

# Core-Task Design:

*A Practice-Theory Approach to Human Factors*

# Synthesis Lectures on Human-Centered Informatics

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# Core-Task Design:

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VIT Technical Research Centre of Finland, Ltd.

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## ABSTRACT

This book focuses on design of work from the human-factors (HF) perspective. In the approach referred to as Core-Task Design (CTD), work is considered practice, composed of human actors, the physical and social environment, and the tools used for reaching the actors' objectives. This book begins with consideration of an industrial case, the modernization of a nuclear power plant automation system, and the related human-system interfaces in the control room. This case illustrates generic design dilemmas that invite one to revisit human-factors research methodology: Human factors should adopt practice as a new unit of analysis and should accept intervention as an inherent feature of its methodology. These suggestions are put into practice in the CTD approach, according to which three general design functions are performed, those being:

- understand-to-generalize—empirical analysis of the work at hand,
- foresee-the-promise—creation of concepts for future work, and
- intervene-to-develop—participatory development and design of work.

For fulfillment of each of the design functions, several CTD methods are introduced. The methods are aimed at modeling the core task and analyzing how the actors actually take the core task features into account in order to achieve balance between potentially conflicting demands in action. Thereby, new understanding of the core task is acquired. Further methods focus on projecting the roles and functionality of technologies in the future work and on implementing changes to the work. Specific studies of the nuclear power plant's control-room renewal constitute an example demonstrating a core task and the associated methods. We argue that the CTD approach offers clear utility for the design of future technology, work, and everyday services and environments.

CTD utilizes achievements of practice theory in the social sciences to generate a creative synthesis of Cognitive Work Analysis, semiotic analysis of practice, and the cultural-historical theory of activity. Core-Task Design facilitates dialogue among human-factors experts, design engineers, and end users in their joint development of work. The intended audience of this book is students, researchers, and practitioners of human factors, industrial art and design, and instrumentation and control-system design.

## KEYWORDS

human factors, practice theory, activity theory, cognitive work analysis, functional modeling, ecological approach, core task, habit, orientation, human-factors design, nuclear power plant, complex socio-technical systems, human-computer interaction

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# Preface

Human-factors work is defined as a design discipline, but it has proved difficult to pay heed to this intrinsic element effectively in real-world design practice. While digital information technology and Internet-based communication create new possibilities for work and services in all spheres of life, they challenge people's learned ways of thinking, acting, and collaborating. Addressing these challenges effectively in design performed by human-factors professionals requires the discipline's methods and tools to develop, along with its ways of participating in the design processes. This book provides one perspective for analysis of digitalized work and everyday services and for improving our discipline's input to their design.

The approach described in this book has emerged in the course of several years of human-factors research at VTT Technical Research Center of Finland. The research environment of a multi-disciplinary research institute has promoted research giving input from several technical fields on customers' practice-relevant problems and has facilitated collaboration with customers representing a broad spectrum of domains.

The approach introduced here is characterized as a practice-theory approach to human factors. The claim defended in this work is that a practice-theory approach has potential to capture human activity in a context-dependent manner and appreciate the role of tools and technologies in human conduct. Hence, it has an intrinsic capability to develop good interplay with engineering and other relevant design-oriented disciplines.

There are three main arguments in support of the above claim. First, shifting the key concept and the unit of analysis in human-factors activities from the traditional "action" to "practice" means that the focus of research is redefined to encompass the totality of the socially distributed ways of acting instead of emphasize the individual and his or her mental processes. It follows from this that the design of technologies under such an approach is not human-centered in the usual sense. Instead, it is ecological, entailing emphasis on the mutual relationships of the environment, technology, and human actors. Focusing on the joint functioning of these main elements enables design of sustainable future technologies, services, and living environments.

The second argument is related to how practices are formed and perpetuated. A practice-theory-based approach acknowledges the power of cultural, social, and technological structures in shaping the content and forms of practices, but it also emphasizes and represents an interest in uncovering people's intentions, the meanings given to these structures, and the capability of people to develop practices and social and technological structures.

The final main argument has to do with the variety of theoretical conceptions of the notion of practice. This diversity becomes a strength for the concept through the possibility of identifying sufficient commonality among the various conceptions. In consequence, different perspectives can be brought together in a theoretically sound synthesis that fits the practical problems to be studied.

The authors believe that adoption of the concept of practice as the central methodological tool is novel within human-factors approaches. This does not mean that we would not acknowledge attempts representing similar reorientation, especially those in human-computer interaction research. In fact, joint interest in the practice-theory approach could be an important incentive for strengthening interaction between the human factors and human-computer interaction communities. Our approach shares with the systems-theory-oriented line of human-factors research the intention to view human behavior holistically. Reflecting on the connections between practice-theory- and socio-technical-system-based approaches would be fruitful.

The relatively restricted space for these lecture notes in the context of the Morgan & Claypool series led us to concentrate on describing the roots and characteristics specific to our approach, Core-Task Design methodology. We hope the future will offer opportunities to exploit the connections among relevant research approaches to create a comprehensive understanding of how human-factors theory and methodology can be developed further. We consider today's students and young researchers to play a central role in integrating approaches and developing practices for effective support of design related to technologically and societally complex work, everyday services, and living environments.

The authors of this book have collaborated intensively over several years in many research projects. The chance to prepare these lecture notes together gave us an opportunity to reflect on our previous work and to put the pieces of our methodology in place in a clear and consistent picture. This book has its broader background in the work of the human-factors research group at VTT Technical Research Center of Finland. In preparing this volume, the authors have had the opportunity to summarize and extensively exploit the achievements of this research group. We express tremendous gratitude to the other members of the group: Maaria Nuutinen, Jari Laarni, Leena Salo, Marja Liinasuo, Iina Aaltonen, Hannu Karvonen, and Mikael Wahlström.