# Cognitive Work Analysis

Cognitive Work Analysis (Vicente, 1999) is a work-centered conceptual framework developed by Rasmussen, Pejtersen & Goodstein (1994) to analyze cognitive work. The purpose of Cognitive Work Analysis (CWA) is to guide the design of technology for use in the work place. It is unique because of its ability to analyze real-life phenomena while retaining the complexity inherent in them. When applied to information behavior, the approach guides the analysis of human-information interaction in order to inform the design of information systems.

CWA's theoretical roots are in General Systems Thinking, Adaptive Control Systems, and Gibson's Ecological Psychology, and it is the result of the generalization of experiences from field studies which led to the design of support systems for a variety of modern work domains, such as process plants and libraries. In the context of Information Science, the concept "information system" refers to any system, whether intellectual or computerized, that facilitates and supports human-information interaction. Thus, a library as a whole could be considered an information system, and so could a reference desk, the Web, an OPAC, or a cataloging department.

Unlike the common approach to the design of information systems—design and development first and evaluation later—CWA evaluates first the system already in place, and then develops recommendations for design. The evaluation is based on the analysis of information behavior in context. CWA has been successfully applied to the evaluation and design of information systems and collaboratories. For example, it guided the development of the first retrieval system for fiction called BookHouse (Pejtersen 1989; Rasmussen et al., 1994; Pejtersen, 1992). Based on the analysis of reference interviews in public and school libraries, Pejtersen developed a fiction retrieval system, with a graphical user interface, in which users can look for books by a variety of attributes,

such as the subject, historical period, mood, and the cover design. It serves children and adults, as well as library catalogers. The system also caters to various strategies: users can just browse without any particular attribute in mind, look for a specific book, or look for books that are similar to one they liked. More recently, CWA was used to analyze data collected in a study of Web searching by high school students (Pejtersen & Fidel, 1998; Fidel et al., 1999). In this study, the framework proved to be very powerful in helping to uncover the problems that students experienced when using the Web to search for information, and offered recommendations for designs that can alleviate such problems. Pejtersen and her colleagues have recently completed the COLLATE project that will support multi-institutional collaboration in indexing and retrieval among the national film archives of Germany, Austria, and the Czech Republic (Albrechtsen et al., 2002, Hertzum et al., 2002).

Cognitive Work Analysis considers people who interact with information "actors" involved in their work-related actions, rather than as "users" of systems. Focusing on information behavior on the job, CWA views human-information interaction in the context of human work activities. It assumes that in order to be able to design systems that work harmoniously with humans, one has to understand:

- The work actors do,
- Their information behavior,
- The context in which they work, and
- The reasons for their actions

Therefore, CWA focuses *simultaneously* on the task actors perform, the environment in which it is carried out, and the perceptual, cognitive, and ergonomic attributes of the people who do the task. A graphic presentation of the framework is given in Figure 1. In this presentation each set of attributes mentioned above is designated with a circle and is considered a dimension for analysis. Thus, each dimension is a host of attributes, factors, or variables—

depending on the purpose and method of a study. In addition to the dimensions for analysis, CWA provides several templates to support both analysis and modeling. These templates are particularly suitable for the analysis of complex and dynamic phenomena.

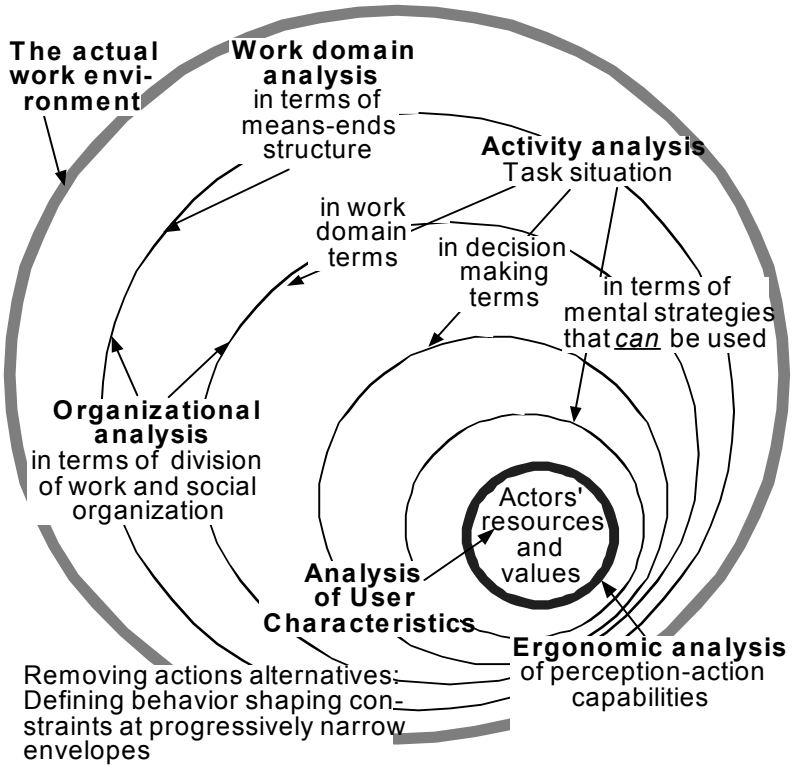


Figure 1. The dimensions for analysis in Cognitive Work Analysis

To illustrate the content of each dimension, Table 1. provides a few examples of questions one may want to ask when analyzing along each dimension.

| Dimension | Examples of Questions to Ask in Analysis |
|---|---|
| Environment | What elements outside the organization affect it? |
| Work domain | What are the goals of the work domain? The constraints? The priorities? The functions? What |

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| | physical processes take place? What tools are employed? |
| Organizational analysis | How is work divided among teams? What criteria are used? What is the nature of the organization, hierarchical, democratic, chaotic? What are the organizational values? |
| Task analysis in work domain terms | What is the task (e.g., design of navigation functionality)? What are the goals of the task that generated an information problem? Constraints? The functions involved? The tools used? |
| Task analysis in decision making terms | What decisions are made (e.g., what model to select for the navigation)? What information is required? What sources are useful? |
| Task analysis in terms of strategies that can be used | What strategies are possible (e.g., browsing, the analytical strategy)? What strategies does the actor prefer? What type of information is needed? What information sources does the actor prefer? |
| Actor's resources and values | What is the formal training of the actor? Area of expertise? Experience with the subject domain and the work domain? Personal priorities? Personal values? |

Table 1. Examples of questions to ask for each of teh CWA's dimension

Although the dimensions are laid out in a certain order, employing them in actual projects follows no fixed sequence. Because of the interdependence among the dimensions, a researcher moves from one dimension to another in an iterative process. The path of this movement is determined by the particular problem at hand, and also by pragmatic considerations.

The dimensions presented by CWA represent the constraints on information seeking, starting with the individual resources and values of the actor to the external environment of the work place. For some dimensions, a dimension creates the constraint for the one nested in it. Thus, the work environment affects how a work place is operating, and this mode of operation shapes the task that an actor performs. The task, in turn, affects the decisions that an actor makes, and these decisions influence seeking behavior. In addition, the actor's characteristics have an effect on seeking behavior and so does the social organization of the work place. CWA assumes that while one can *describe* information behavior without taking these constraints into account, the best way to *analyze* information behavior is through an in-depth understanding of these constraints. Work analysis is, therefore, an analysis of the constraints that shape information behavior.

Because CWA investigates information behavior in context, individual studies create results that are valid for the design of information systems in the context investigated, rather then for the design of general information systems. Results from a variety of studies, however, can be combined together and generalized to inform the design of other information systems.

Cognitive Work Analysis has several distinct attributes that are useful for the study of human-information interaction and for the design of information systems. Most importantly, it provides for a holistic approach that makes it possible to account for several dimensions simultaneously. In addition, the framework facilitates an in-depth examination of the various dimensions of a context. A study of a particular context is, therefore, a multi-disciplinary examination with the purpose of understanding the interaction between people and information in the work context. These two attributes make the framework a powerful guide for the evaluation and design of information systems for the context under investigation because in reality all dimensions—personal, social, and organizational—play a role simultaneously and interdependently.

Lastly, while the framework is based on a set of conceptual and epistemological constructs, it provides a *structure* for the analysis of human-information interaction, rather than subscribing to specific theories or models. Sanderson (2003) explained that "The scientific foundations of CWA are various—a "conceptual marketplace" as Rasmussen described it—because they have been appropriated to fulfill a practical need." One can employ a wide variety of theories, methods, or tools that may be deemed helpful for the analysis of a specific situation. This flexibility turns the focus of an investigation to the phenomenon under study, rather than to the testing and verification of models and theories, or to the employment of a particular methodology. At the same time, CWA has build-in mechanisms to carry out rigorous and systematic research.

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