EXECUTIVE SUMMARY

Large scale multi-user research infrastructure is a critical component of the federal science and engineering research enterprise. Developing infrastructure for multidisciplinary research requires large investments over long periods of time and typically involves partnerships among multiple geographically-distributed institutions for planning and implementation. In the scientific, political, and public spheres, large multi-user research facilities are high visibility endeavors, and engage thousands of domestic and international stakeholders across academia, industry, government, and the public.

The National Science Foundation (NSF) supports large research facilities that are created in response to community need and that span a broad range of disciplines including physics, astronomy, materials research, geosciences, ecology, engineering, nanotechnology, and polar research. Collectively, NSF's facilities are characterized as shared-use infrastructure, instrumentation and equipment that are accessible to a broad community of researchers and/or educators. Each year, NSF-supported facilities provide access to thousands of researchers. In FY2011, NSF invested $1.1 billion dollars in large facilities (construction and operations costs) with the operating costs of its operational facilities ranging from $7 to 98 million per year.

Multiple policy questions surround federal investments in large research facilities: who is benefiting from these investments? What is the best way to maximize scientific productivity across the research enterprise? How should investments in big science be balanced with support for individual or small group research? Ultimately, decisions on these issues are directly related to and significantly impact the individuals who constitute the scientific research community. For NSF facilities, the answers to these questions become focused on the activities of individuals who are interacting with the facility for the purpose of furthering scientific research and/or education – the "users."

This study provides the first known analysis of facility utilization at NSF. Four NSF-supported large facilities are used as case studies to create a conceptual framework for characterizing facility utilization, to identify how facilities know who their users are and how they are using their facilities, to examine changes in use over time, and to define how lessons learned from user analysis can be applied to facility management and planning. Results show that there is a broad spectrum of users who interact with each facility in different ways and that NSF is likely serving many more users than previously thought. New users discover facilities through different mechanisms; for some facilities, unanticipated users are driving new areas of research. Facilities enabled by cyberinfrastructure are experiencing rapid increases in data use and in some cases, the next generation of large facility users appears to be developing new skills for working in an increasingly data-intensive research environment.

This study suggests that characterizing and quantifying large facility use will likely become increasingly important as the federal government continues to focus on developing metrics and evaluation tools for assessing its investments in science and engineering research. It shows that facility users and the type of use may change as science and technology change over time and points to the importance of facilities recognizing the opportunities for growth and the need to balance these opportunities with their mission. Analyses in this study show that trends and observations in facility utilization across NSF can indicate areas of synergy and possible new avenues of collaboration between facilities, centers, and initiatives that may otherwise go unseen. Finally, changes in new user skills, backgrounds, and expectations may be important indicators of future needs for workforce development and user training. This work establishes a foundation for evaluating facility use and shows that this area is ripe for future work that may include portfolio-wide analyses, network or community mapping, and applications to other research investments such as mid-scale infrastructure or science centers.