

## Collaboratory: The New Approach to Scientific Research

Computer software continues to revolutionize the applications that computers can provide to its users. Software transformed the field of science with the research and development of expert systems such as DENDRAL in the 1970's. Software has again made giant strides for science by the creation of what is now known as collaboratory, a mode of research that focuses on making research more efficient by pooling together resources for scientists. While the software for laboratories is constantly being revised and perfected as to allow easier usability, questions remain about how effective this new approach to scientific research will be.

The notion of a collaboratory has been around for quite a few years. Its roots date back to 1989 when the idea of a collaboratory was first formally discussed at a National Science Foundation workshop. The term itself, as defined by computer scientist William Wulf, is a "center without walls" [Ross-Flanigan p. 54]. At its heart, the term describes a manner of interaction among scientists with colleagues, vast amounts of information and computational resources that disregards geographic location.

Collaboratories emerged almost instantly after their introduction, turning the once notion into reality. The Michigan based Upper Atmospheric Research Collaboratory (UARC) allowed scientists to share access to radar and other instruments to study space weather and related space weather phenomenon. Richland, Washington is home to the Collaboratory for Environmental and Molecular Sciences, which scientists from different disciplines and from many locations can work together on environmental problems, sharing analytical instruments, expertise and a powerful supercomputer. Having realized its success, the Department of Energy has begun sponsoring two new laboratories. One seeks new designs for diesel engines to minimize pollution; the other is looking into innovative ways to make corrosion-free materials.

This new technology, however, has sparked much discussion over key issues surrounding the use of collaboratories as a method of scientific research. The foremost advantage collaboratories have over old scientific research is interaction and accessibility in interacting with other colleagues. Time is saved since scientists need not travel to work with others. Scientist also save time since data can be collected using instruments at remote sites in real time. The real time capability also allows scientists to quickly verify results, easily comparing theory with reality. However, since so much interaction is done electronically, one downside is how scientists can place trust in another scientist they have not yet met.

With collaboratories, although scientists gain the ease of accessing resources, both expertise from other professionals and digital libraries of information, scientists lose the face to face interaction characteristic of the old method of scientific research. Eleana Rocco, a researcher at the University of Michigan, studied the connection between face to face interaction versus electronic communication as it relates to trust. Her findings showed that face to face contract results in greater cooperation [Ross-Flanigan p.58]. As a result, better research could be achieved by having scientist who will work together

meet each other, even if only once. Being such a critical component to the success of any scientific endeavor, trust should be fostered by interaction while overall science is conducted using collaboratories.

Trust, however, is not the only drawback of collaboratories. Scientists, I fear, will lose the hands-on of part of research as the dependence on collaboratories increases. While the scientist does collect data from remote sites, it is not performed directly by the scientist, rather, the scientist relays to technicians who know how to operate the instruments, what to do in order to obtain desired results. By telling others what to do, the scientist is not directly using the tools of the trade. Telling others what to do with equipment is strikingly different than operating and trouble shooting the equipment oneself, as use to be done before scientists used collaboraries. As research science transitions more towards collaboratories, new scientists will lose these hands on skills, becoming more of a narrator in the research as opposed to an active participant, with the nitty gritty left to specialized technicians with perhaps non-specialized scientific background.

It seems increasingly clear that the future of science will be one based largely in part on collaboratories. More specifically, I envision the future of collaboratories being based on grid computing using TeraGrid, in a manner such that one collaboratory fuels other disciplines that rely on its particular data while still being a part of the same entire network. An example of this might be the dependence of geology and space physics. One geologist collaboratory might be investigating volcanic activities. A space physics collaboratory might be concerned with the changing atmosphere. Geologists might obtain a better understanding of recent volcanic activites not only by using movement readings, but also coupled with data about the atmosphere, whether it is hotter or colder than normal. Atmospheric researchers might understand changing patterns more precisely if volcanic activities are taken into account. Supercomputers from both disciplines could interact with each other, after doing all that it can within its own domain, to give researchers a more complete picture.

Collaboratory software has given scientists the ability and ease to network and interact with other scientists who would otherwise be geographically isolated. In addition, collaboratories save scientists time and effort by simplifying the manner in which data can be collected. Although a novel idea, it has raised many issues, namely about trust. While on the right track to continued success, these few points illustrate that there still remains much to be addressed about collaboratories before it can be really successful. It has begun to challenge what it means for a scientist to do research, for collaboratory is markedly different to how scientific research was carried out in the past. In any case, it is apparent that the future of scientific research will increasingly depend more on the interaction of collaboratories as well as grid computing.

## Bibliography

Ross-Flanigan, Nancy. "The Virtues (and Vices) of Virtual Colleagues." *Technology Review* (March-April 1998): 52-59.