

Cognitive Work Analysis: A Framework for Research in Collaborative Information Seeking

Patricia Katopol
School of Library and Information Science
University of Iowa
Iowa City, IA
319.335.5714 (vox) 319-335-5374 (fax)
patricia-katopol@uiowa.edu

ABSTRACT

This paper introduces Cognitive Work Analysis (CWA) as a multidisciplinary framework for studying information behavior during collaborative information seeking (CIS). It suggests that CWA enables the researcher to see actors engaged in CIS as being as constrained by their organizational environment as they are by the tools that they use and that failure to include this environment is likely to result in poor design of tools for collaborative information retrieval.

1. INTRODUCTION

In addressing information retrieval, individual or collaborative, the focus often is on creating or critiquing tools that support the task. But what if we stepped back from a focus on developing technological systems and looked first at the people and the context in which information retrieval tasks take place? What if we stopped thinking about 'users,' and started thinking about 'actors' and their behaviors in the face of constraints in the system? This paper suggests Cognitive Work Analysis as a methodological framework that addresses these questions as it aids in the examination of human information behavior in the work place, including collaborative information seeking and retrieval.

2. COGNITIVE WORK ANALYSIS

Cognitive Work Analysis is a multifaceted approach to analyzing human information behavior (Rasmussen, Pejtersen et al. 1994; Vicente 1999; Pettigrew, Fidel et al. 2001; Fidel, Pejtersen et al. 2003). It grew out of systems and human factors engineering and has been applied to the study of complex systems from command and control systems (Chin, Sanderson, Watson 1999) to patient monitoring (Sanderson, Crawford, Savill, Watson, & Russell 2004). More recently, Cognitive Work Analysis has been applied to studies of human information behavior using information technologies and knowledge management (Fidel and Pejtersen 2004; Fidel, Pejtersen, Cleal, 2004; Pejtersen, Albrechtsen, Cleal, Hansen,

Hertzum 2001, Katopol 2006, Katopol 2008). A multifaceted approach allows the researcher to observe the complexity of human information behavior, rather than centering on the social, which often uses social network theory, or on the cognitive, which focuses on the individual's behavior, independent of context.

In using Cognitive Work Analysis we examine the actions of *actors* (a person acting in a context, not simply a user of a system) who are affected by *constraints* (factors outside of the actor's control and which shape his behavior). Constraints occur in the work environment, work domain, task situation, social organization, and the actors' resources and values. Instead of focusing on the observed behavior, the analysis focuses on the constraints that shape the behavior. We learn why people do what they do when engaging in information behaviors, not only what they do. Focusing only on behavior can lead to poor system design because behavior can be based on a number of factors, one of which is an inaccurate mental model of the problem (Fidel and Pejtersen 2004). If we design based on pre-existing behaviors and mistaken mental models, we are designing for failure and not for improvement or innovation. All the dimensions are important to understanding the actor's environment and task in order to design better systems and services for the actor's use. To examine these dimensions of information behavior in more detail, this paper uses an example of managerial information behavior in the context of municipal government (Katopol 2006; Katopol 2007a).

2.1 Cognitive Work Analysis Dimensions

The work environment – This is the environments in which the organization operates, such as regional and state governments, vendors, citizens, and nonprofit organizations. These environments usually impose constraints on the actors which they are unable to change. For example, new federal homeland security regulations may require organizational members to rethink how they make information available, such as removing some information from a public web site.

Organizational analysis – This is an examination of management style, organizational culture, social conventions, and role allocation.

Work-domain analysis – This is work done in the organization being studied, here, city government.

Task analysis – Here we examine specific tasks involved in information-related behaviors such as drafting a committee agenda or completing departmental reports.

Decision analysis – In this analysis, we obtain a more specific view of decisions actors make as they engage in information behaviors, such as when managers may decide to read the municipal code themselves rather than ask an attorney in the legal department to interpret the code for him.

Strategies analysis – Which strategies are possible for each task and decision? Why do actors choose certain courses of action? For example, when would managers decide to try to find information on their own as opposed to delegating the task to a subordinate?

Actor's resources and values analysis – Finally, we identify typical characteristics of each group of actors. In our example, managers use a variety of sources, technological and human, to meet their information needs. They might put the values and mission of their department over their personal professional goals.

Once data is obtained, a *mean-end* analysis is applied. Again, using the example of managers in municipal government, we locate the -

Goals & constraints – Depending on the department, one goal might be to negotiate with vendors with constraints being state and local regulations on bidding and contract terms.

Priorities & measurements – A priority might be to get the best deal for the city with measurement being better terms than for the same deal in previous years.

Functions – What needs to be done; in this example, purchasing and contracting.

Processes – How what needs to be done gets done, such as sending out requests for proposals (RFPs).

Resources – The tools used to get the job done, such as computers, other people, RFP forms, and meetings.

To obtain this data, we ask questions such as: Why do you do your work this way? How would you like to do it? What tools do you use? In this work, what are your constraints? What are your priorities? How do you determine a successfully completed task? What do you like most about the work? What do you like least? Who assigns work to you? What choices do you have in how you do your work? How (in what format) would you like to receive information? How would you like to share information with others? Tell me what it's like to work here.

Cognitive Work Analysis recognizes that information behaviors are affected by social networks in the workplace, personal networks outside of work, hierarchies, conflicts, and institutional pressures. All of these forces cause people to act,

or not act, in ways that are not directly responsive to the task at hand, but address some other need that must be filled (DiMaggio and Powell 1991). Asserting that actors will seek to fill an information need without considering all of the other personal, contextual, and task-based constraints facing them does not adequately address the complexity in which many information behaviors, including collaborative information seeking, take place.

In the city government departments, Cognitive Work Analysis exposed organizational forces, such as a need to react quickly to citizen information requests and to share information orally and in person rather than in writing. Questions about the organization revealed that managers were concerned that citizens might request information before they deemed it ready for public consumption. Without this knowledge, the researcher might assume that the departments needed a tool to help capture all information prior to production of a final document, such as capturing information exchanged in meetings, when in actuality the last thing managers wanted was a paper or electronic trail that might have to be produced as evidence of actions or failure to act. To be clear, managers were not trying to act in an underhanded manner and hide information from the public, but believed the public was better served when it had complete information, rather than information used preparatory to creating documentation.

In an application of Cognitive Work Analysis specifically to collaborative information retrieval, CWA was used to inform the design of tools to assist with collaborative film indexing (Albrechtsen, Pejtersen, and Cleal 2002). The collaborative nature of this task presented design concerns as indexing is usually an individual activity. Understanding the organization and its goals - a national film archives attempting to provide one set of index terms and to address the needs of various segments of the population – aided the analysis and suggested tools that might have been ignored otherwise. Here, CWA indicated that for this organization, collaboration needed to be made visible, collaborators needed a tool that would allow them to see the history of the discussion, and they needed a taxonomy of agreed upon terms to counter the tendency of collaborators to speak past each other as they used different terms during analysis of the film for indexing.

Following Shah's definition of collaboration as involving "creating a solution that is more than merely the sum of each party's contribution" (Shah 2008), we see that the better index is not one that simply lists all of the collaborators' indexing suggestions, but one that builds on the suggestions and structures so that it represents a 'total view' of the collaborators reactions to and interpretations of the film. Without an understanding of the constraints presented by the organizational and societal goals faced by the indexers, it is unlikely that any tool built for them would have met the indexers' actual collaborative information needs.

3. BENEFITS OF THE FRAMEWORK

Cognitive Work Analysis is a flexible framework which permits the researcher freedom to apply those theories that are the most useful to the study. For studies in collaborative information retrieval, theories from organization science such

as institutionalism (Powell and DiMaggio 1991), organizational culture (Martin 2002, Schein 1992), and power and roles (Miller, Hickson et al. 1996; Hardy and Clegg 1996) are useful to explain pressures that force actors to behave in certain ways. When we ignore the pressures of organizational membership on actors as they engage in information seeking behavior and interact with other actors or technology, we ignore the very real pressures that force people to act in ways that may not seem rational, efficient, or effective, but, for reasons known to the actor, are the ways he or she must act within a particular environment.

Another benefit to using CWA is the ability to add additional elements. In studies of complex technologies such as power plant controls, it is of little use to return to obsolete technologies in the design of new systems. However, in using CWA to inform systems and services that are not technological in nature, it makes sense to ask actors about previous work routines and systems and whether they worked better than those in current use.

In speaking with the municipal managers, for example, the additional element of historical data was added to interview questions. There is a benefit to knowing what came before and whether actors found previous information-related processes and procedures effective. In government organizations where management (and their preferences for certain work routines) come and go with the change of administrations, there maybe an organizational memory of previous practices that worked well and could be revived if applicable to the current situation.

4. FRAMEWORK LIMITATIONS

Despite the benefits that CWA can bring to investigations of human information behavior, there are limitations to the framework. First, it can elicit a large amount of data which correspondingly takes a long time to analyze. Because of the amount of data generated, Cognitive Work Analysis researchers, who often work alone or in small research groups, do not use large sample sizes. For those used to sending a survey to hundreds of possible respondents, this may seem problematic; however, since we are trying to design systems for specific workplaces and tasks, rather than a one-size-fits-all system, small sample sizes with thick data actually benefit CWA researchers.

Second, to apply additional theories, the researcher must become familiar with literatures outside of his or her field and be comfortable with multidisciplinary work. Knowledge of LIS or computer science theories alone are generally insufficient to explain all of the observations uncovered during the study.

And third, in the ideal situation, after system design, researchers and designers would return to evaluate the system and make changes as necessary. Unfortunately, this is expensive and time consuming. It is easier for organizations to go with the initial design until problems erupt again.

5. CONCLUSION

Cognitive Work Analysis and addressing the context and constraints in which collaborative information retrieval behavior takes place, permits a holistic view of information behaviors, not those we wish existed or those that would make design easier. Cognitive Work Analysis provides more information about work-related information behaviors than surveys and observations alone, providing rich data to inform design. When there is an appreciation of the entire environment in which collaborating actors must function, we avoid designing systems and services that fit the ideal but fail when applied in context.

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