Joker One:
A Tutorial in Cognitive Work Analysis

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Abstract

Cognitive work analysis is a multi-stage analytic framework for identifying the human-relevant work constraints in a socio-technical system. It offers a set of knowledge representation tools specifically tailored to analysis and design of large-scale information systems. Many cognitive engineers experience initial difficulty in understanding the diverse analytic stages that make up the framework of cognitive work analysis. They also experience initial difficulty in understanding how the stages inform each other and how the stages inform design. In this tutorial, I work through an example to illustrate each of the analytic stages and how the different analyses flow into each other. I also illustrate the implications of each stage for design of a cognitive support system. For source material, I draw primarily on a narrative of US Marine counter-insurgency operations provided by Donovan Campbell in his book, Joker One.

Author's Note

Over the 20 years or so that I have engaged with cognitive work analysis, I have struggled with two issues. One concerns the mechanics of how to do it and the other concerns terminology.

As many of you will already know, the framework of cognitive work analysis is based in the work of Jens Rasmussen, for example, Rasmussen (1986) and Rasmussen, Pejtersen and Goodstein (1994). These treatments are rich in conceptualisation but lack structure. Vicente (1999) performed a major service in providing that structure. In addition, he established a coherent and persuasive argument for why we would want to embark on such an extensive analytic endeavour. However, despite the structured approach offered by Vicente, the actual execution of the analysis remained a struggle.

My first book on this topic (Lintern, 2009) offered a theoretical perspective that had been neglected and also explained the mechanics of the analysis. Since the release of that book, I have taught this framework many times within extended workshops. The students within those workshops have primarily been professionals from the cognitive engineering and systems engineering communities. As I teach this material within those disciplines, I continue to be troubled by the terminology. Those of us who have experience in the use of cognitive work analysis have not been kind to others who seek to understand this framework for the first time. We do not always use words in a sense that corresponds to their natural language meaning and some of the words we use are just outright obscure.

In this book I describe the process of analysis in more detail than I have done before. Additionally, I continue to adjust the terminology. All of those adjustments are in the service of making this material more accessible. This is an ongoing effort. If you who have read my earlier book or have taken one of my workshops, you will notice that I even adjust my own terminology. I like to think that this book will be my final word but I fear that a month or a year from now I will find something I do not like and I will want to change the words I use. Nevertheless, I hope that any of my adjustments in terminology enhance accessibility sufficiently to overcome any confusion created by lack of consistency with my earlier treatments.

The Strategy for this Tutorial

The purpose of cognitive work analysis is to describe requirements for a future system. In a tutorial on a subject as extensive as cognitive work analysis, it is difficult to explain analytic techniques with reference to a work system that does not yet exist. The illustrations become obscure.

In this tutorial, I have chosen a different course. I take narratives from a work system in action and show how they can be represented within the framework of cognitive work analysis. I represent the system as it is, touching only occasionally on how it could be. Throughout this tutorial, you, the reader, should remain aware that this is not what cognitive work analysis is for. I become futuristic only in a later chapter on functional workspace design. I like to think that this later chapter will suffice to carry the important message that this is an analytic framework to be aimed at designing the future.

What I do here is most specifically aimed at familiarising you with the mechanics of the framework. To do that, I proceed systematically through the framework of cognitive work analysis to demonstrate how to develop each of the representational products and how to use them for design.

My tutorial illustrations draw on US Marine combat narratives offered by Donovan Campbell (2010) in his book, Joker One. The book provides an account of his experiences in Ramadi, Iraq in 2004, where his platoon battled insurgents for seven months. Figure 1 shows the area of operation and the location of the combat outpost and other key features within Ramadi. I list relevant pages of the book within the analytic products I develop. I also use several other sources to complete the analysis and design illustrations.
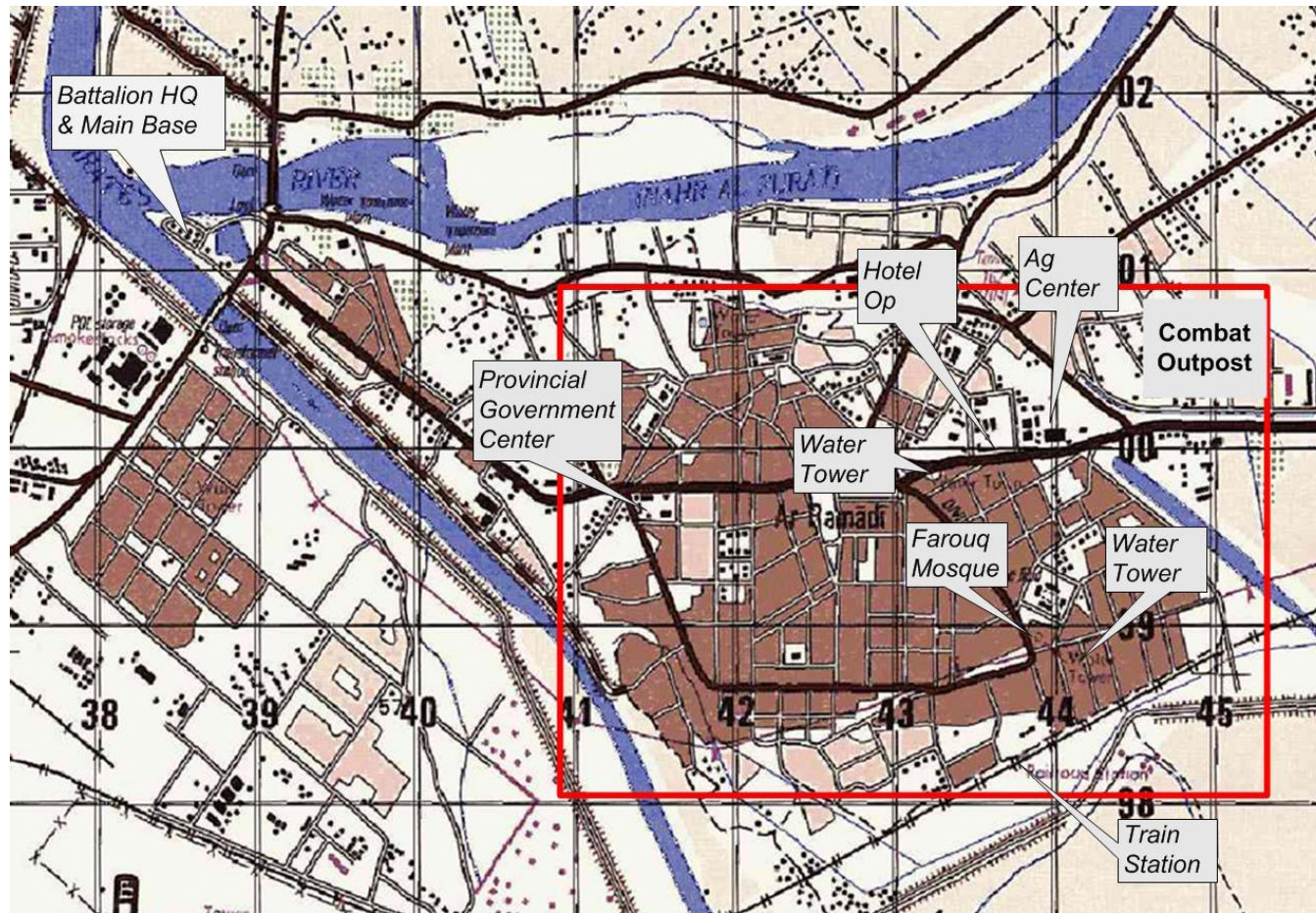
Figure 1: Ramadi, Iraq, showing Joker One's area of operation within the red perimeter and the location of their combat outpost and other significant features

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The Framework of Cognitive Work Analysis

Cognitive work analysis is employed to develop the basis for design of a new work system, one that is not constrained by existing work practices developed for use with obsolete technologies or for resolution of past problems. Cognitive work analysis identifies the constraints on work and is said to support a formative approach to design because it describes requirements that must be satisfied as it shows the space of possibilities. It supports design for the future. We ask, *given the socio-technical constraints that exist within the work domain together with the constraints on human action, what are the possibilities for satisfying the purpose for which the system is being designed*?

There is, however, an issue. We can only design what we can imagine, and our imagination is shaped by our experience. The struggle in design for the future is to imagine possibilities beyond the familiar. We need to be creative, allowing the past to seed our imagination without permitting it to lock us into old, unproductive ways. In formative design, there is an ongoing dance between the past and the future. We reflect on the past to discover immutable constraints on work but we do not want to be captured by habits or patterns of the past that no longer mesh with current demands or possibilities. Cognitive work analysis offers one strategy for engaging in that ongoing dance between the past and the future.

Cognitive work analysis is a multistage framework that offers a set of knowledge representation tools specifically tailored to analysis and design of large-scale information systems. In this tutorial, I identify six stages; work domain analysis, work organization analysis, social organization analysis, work task analysis, cognitive strategies analysis, and cognitive modes analysis. I depict these six stages in Figure 2.
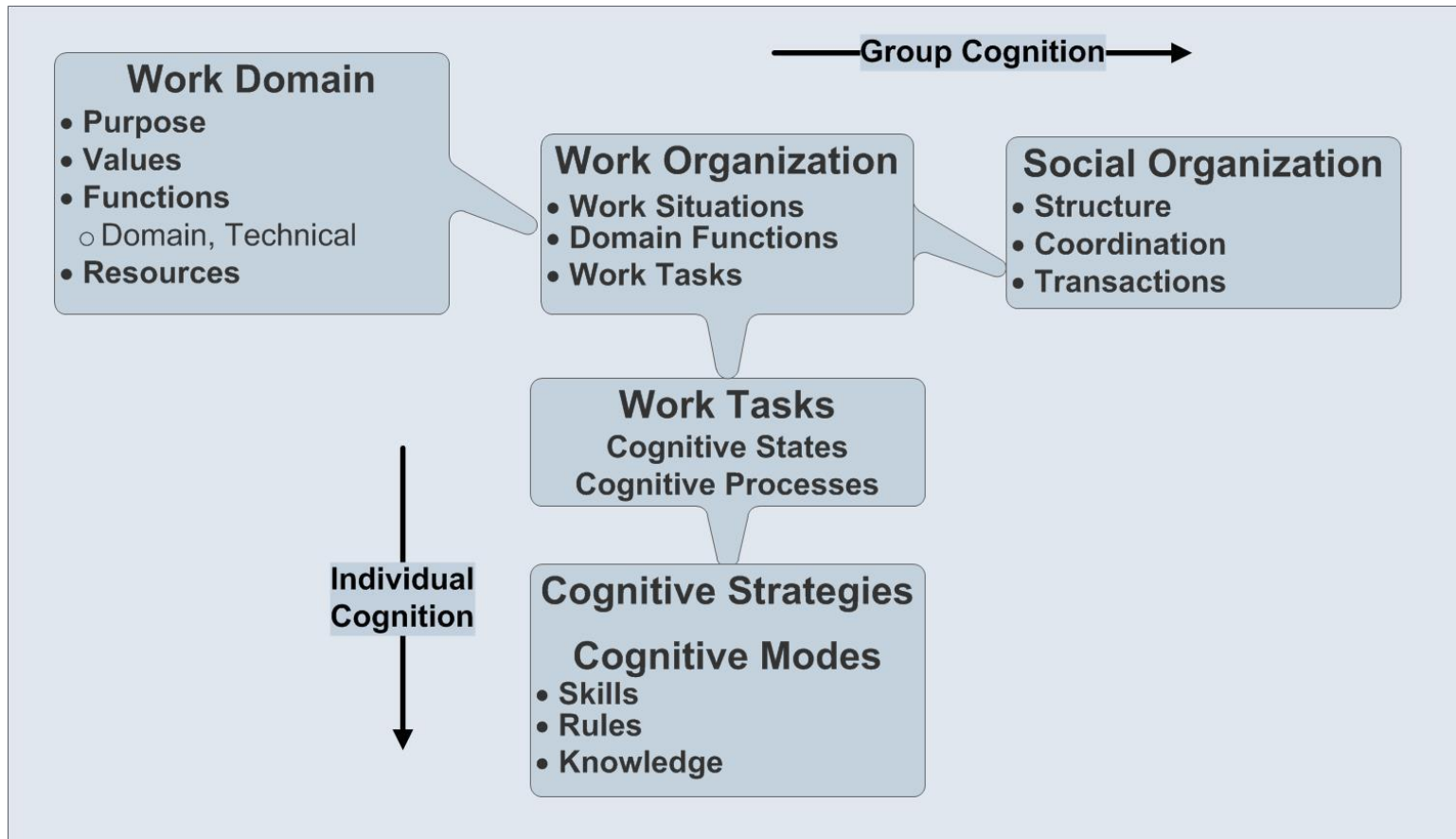
Figure 2: Cognitive work analysis is a multistage framework in which later stages draw on products from earlier stages

The Analytic Sequence

Figure 2 shows that the analysis is initiated with work domain analysis, the products of which inform work organization analysis. The analysis may then follow one of two branches, one dealing with group cognition by use of social organization analysis and one dealing with individual cognition by use of work task analysis, cognitive strategies analysis and cognitive modes analysis in that sequence. The analyst is free to choose which branch to follow first but, for a comprehensive cognitive work analysis, the analyst should then return to complete the other branch.

Different treatments of cognitive work analysis identify different numbers of stages and give them different names. Figure 3 compares the different stages as described by Vicente (1999) to those I describe here. However, there is no substantive difference in the analytic content between the different treatments. Rather, differentiation of analytic content by reference to stages is a pragmatic device that serves to aid organization of analytic workflow and description of the analytic work. Additionally, the names of the stages and the allocation of analytic content to various stages have evolved as analysts have sought better ways to organize their workflow and to describe what they are doing.

Name of Analysis (This Tutorial)	Representational Product (This Tutorial)	Vicente (1999) Chapter Titles
Work Domain Analysis	Abstraction-Decomposition Space	Work Domain Analysis
Work Organization Analysis	Work Task Scratch Pad Work Task Docket	
Work Task Analysis	Decision Ladder Cognitive States & Processes Table	Control Task Analysis
Cognitive Strategies Analysis	Annotations on a Decision Ladder Cognitive Strategies Table	Strategies Analysis
Cognitive Modes Analysis	Annotations on a Decision Ladder Cognitive Modes Table	Worker Competencies Analysis
Social Organization Analysis	Network Diagram Staffing & Transactions Dockets	Social Organization & Cooperation Analysis

Figure 3: Comparison of stage names from Vicente (1999) with those of this tutorial