

A Scientific Methodology for Relating People and Automation in Work Systems

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Technology that has come into common usage in the past decade—including mobile computing, interoperable and reconfigurable system architectures, miniaturized biomedical sensors, voice commanding and touch interfaces—has fundamentally changed what automated systems can do and, more importantly, how they need to be designed and developed. Because of the interactivity and adaptability that today's technology enables, computerized devices and tools are best conceived and designed as *total systems*, which includes the people and their environment. This is accomplished by developing systems *iteratively in the context of use* through partnerships with vendors, institutions, and people who use the technology and whose lives may rely upon it. Such a systems design methodology is facilitated by *Brahms*, a multi-agent modeling and simulation tool for designing and evaluating total work systems, relating people, technology, and the environment. Practices are located, chronological behaviors, called *activities*—including perceiving, reasoning, communicating, using tools, and moving. Activities are conceived socially in terms of roles and modes of participation by which we distinguish coordination, cooperation, and collaboration. Brahms simulations relate how people's mental models change through interaction and how monitoring and interpreting the environment using tools is *conceptually organized* by activities (i.e., cognition is situated). Brahms has been applied to design and deploy automation for a variety of space science, medical, office, and commercial flight work systems.