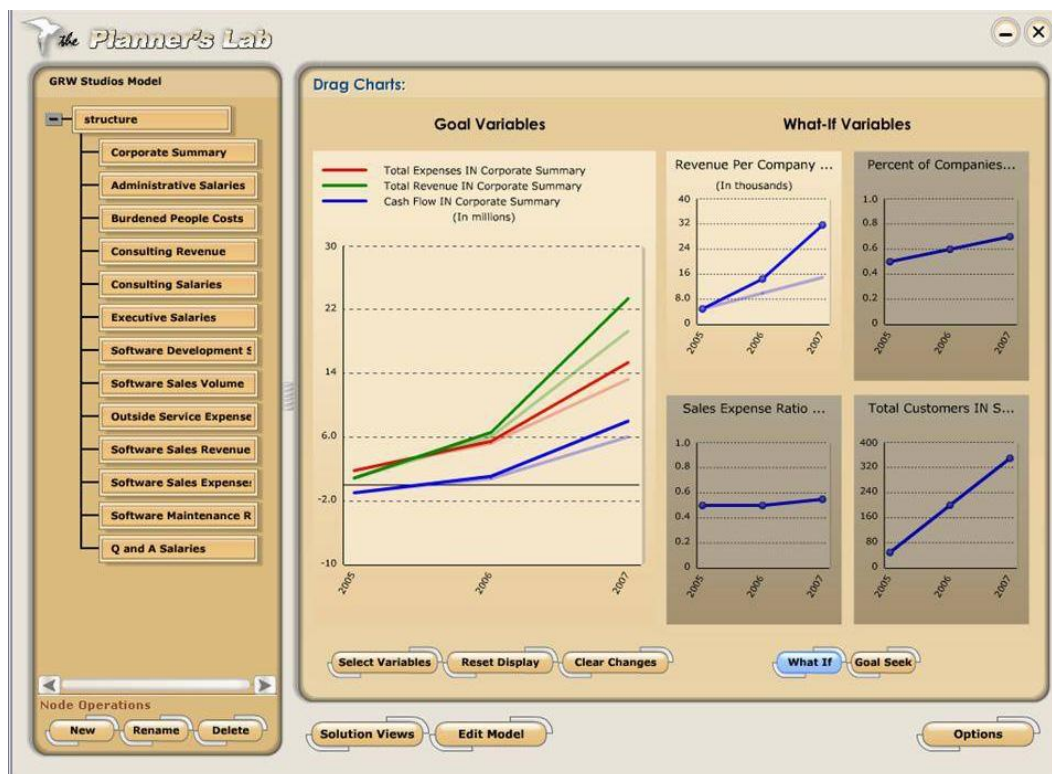


Figure 1: What-if analysis using trend lines.

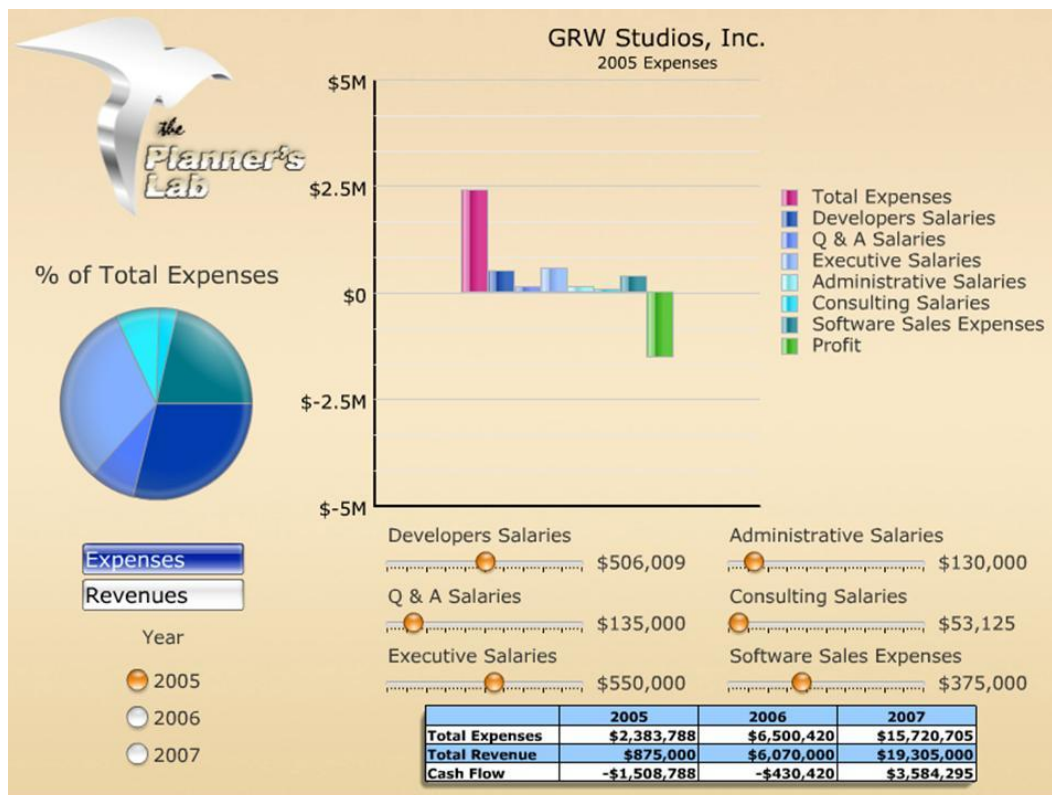
Flash applications take advantage of the user's Internet connectivity when available and can cache data for use when connectivity is not present. These tools are made even more powerful by Flash's ability to handle data in XML format and connect to many common data sources and Web services. Because Flash movies are small, these applications are quickly downloadable from the Web or easily sent to others via e-mail. These features support the design principles of multiplicity and mixed form displays. The use of inquiring systems and communicative action in the discussion forums promotes the emergence of individual and collective knowledge. The forums in effect become a knowledge base, documenting how

models have evolved, supporting the exchanging of beliefs about models and model assumptions. Complete models are not required, hence indeterminacy is supported as well. To illustrate mixed forms, an alternative format is shown in Figure 2. Here the model has been exported to Xcelcius, another package that integrates with The PL and Flash. It produces Flash movies with animated charts, dials and sliders.

Equal opportunity to engage in the discourse is provided through the forums. The system supports the basis of the ideal speech situation in that all parties are free to participate to the extent they desire, and of course, the software gives no preference to any particular participant. We do assume that the organization provides approximately equal access to computing facilities and that users are trained so that their skills in using the system are approximately equal as well. Finally, the parties involved in the discourse are expected to agree to the Habermasian rules of co-operatively seeking the truth, and to accepting the force of the better arguments.

## Conclusion

Cognition in organizations is distributed among its individual members, but individual and organizational learning is heavily dependent on communication. Communicative action and rational discourse in the form of discursive action can be used to foster the emergence of individual and organizational knowledge and to resolve disputes among asserted relations between variables in causal models of an organizational problem domain. We have described a system called DISCOMAP that supports the development and sharing of visually oriented cognitive maps using The PL and Flash technology. We believe that this approach can enhance the development and sharing of validated organizational knowledge through the process of communicative action.



## REFERENCES

1. Axelrod, R., (1976) *Structure of Decision: The Cognitive Maps of Political Elites*, Princeton University Press, Princeton, NJ.
2. Benoit, G., (2002) "Toward A Critical Theoretic Perspective in Information Systems," *Library Quarterly*, Vol. 72, no. 4, pp. 441-471.
3. Boland, J., Ramkrishnan, T., Te'eni, D., (1994) "Designing Information Technology to Support Distributed Cognition," *Organization Science*, Vol. 5, No. 3, August, pp.456-475.
4. Churchman, C.W., (1971) *The Design of Inquiring Systems: Basic Concepts of Systems and Organizations*, Basic Books, New York, NY.
5. Courtney, J.F (2001) " Decision Making and Knowledge Management in Inquiring Organizations: Toward a New Decision-Making Paradigm for DSS", *Decision Support Systems*, Vol. 31. No. 1, 17-38.
6. Courtney, J.F., Croasdell, D.T., and Paradice, D. B., (1998) "Inquiring Organizations," *Australian Journal of Information Systems*, Volume 6, Number 1, September, pp. 3-15, and reprinted in *Foundations of Information Systems: Towards a Philosophy of Information Technology*, <http://www.cba.uh.edu/~parks/fis/fisart.htm>.
7. Habermas, J., (1984) *The Theory of Communicative Action: Reason and the Rationalization of Society*," Beacon Press Books, Boston, MA., Vol. 1.
8. Habermas, J., (1985) *The Theory of Communicative Action: Lifeworld and System*," Beacon Press Books, Boston, MA., Vol. II.
9. Lee, S., Courtney, J.F. and O'Keefe, R.M., (1992) "A System for Organizational Learning Using Cognitive Maps," *OMEGA: the International Journal of Management Science*, Vol. 20, No. 1, pp. 23-36.
10. Lyytinen, K., and Hirschheim, R., "Information Systems as Rational Discourse: An Application of Habermas's Theory of Communicative Action," *Scandinavian Journal of Management*, Vol. 4, No. ½, 1988, pp. 19-30.
11. March, J. G. and Olson, J. P. (1976) *Ambiguity and Choice in Organizations*, Bergen, Norway.
12. Ngwenyama, O. K., and Lyytinen, K. J., (1997) "Groupware Envrionments as Action Constitutive Resources: A Social Action Framework for Analyzing Groupware Technologies," *Computer Supported Cooperative Work: The Journal of Collaborative Computing*, 6, 71-93.
13. Richardson, S. M. (2005), "Knowledge Management and the Design of Distributed Cognition Systems," *Proceedings of the 38<sup>th</sup> International Conference on System Sciences*, IEEE Computer Society Press.
14. Richardson, S. M., Courtney, J. F. and Paradice, D. B., "An Assessment of the Singerian Approach to Organizational Learning: Cases from Academia and the Utility Industry," Special Issue of *Information Systems Frontiers on Philosophical Reasoning in Information Systems Research*, Vol. 3, No. 1, 2001, pp. 49-62.
15. Wagner, G. R., Paradice, D. B. and Courtney, J. F. (2005) "A Software Laboratory for Advancing Decision Support Simulation," working paper, Peter Kiewit Institute, University of Nebraska at Omaha.