

# Appendix E

## Validation of Estimates of Deferred Project Costs

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# Validation of Estimates of Deferred Project Costs

## Background

Since estimating the costs of deferred projects is of great policy relevance, this appendix tests an alternative method of estimating unfunded construction and repair/renovation needs. This approach relies on institutional estimates of how much additional space is needed in each field and what proportion of the space in the field requires repair/renovation.

## The Survey Questions

In addition to the questions asking about deferred projects reported in Chapter 6, the 1996 survey made two further efforts to measure construction and repair/renovation needs. In Item 2, institutions reported whether the amount of space they currently had for S&E research in each of the fields was adequate for supporting their current research program commitments. If institutions reported an inadequate amount of space, they were asked to indicate the additional space needed (see Item 2 of the survey in Appendix C).

Item 3 requested institutions to evaluate the condition of their current research space in each S&E field by reporting the percentage of space that met certain conditions. For space that required major repair/renovation or replacement, institutions also reported either the space or percent of that space that was funded and scheduled to undergo major renovation or replacement (see Item 3 of the survey in Appendix C).

## Data Considerations

In these questions, institutions assessed how much more S&E research space is needed and how much of the existing S&E research space is in poor condition. They also reported how much of the total space is scheduled for construction or renovation. At the same time, however, institutions are bound by their current

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research commitments. An institution's interest in expanding in a particular S&E field is not included in such estimates, nor are state or national needs to increase knowledge in specified areas reflected in this approach.

## Findings

### How Much More S&E Research Space Did Colleges and Universities Need?

In 1996, research-performing colleges and universities reported they needed an additional 21.6 million NASF of S&E research space (Table E-1). Of this need for additional space, 10.8 million NASF (50 percent of the needed space) were scheduled for construction in fiscal year 1996 or 1997.

**Table E-1. Need for additional science and engineering (S&E) research space  
(NASF in thousands)**

<i>Field</i>	<i>Existing Research NASF(A) <sup>1</sup></i>	<i>Additional NASF Needed (B) <sup>2</sup></i>	<i>Scheduled New Construction (C) <sup>3</sup></i>	<i>Additional NASF Needed and Not Scheduled for Construction (D) <sup>4</sup></i>	<i>Percent of NASF Needed and Scheduled (E) <sup>5</sup></i>
Total	136,481	21,647	10,843	10,804	50%
Biological sciences-- outside medical school	18,662	3,247	1,804	1,443	56
Physical sciences	17,872	2,779	1,152	1,627	41
Psychology	3,404	626	82	544	13
Social sciences	3,977	984	176	808	18
Mathematics	1,005	167	72	95	43
Computer sciences	2,075	387	121	266	31
Earth, atmospheric, and ocean sciences	7,246	1,425	746	679	52
Engineering	21,832	3,589	2,122	1,467	59
Agricultural sciences	22,118	2,192	1,051	1,141	48
Medical sciences-- outside medical school	7,313	1,535	926	609	60
Medical sciences-- medical school	17,815	2,853	2,049	804	72
Biological sciences-- medical school	10,797	1,517	465	1,052	31
Other	2,364	345	77	268	22

<sup>1</sup> Data from Table 1-6, total S&E research space.

<sup>2</sup> Data from Table 2-1 (percent additional space needed), converted into NASF.

<sup>3</sup> Data parallels Table 3-6, reported in NASF.

<sup>4</sup> Column (B) minus column (C).

<sup>5</sup> 100% minus Column (D) divided by column (B).

SOURCE: National Science Foundation/SRS, 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Institutions reported that the greatest need for additional S&E space was in engineering, for which 3.6 million more NASF were needed. However, 59 percent of this need (2.1 million NASF) was scheduled for construction in either 1996 or 1997. Biological sciences outside of medical schools also accounted for a large amount of needed space (3.2 million NASF), and 56 percent was scheduled for construction in 1996-1997. By contrast, a smaller proportion (31 percent) of the 1.5 million NASF needed in biological sciences in medical schools was scheduled for construction in 1996-1997 (Table E-1).

## How Much Renovation or Replacement of Existing S&E Research Space Did Colleges and Universities Need?

Colleges and universities indicated that 25. 2 million NASF of their current S&E research space required major renovation or replacement. This represented 18 percent of all S&E research space (25. 2 million divided by 136.5 million). Only 22 percent of the space needing such attention (5. 5 million NASF) was scheduled for repair/renovation in fiscal year 1996 or 1997 (Table E-2).

**Table E-2. Need for renovating or replacing existing science and engineering (S&E) research space (NASF in thousands)**

<i>Field</i>	<i>Existing Research NASF (A) <sup>1</sup></i>	<i>Existing Research NASF that Require Major Renovation or Replacement (B) <sup>2</sup></i>	<i>Existing NASF that Require Major Renovation or Replacement and are Scheduled for Renovation or Replacement (C) <sup>3</sup></i>	<i>Existing NASF that Require Renovation or Replacement and are not Scheduled for R/R (D) <sup>4</sup></i>	<i>Percent of NASF Needing Renovation or Replacement and Scheduled for R/R (E) <sup>5</sup></i>
Total	136,481	25,195	5,497	19,698	22%
Biological sciences-- outside medical school	18,662	3,314	782	2,532	24
Physical sciences	17,872	3,356	1,028	2,328	31
Psychology	3,404	419	125	294	30
Social sciences	3,977	522	46	476	9
Mathematics	1,005	99	13	86	13
Computer sciences	2,075	156	32	124	21
Earth, atmospheric, and ocean sciences	7,246	1,384	384	1,000	28
Engineering	21,832	3,899	1,057	2,842	27
Agricultural sciences	22,118	5,201	490	4,711	9
Medical sciences-- outside medical school	7,313	1,506	302	1,204	20
Medical sciences-- medical school	17,815	3,506	780	2,726	22
Biological sciences-- medical school	10,797	1,591	442	1,149	28
Other	2,364	239	16	223	7

<sup>1</sup> Data from Table 1-6, total S&E research space.

<sup>2</sup> Data from Table 2-2 (percent of space requiring major renovation or replacement), converted into NASF.

<sup>3</sup> Data parallels Table 3-7, reported in NASF.

<sup>4</sup> Column (B) minus column (C).

<sup>5</sup> 100% minus Column (D) divided by column (B).

SOURCE: National Science Foundation/SRS, 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Institutions indicated that the greatest need for major renovation or replacement to S&E research space was in the agricultural sciences, with 5.2 million NASF requiring such work, representing 21 percent of all S&E research space requiring major renovation or replacement (5.2 million divided by 25.2 million), and 24 percent of all of the S&E research space in agriculture (5.2 million divided by 22.1 million). However, only 9 percent of the agricultural research space needing major renovation or replacement was scheduled for such work in either 1996 or 1997.

## What Was the Estimated Cost for Meeting the S&E Research Facilities Needs of Colleges and Universities?

If the additional S&E research space institutions reported needing were constructed, and if the current space that required major renovation or replacement were renovated or replaced, the estimated cost of meeting an unmet need would be roughly \$8.0 billion (Table E-3).

**Table E-3. Estimated costs of repairing existing science and engineering (S&E) research space and building new S&E research space**

	<i>Repair</i>	<i>Construction</i>
NASF (in thousands) needing repair/renovation or construction and not scheduled	19,698	10,804
Cost per NASF	\$230	\$325
Estimated Cost (in millions)	\$4,531	\$3,511
<b>Total Estimated Cost (in millions)</b>	<b>\$8,042</b>	

*SOURCE: National Science Foundation/SRS, 1996 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.*

Table E-3 shows that institutions reported that approximately 19.7 million NASF needed major renovation or replacement, and that such work was not scheduled. An additional 10.8 million NASF in new construction was reported needed to meet existing program commitments. To derive an estimate of cost for S&E research space needs, an average repair/renovation cost of \$230 per NASF was multiplied by the estimate of space needing repair/renovation; and an average new construction

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cost of \$325 per NASF<sup>1</sup> was multiplied by space requiring construction. An estimate of \$8.0 billion of combined need for new S&E research space and major renovation to existing space was the result (Table E-3).<sup>2</sup>

This estimate is fairly close to the estimate of deferred project needs reported in Chapter 6 of \$9.3 billion. This difference of roughly 15 percent given these two very different methods of calculating need provides some convergent validity for the overall estimate.

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<sup>1</sup> The average construction cost per NASF was derived by dividing the total costs of construction reported by institutions by the number of NASF that were being constructed. The average repair/renovation cost was derived similarly (see question 3). Although several factors (e.g., type of project, geographic location) can result in varying construction and repair costs, the overall average is the safest figure to use when information is not available concerning the specific nature of the projects.

<sup>2</sup> Since some proportion of the space requiring major renovation will need to be replaced at a higher cost than the average for repair/renovation, total costs actually may be higher than the \$8.0 billion cited. The 1994 Facilities survey found that about 25 percent of all major renovation projects require replacement of the space. Assuming a quarter of the renovations will incur costs similar to new construction, the total need estimate would rise to \$8.5 billion.