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UNIVERSITIES CONTINUE TO EXPAND THEIR RESEARCH SPACE WITH THE LARGEST INCREASE SINCE 1988; DATA REPORTED FOR NETWORKING CAPACITY

by Leslie Christovich

According to the National Science Foundation's (NSF's) biennial survey of Science and Engineering Research Facilities, research-performing colleges and universities reported an 11 percent increase in the amount of research space from FY 2001 to FY 2003, for a total of approximately 173 million net assignable square feet (NASF) (table 1).[1] Ninety-five percent of this space is located at doctorate-granting institutions. While substantially greater than any previous 2-year increase since FY 1988, this growth continues a trend of increases in the amount of academic NASF used for research. During this 15-year time period, the amount of research space increased biennially at a rate of at least 4 percent.[2]

Except for agricultural sciences, which experienced a slight decline, all fields of science and engineering experienced increases in research space from FY 2001 to FY 2003. Mathematics experienced the largest relative increase, 50 percent (but its total space was the smallest among all fields reported). After mathematics, three fields experienced substantial growth at similar magnitudes (25–30 percent) –computer science, medical science, and social sciences.[3] The biological sciences and medical sciences remained the fields with the largest total amount of space, 36 million and 35 million NASF, respectively.

Construction of Research Space

Academic institutions reported an investment of at least $7.6 billion for the construction of new research space started during FY 2002 and FY 2003 (table 2). Two hundred sixteen institutions, or 48 percent of all research-performing institutions, began 420 construction projects. These projects are expected to total 16 million NASF of research space. The large majority (85 percent) of the institutions starting new construction were doctorate granting.

While colleges and universities began construction of research space in all fields of science and engineering, the greatest number of institutions began construction in the fields of biological and medical sciences. Further, 56 percent of the newly constructed space started in FY 2002 or FY 2003 is to be used for research in these two fields. Adding engineering research space, these three fields account for about 70 percent of the new construction started.

The amount of NASF used for research in biological sciences, medical sciences, and engineering will

[1] The NSF Survey of Science and Engineering Research Facilities also collects data from nonprofit, biomedical research institutions (hospitals and research organizations) receiving research funds from the National Institutes of Health, as well as from academic institutions. Although biomedical research space at universities is reported here, such space at biomedical institutions is not.

[2] Data reported in this *InfoBrief* on research space, construction of research space, and construction costs of research space are imputed for item nonresponse and weighted to national estimates for unit nonresponse. The data reported on networking and information technology planning are not imputed or weighted.

[3] Research space in other unspecified science fields also increased by a similar amount.

Information and data from the Division of Science Resources Statistics are available on the web at http://www.nsf.gov/statistics/. To request a printed copy of this report go to http://www.nsf.gov/publications/orderpub.jsp or call (703) 292-PUBS (7827). For NSF's Telephonic Device for the Deaf, dial toll-free (800) 281-8749 or (703) 292-5090.

TABLE 1. Science and engineering research space in academic institutions, by field: FY 1988–2003

(Net assignable square feet in millions)

Field	1988	1990	1992	1994	1996	1998	1999	2001	2003
All fields	112	116	121	127	136	143	148	155.1	172.6
Agricultural sciences	18	21	20	20	22	25	24	26.7	26.4
Biological sciences	24	27	28	28	30	31	31	33.4	36.0
Computer sciences	1	1	2	2	2	2	2	2.4	3.1
Earth, atmospheric, and ocean sciences	6	6	7	7	7	8	8	8.1	8.9
Engineering	16	17	21	21	22	23	24	25.5	27.4
Mathematics	1	1	1	1	1	1	1	1.0	1.5
Medical sciences	19	20	23	23	25	25	26	27.8	34.9
Physical sciences	16	16	17	17	18	18	19	19.2	20.4
Psychology	3	3	na	3	3	3	4	3.6	4.4
Social sciences	3	3	na	3	4	5	3	4.5	5.7
Other sciences	4	2	2	2	2	3	3	3.0	3.8
Animal research space	na	na	na	11	12	12	13	na	16.7

na = not available.

NOTES: Details may not add to totals due to rounding. Animal research space is included in the space totals for individual fields where appropriate.

SOURCES: National Science Foundation/Division of Science Resources Statistics, Survey of Science and Engineering Research Facilities, Fiscal Years 1988-2003.

TABLE 2. New construction of science and engineering research space in academic institutions, by field and completion costs: FY 2002–03

Field	Number of institutions	Total NASF (millions of square feet)	Completion costs ($ millions)
All fields	216	16.1	$7,633
Agricultural sciences	32	0.8	142
Biological sciences	107	4.0	2,061
Computer sciences	27	1.0	347
Earth, atmospheric, and ocean sciences	30	0.6	221
Engineering	63	2.2	1,053
Mathematics	5	*	11
Medical sciences	76	5.0	2,340
Physical sciences	59	1.5	792
Psychology	19	0.2	73
Social sciences	11	0.2	149
Other sciences	23	0.7	445
Animal research space	64	1.4	740

* = greater than 0, but less than 50,000.

NASF = net assignable square feet.

NOTES: Details may not add to totals due to rounding. Animal research space is included in the space totals for individual fields where appropriate. Institutions may have had more than one construction project and/or more than one project in a field. Therefore, the number of institutions for individual fields will not total to the total number of institutions with projects.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Science and Engineering Research Facilities, Fiscal Year 2003.

continue to dominate the amount of all research space if colleges and universities are able to follow through on their plans for FY 2004 and FY 2005. Academic institutions planned to begin construction of an additional 19 million NASF of research space during this time period at an estimated cost of $9.1 billion. Engineering and the biological and medical sciences accounted for 72 percent of the planned NASF.

Information Technology Infrastructure

For the first time, in addition to traditional "bricks and mortar" research infrastructure, the survey collected information on computing and networking infrastructure, which is playing an increasingly important role in the conduct of scientific research.[4] Academic institutions reported having multiple commodity Internet (Internet1) connections at a variety of speeds at the end of FY 2003 (table 3). The greatest numbers were at a speed of 1.5 megabits/second (e.g., T1 or DS1 lines). The large majority of connections (71 percent) was at the two lowest connection speeds of 1.5 megabits or 45 megabits (T3 or DS3 lines). However, at least 6 percent of the connections were at 1 gigabit or faster. Doctorate-granting institutions had a substantially greater percent of their connections at a speed of at least a gigabit (8 percent), when compared to non-doctorate institutions (1 percent).

Sixty-five percent of all institutions had their *highest speed* connections at either 45 or 155 megabits/second (table 4); 12 percent had their fastest connections at a gigabit/second or faster. Compared to nondoctorate institutions, doctorate-granting institutions were more likely to have their highest speed connections at the fastest speeds.

Overall, institutions did not anticipate a large increase in the total *number* of connections at their institutions from FY 2003 to FY 2004. However, they were planning fewer connections at the slowest connection

TABLE 3. Commodity Internet (Internet 1) connection speeds, by type of institution: FY 2003 and FY 2004 (estimated)
(Percent distribution)

Type of institution	Number of connections	Speed of connection						
		T1 or DS1 (1.5 mb)	T3 or DS3 (45 mb)	OC-3 (155 mb)	OC-12 (622 mb)	1 gb	OC-48 (2.4 gb)	Other
FY 2003								
All academic institutions	1,130	49	22	15	3	6	*	5
Doctorate granting	864	48	20	17	3	8	*	5
Nondoctorate granting	266	53	29	11	1	1	*	4
FY 2004 (estimated)								
All academic institutions	1,137	43	22	15	3	10	1	7
Doctorate granting	893	43	18	15	3	12	1	7
Nondoctorate granting	244	42	33	13	2	4	*	5

* = greater than zero, but less than .5 percent.
mb = megabits per second.
gb = gigabits per second.

NOTES: Details may not add to 100 percent due to rounding. Three academic institutions did not respond to this question. Institutions may have multiple connections at the same or different speeds.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Science and Engineering Research Facilities, Fiscal Year 2003.

[4] The "bricks and mortar" section of the research facilities survey asked institutions to report on their research space only. The reported figures therefore do not include space used for other purposes such as instruction or administration. On the networking and computing section of the survey, however, respondents were asked to identify all of their computing and networking resources, regardless of whether these resources were used for research.

TABLE 4. Highest institutional connection speed to commodity Internet (Internet 1), by type of institution: FY 2003 and 2004 (estimated)
(Percent distribution)

Fiscal year and type of institution	Number of institutions	Highest speed of connection						
		T1 or DSL (1.5 mb)	T3 or DS3 (45 mb)	OC-3 (155 mb)	OC-12 (622 mb)	1 gb	OC-48 (2.4 gb)	Other
FY 2003								
All academic institutions	424	9	36	29	4	11	1	10
Doctorate granting	301	6	29	32	6	14	1	12
Nondoctorate granting	123	15	54	20	2	2	1	7
FY 2004 (estimated)								
All academic institutions	420	5	33	26	6	16	1	13
Doctorate granting	299	5	25	28	7	20	1	14
Nondoctorate granting	121	7	51	22	3	7	1	9

mb = megabits per second.
gb = gigabits per second.

NOTES: Details may not add to 100 percent due to rounding or absence of commodity (Internet I) connection. Some institutions reported connection speeds in a category called "other." For this table, the "other" speed is always designated as the highest speed.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Science and Engineering Research Facilities, Fiscal Year 2003.

speed (table 3). Institutions expected a 5 percentage point increase in the number of connections at the faster speeds of at least a gigabit or more by the end of FY 2004, an 80 percent increase in the number of connections at that speed. Both doctorate and nondoctorate institutions expected increases in speed, including at the highest speeds. In fact, nondoctorate institutions were planning for fewer connections overall but a greater proportion at the higher speeds.

In addition to their hardwire commodity Internet connections, many colleges and universities also have wireless Internet connections and connections to advanced or high-performance networks. Sixty-five percent of academic institutions had connections to the high-performance network Abilene[5] at the end of FY 2003. A substantially larger proportion (79 percent) of doctorate-granting institutions had these connections available compared with nondoctorate institutions (28 percent).

While wireless connections are used less frequently for research purposes than hardwire connections, colleges and universities are moving toward greater institutional coverage by wireless. A large majority (67 percent) of institutions had 20 percent or less of their building areas covered by wireless at the end of FY 2003. By the end of FY 2004, institutions believed that their institutional wireless coverage would expand substantially. Only a minority of institutions (30 percent) estimated that their coverage would be 20 percent or less.

Most institutions reported managing these information technology resources using either a centralized, institution-wide plan or a college/departmental plan. Only 8 percent of the institutions did not have either a central plan or a college/departmental plan for upgrading or replacing their information technology. Institutions used different types of plans for the different types of resources. For example, 74 percent of the institutions had a central, institution-wide plan for network replacement, while 51 percent upgraded their personal computers on a regular schedule using a college or departmental plan.

Data Notes

The data presented in this *InfoBrief* were obtained from a census of 465 colleges and universities that grant degrees in science or engineering and expended at least $1 million in research and development (R&D) funds in FY 2002. Each academic institution's level of R&D expenditures was determined by the NSF's FY

[5] Abilene is a high-performance backbone network that enables the development of advanced Internet applications and the deployment of leading-edge network services to member colleges, universities, and research laboratories across the country.

2002 Survey of Research and Development Expenditures at Universities and Colleges.

The FY 2003 Survey of Science and Engineering Research Facilities detailed statistical tables will be available on the NSF Web site at http://www.nsf.gov/statistics/. Current survey data for individual institutions will be available from the Integrated Science and Engineering Resources Data System (WebCASPAR) database system, a Web tool for retrieval and analysis of statistical data on science and engineering resources (http://webcaspar.nsf.gov).

For more information related to the Survey of Science and Engineering Research Facilities, contact

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