Being Scientific on Mars: The Challenges and Accomplishments of the Phoenix Lander Mission

By: William Clancey
September 8, 2009

Abstract:
In school we are taught that the "scientific method" is a procedure for relating data, hypotheses, experiments, and theory. In practice "being scientific" on missions is an ongoing accomplishment in a world of shutes and ladders. The scientific method itself is adapted and improvised, as scientists work within the constraints of computer programming, spacecraft resources, and communication timings—while negotiating among themselves, preparing publications, and needing to keep the public informed about their progress.

Based on my observations of the Science Operations Center in Tucson and analysis of reports during the mission, I present a perspective on the challenges of doing science with the Phoenix lander. How did the scientists construct standards, goals, procedures, and responsibilities to fit the instruments available? How did the technology facilitate or stymie their efforts? In the end, I am left with some conundrums about how we are to balance costs, scientific return, and our ideals.

About the Speaker:
William J. Clancey is the Chief Scientist for Human-Centered Computing in the Intelligent Systems Division at NASA Ames Research Center. He is on an intergovernmental appointment from the Florida Institute for Human and Machine Cognition (Pensacola), where he is a Senior Computer Scientist.

Clancey holds a doctorate in computer science from Stanford University (1979), in which he developed the first computer program to use an expert system for teaching. He also has a BA degree in mathematical sciences from Rice University, Houston (1974). Prior to joining NASA, Clancey was Senior Research Scientist and founding member of the Institute for Research on Learning (1987-1997), where he collaborated in business anthropology projects for large corporations; earlier he was at the Knowledge Systems Lab in the Computer Science Department at Stanford University (1979-1987). He holds five software patents involving instruction, finance, and work practice simulation.

At NASA Clancey manages the multidisciplinary group, "Work Systems Design & Evaluation." His team has deployed software in Mission Control to automate file transfer between the ground and Space Station crew. He has participated in ten Mars mission simulations in the Canadian Arctic, Utah, and Arizona, in which he studied how scientists explore a new terrain. He was commander of the Mars Desert Research Station for five years, experimenting with computer "agents" to assist astronauts who are unable to have
real-time conversations with support teams on earth. He also co-led development of an agent system to help astronauts manage their life support and resources during EVAs.

Clancey has published six books, including *Situated Cognition: On Human Knowledge and Computer Representations* (1997). He has presented invited tutorials and keynote addresses in 20 countries. He is currently writing a NASA Special Publication for the History Division on how working with the Mars Exploration Rover has changed the nature of field science.