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ABSTRACT

This analysis looked at higher education facilities management that, despite exponential growth in responsibilities since the 1960s, has seen reduced resources for operations and maintenance. By extrapolating 1988 data from the National Center for Education Statistics, the review estimated that there are now 3.4 billion square feet of higher education facilities in the United States. Five tables show U.S. and campus populations, number of higher education institutions, number and square footage of higher education buildings, book value of physical plant buildings, and higher education expenditures for operation of physical plants. The data show that the scope of the typical physical plant department has increased significantly to include, such activities as round-the-clock operation of research buildings with complicated supporting services. The typical building is a mixture of air conditioned spaces featuring electronically-ballasted lighting fixtures serving complicated animal care facilities, computer-based instructional rooms, on-line libraries, or recombinant gene research laboratories, all linked by fiber optic cable to the rest of the campus and the world. At the same time, recent decades have seen a large expansion in campus populations. However, when adjusted for 1990 dollars, expenditures for physical plant departments per campus occupant have changed very little in the past three decades. (Contains 14 references.) (JB)

FACILITIES MANAGEMENT IN HIGHER EDUCATION:

DOING MORE WITH LESS

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FACILITIES MANAGEMENT IN HIGHER EDUCATION: DOING MORE WITH LESS

Facilities Managers in the academy have seen exponential growth in their responsibilities since the 1960s. Unfortunately, during this period higher education has reduced expenditures for the operation and maintenance of its buildings. This paper will explore the magnitude of this problem, based on available data and recent events.

In order to begin to evaluate these facilities-related issues, the scope of the academy's buildings, grounds, and infrastructure first must be identified. Unfortunately, the publication of data concerning the physical facilities of the academy, in terms of expenditures for plant, building numbers, building types, floor areas and occupancy, has been inconsistent at best. For example, in 1914 facilities managers from about a dozen institutions first met to discuss their mutual problems. At that time, no one knew exactly how many buildings existed in higher education institutions. Even present data concerning the floor areas and the number and nature of structures in the academy in the United States also is not exact. A recent survey on deferred maintenance commissioned by The Association of Higher Education Facilities Officers (APPA) and the National Association of College and University Business Officers (NACUBO) utilized imputed and extrapolated data to estimate some of this information[1]. The only data available to allow even a rough estimate of this basic information to be made

in 1914 was contained in the Report of the Commissioner of Education[2]; the Office of Education had been producing this report, which contained incomplete statistical information on the academy, since 1870[3]. The 1914 building data, which was supplemented that year with a U.S. Bureau of Education Bulletin Statistics of State Universities and State Colleges[4], covered only the estimated value of the physical property and lands of certain state universities and colleges. This information had been collected by the National association of State Universities until 1908, when the Bureau of Education began publishing the information from reports received from institutional presidents. The values of buildings and grounds in 1914 at eighty-eight public higher education institutions were listed, with the University of California reporting the highest total value of eight million dollars. The University of Georgia listed a value of slightly over one million dollars in this report. Based on this data, members of the academy could have made an educated guess, albeit after considerable effort, concerning the scope of higher education's facilities.

U.S. Government statistical sources will be used to track the expansion of facilities, including the number of buildings and square footage in higher education institutions, insofar as these data are available. The 1974 Inventory of Physical Facilities in Higher Education[5] appears to be the last such publication which includes much of this information. For the period 1975 to 1990, data developed by Coopers & Lybrand, the consultants who helped

prepare the deferred maintenance study The Decaying American Campus, will be employed.

For the sixty years from 1914 to 1974, statistical information has been collected at the Federal level by what is now known as the National Center for Education Statistics (NCES). This agency was one of the first in the federal government to recognize the value of data collection, and hired its first statistician in 1872. The NCES collected information on all levels of education, and from 1918 to 1958 published the results of its major surveys in the Biennial Survey of Education. Between 1914 and 1918, certain building data also was included in the Report of the Commissioner of Education. In 1962, the first Digest of Education Statistics appeared; this annual publication continues to serve as the principal source of education statistics for all levels of education.[6]

For more specific higher education data, NCES has utilized the Higher Education General Information Survey (HEGIS) and the Integrated Postsecondary Education Data System (IPEDS). The former was employed from 1966 until the mid 1980s, and covered colleges and universities[7]; the latter survey now includes all post-secondary institutions.[8] Neither survey has reported specific information concerning the number of buildings or exact square footage data for the academy. When the authors of The Decaying American Campus realized that no information had been published concerning building and square footage data after 1974, they calculated the gross square footage of the academy by extrapolating NCES data from 1974 to 1988. To arrive at the estimated area of higher education buildings of three billion square feet, the authors took the book value of annual building

additions published by NCES and applied square-foot building costs from a construction price index to estimate the amount of space added per year until 1988. As the authors indicate, they actually calculated 3.4 billion square feet, but rounded this off to a more readily usable number of three billion. While this publication did utilize Carnegie classification typology, and presented the average number of buildings for each category, it did not estimate the number of buildings on college campuses. This author estimated the number of structures in the academy, since this information is considered important when evaluating the scope of work confronting facilities officers..

To describe the evolution of facilities in the academy since 1914, several tables have been developed. The information presented in these tables, which cover the period from 1914 to 1990, includes:

Table 2.1 - United States and Campus Population

Table 2.2 - Number of Higher Education Institutions

Table 2.3 - Number and Square Footage of Higher Education Buildings

Table 2.4 - Book Value of Physical Plant and Buildings

Table 2.5 - Higher Education Expenditures for Operation of Physical Plants

Table 2.1 illustrates that the growth of the academy was more rapid than the population of the country after World War II. The enrollment figures represent Fall headcount numbers, and show the rise from under 400,000 students in 1914 to over 13,000,000 in 1990. The percentage

of the total population enrolled in higher

TABLE 2.1
UNITED STATES AND CAMPUS POPULATION[1]

YEAR	TOTAL US[2]	FALL ENROLLMENT[3]	FACULTY[4]	STAFF[5]	TOTAL CAMPUS[6]
1914	99,111	379	*35	41	455
1920	106,461	598	*45	48	692
1930	123,077	1,101	82	80	1,263
1940	132,122	1,494	110	147	1,752
1950	151,689	2,281	190	246	2,718
1960	179,979	3,893	282	381	4,555
1970	203,984	8,581	551	765	9,897
1980	227,255	12,097	*755	1,155	14,007
1990	249,415	13,710	988	1,531	16,228

1. Population in 1,000's; 2 to 5. From 120 Years of American Education NCES (1993); 6. Calculated by Author.
*Interpolated.

education rose during that time from less than one-half of one percent to over five and one-half percent; as late as 1937, less than one percent of the population attended these post-secondary institutions. The total population of higher education's campuses was calculated to demonstrate the number of people served by physical plant operations; this data is considered significant, since it represents the "customers" served on a daily basis by those service

organizations. The increased rate of expansion of professional staff from 1930 to 1990 is clearly indicated; during this period, the staff population increased almost fifty percent faster than the faculty.

Table 2.2 depicts the increase in the number of higher education institutions, the average number of fall enrollees and the average campus population during the same periods. The average institution had fewer than 900 students prior to World

TABLE 2.2
NUMBER OF HIGHER EDUCATION INSTITUTIONS

YEAR	INSTITU-TIONS[1]	STUDENTS/ INSTITUTION[2]	CAMPUS POPULATION/ INSTITUTION[3]
1914	3,265	393	472
1920	1,041	574	665
1930	1,409	781	896
1940	1,708	874	1,026
1950	1,851	1,232	1,468
1960	2,004	1,942	2,273
1970	2,525	3,398	3,920
1980	3,152	3,838	4,444
1990	3,535	3,878	4,637

1. From 120 Years of American Education NCES (1993); 2 and 3. Averages calculated by Author.

War II. Each set of averages signals the phenomenal growth of campuses; in 1990, both the total campus population and the fall enrollment averages were approximately ten times the size of the 1914 institutions. The average figures shown do not reflect the impact of higher education institutions which have enrollments and campus populations

well in excess of these averages. In 1990, 120 institutions, 111 of them publicly controlled, had enrollments of over 20,000; while these represented only 3.4% of the 3535 institutions, they enrolled 25% of the students in the United States.[9]

TABLE 2.3
NUMBER AND SQUARE FOOTAGE
OF HIGHER EDUCATION BUILDINGS

YEAR	GROSS AREAS SQ. FT.[1]	NO. OF BLDGS.[2]	AVERAGE SQ. FT./INST.	AVERAGE NO. BLDGS./INST.
1914	*126,648,000	6,572	131,200	6.8
1920	162,513,000	8,437	156,100	8.1
1930	269,726,000	13,435	191,400	9.5
1940	359,503,000	18,038	210,500	10.6
1950	469,560,000	31,817	253,700	17.2
1957	637,245,000	40,237	330,100	20.9
1960	990,000,000	56,597	494,000	28.2
1970	1,830,000,000	87,142	724,800	34.5
1980	2,610,000,000	110,332	828,000	35.0
1990	3,400,000,000	130,292	961,800	36.9

1. Data from 1914 to 1957 from Inventory of Physical Facilities (1974); from 1960 to 1990, from Decaying American Campus; 2. Data from 1914 to 1957 from College and University Facilities Survey - Part 3 (1965); from 1960 to 1990 estimated by Author. *Interpolated.

Table 2.3 presents information concerning the size and number of campus buildings in higher education institutions in the United States. Gross areas are based on two sources of information, the Inventory of Physical Facilities published in 1974, and the square footage data calculated for The Decaying American Campus in 1988. The estimated

number of buildings from 1914 to 1957 is taken from the Facilities Survey[10] of 1965. The balance of the data from 1958 to 1990 was developed by the author, based on average building areas extrapolated from Facilities Survey.
As indicated previously, data concerning these two important aspects of the academy have not been published since the Inventory publications were discontinued in the 1970s. In 1993, a committee of higher education officials helped NCES design a new facilities survey manual; its authors hope that this will produce in a comprehensive report covering all aspects of facilities in the academy. The chairman of that committee, in an understatement, reported "we really don't have a good handle on what facilities there are out there and how they are being used".[11] When these data are finally compiled, it will be interesting to compare them with the estimated areas in The Decaying American Campus and the number of buildings estimated by this author. In 1914, the average campus had 7 buildings with a gross area of 130,000 square feet. The information presented indicates that the average institution's area grew almost ten-fold from 1914 to 1990, and the average number of campus buildings increased by a factor of five. The total area of the academy rose from 126 million to an astounding 3.4 billion square feet, and the total number of buildings rose to over 130,000 from a figure of 6,572 in 1914. By 1990, the average campus had 37 buildings with a gross area of almost one million square feet.

Tables 2.4 and 2.5 highlight the explosive growth of the value of facilities and of expenditures for them in the academy since 1914. From Table 2.4, the book value of physical plants, which includes buildings, grounds and

infrastructure, rose from
570 million to 155 billion dollars; similarly, the book value of buidlings alone rose from 377 million to 102 billion dollars. The replacement value of all buildings on higher education campuses in the United States has been estimated in The Decaying

TABLE 2.4
BOOK VALUE OF PHYSICAL PLANT AND BUILDINGS

YEAR	PHYSICAL PLANT (TOTAL) (MILLIONS)[1]	BUILDINGS (TOTAL) (MILLIONS)[2]	AVERAGE BUILDINGS (THOUSANDS)[3]
1914	$573	$377	$390
1920	747	496	476
1930	2,065	1,490	1,057
1940	2,754	2,065	1,209
1950	4,780	3,600	1,945
1960	13,549	10,472	5,226
1970	42,094	31,865	12,620
1980	83,733	60,847	19,304
1990	155,402	101,909	28,829

1 and 2. From 120 Years of American Education (NCES 1993);
3. Calculated by Author.

TABLE 2.5
HIGHER EDUCATION EXPENDITURES FOR OPERATION OF PHYSICAL PLANTS

YEAR	PLANT O & M EXPENDITURES[1] (MILLIONS)	PLANT O & M AS % OF EDUCATION & GENERAL[2]	PER CAMPUS OCCUPANT (ADJUSTED)[3]
1930	$61	16.2%	$388
1940	70	13.4%	395
1950	225	13.2%	484
1960	470	10.0%	484
1970	1,542	9.2%	570

1980	4,700	10.5%	536
1990	9,458	9.0%	583

1. From 120 Years of American Education (NCES, 1993); 2. Calculated by Author; 3. Adjusted to 1990 dollars, calculated by Author.

American Campus at 340 billion dollars in 1990, based on 3.4 billion square feet of floor space valued at $100 dollars per square foot. Utilizing these data, from 1914 to 1990 the average plant book value rose from $594,000 to $43,961,000, and total building book value rose from $390,000 to $28,829,000. The average replacement value for buildings only for each of the 3,535 institutions in the academy in 1990 was $97,000,000.

As indicated in Table 2.5, data on expenditures in the academy was not available until 1930. While Education and General (E&G) expenditures (not shown) rose from 378 million to 106 billion, the Plant Operation and Maintenance portion of E&G expenditures rose less rapidly, from 61 million to 9.5 billion dollars. As a result, the percentage of E&G dollars allocated to Plant Operation and Maintenance dropped from 16.2% in 1930 to a low of 9.0% in 1990. In 1990 dollars, this means that E&G expenditures were 66 times greater in 1990 than 1914, while Plant Operation and Maintenance increased only to 19 times greater. Similarly, Plant expenditures per campus occupant increased by only 50% in 1990 dollars from 1930. By 1990, the average campus, with a building replacement value of almost 100 million dollars, had a physical plant operating budget of almost 2.7 million dollars.

Based on the trends and developments presented in Tables 2.1 to 2.5, it is readily apparent that the scope of

the typical physical plant department in higher education institutions has increased significantly. To compound matters, however, other factors entered the physical plant sphere of responsibility. Prior to 1950, expenditures for research were always less than those for plant operations. After this date, research costs either equaled or surpassed physical plant costs in all but a few years; since 1983, research costs have increased to the point where they now exceed plant operation and maintenance expenditures by 33%.[12] One effect of this expansion of research activities has been a marked increase in the sophistication and operational difficulties associated with many buildings. For example, the English department or the history department requires services "only" during normal class and faculty hours, and these services consist of basic environmental systems for normal comfort conditions. In contrast, research projects in many diverse disciplines require round-the-clock operation of buildings and complicated supporting services. At the University of Georgia, dozens of major buildings operate on a 24-hour day, seven days per week basis to support research projects in the Colleges and Schools of Arts and Sciences, Agriculture, Veterinary Medicine, Pharmacy, Forestry, and Consumer and Family Sciences. In addition, Libraries are open 16 hours every day, computer centers shut down only for 8 hours in the entire year, and housing and auxiliary enterprise facilities are open for all but a few days during the calendar year. The typical building on a modern campus is, or is about to become, an eclectic mixture of air conditioned spaces featuring electronically-ballasted lighting fixtures serving complicated animal care

facilities, computer-based instructional rooms, on-line libraries or recombinant DNA research laboratories, all linked by fiber optic cable to the rest of the campus and the world. The pace and complexity of the typical campus physical plant department has increased dramatically since the days when blackboard cleaning was so important[13]; trouble calls in today's environment on campus run the gamut from constructing a cast for an elephant's leg to relocating the whale from the roof of the Natural History Museum.[14] All these complex facilities must be operated and maintained by the physical plant department of the institution. In sum, facilities managers in the academy are responsible for some very complex activities indeed, but are expected to function with less real dollars than were available before during less demanding times.

During the period from 1964 to 1990, the total campus population increased from about six million to over sixteen million (Table 2.1), and the average campus population rose to almost 4,700 people (Table 2.2). The total number of institutions went from 2,200 to 3,535 schools (Table 2.2). The average area of buildings on a typical campus rose to over 960,000 square feet, and the average number of buildings on campuses was thirty-seven (Table 2.3). The book value of buildings on an average campus increased to twenty-nine million dollars (Table 2.4), but the replacement value of these structures was estimated to be approximately one hundred million dollars. When adjusted to 1990 dollars, the expenditures by physical plant departments per campus occupant changed very little during this period, amplifying the "do more with less" lament of these facilities managers. During these hectic years of expanding research

requirements, energy crises, cutback management decisions driven by Draconian budget reductions, procrustean regulatory laws and exploding technology, the academy chose to reduce spending on deferred maintenance and capital renewal projects. This dilemma, which has produced a backlog of necessary facilities-related projects estimated at over seventy billion dollars in The Decaying American Campus, exacerbates the funding deficits already faced by higher education institutions. Paying the bills for these problems will be painful but necessary if the academy expects to prosper. Unless utilities roll back their prices, or regulatory agencies decide not to enforce expensive rulings, or roofs decide not to leak, or Americans decide not to go to college, facilities managers will continue to attempt to do more with less. Unfortunately, there is a limit to this charade.....

NOTES

1. Sean Rush and Sandra Johnson, Decaying American Campus, (Alexandria, VA: Association of Physical Plant Administrators, 1989), 15.

2. Department of the Interior, Report of the Commissioner of Education for the Year Ended June 30, 1914, (Washington, D.C.: USGPO, 1915).

3. Vincent P. Barabba, ed., Bicentennial Edition - Historical Statistics of the United States - Colonial times to 1970, (Washington, D.C.: USGPO, 1975), 365.

4. U.S. Bureau of Education, Statistics of State Universities and State Colleges, Bulletin, 1914, No. 50, (Washington, D.C.: USGPO, 1915), 2-16.

5. Richard J. Petersen, Inventory of Physical Facilities in Institutions of Higher Learning, Fall 1974, (Washington, D.C.: National Center for Education Statistics (NCES), 1977).

6. Thomas D. Snyder, ed., 120 Years of American Education: A Statistical Portrait, (Washington, D.C.: NCES, 1993), 1-3. This book summarizes much of the data from Digests of Education Statistics and Biennial Surveys, but covers no new information. This publication should not be confused with Seymour E. Harris's A Statistical Portrait of Higher Education, (New York: McGraw-Hill, 1972), which was prepared for the Carnegie Commission on Higher Education.

7. National Center for Education Statistics, Institutional Characteristics of Colleges and Universities, (Washington, D.C.: U.S. Department of Education, 1986). This report, known as the HEGIS file, is an enormous computer data file.

8. Snyder, 120 Years, 3.

9. Thomas D. Snyder, and Charlene M. Hoffman, Digest of Education Statistics - 1992, (Washington, D.C.: NCES, 1992), 213. This lists the University of Minnesota with the highest total enrollment in 1990 of 57,168.

10. E. Eugene Higgins, and Mary B. Fuller, College and University Facilities Survey - Part 3, (Washington, D.C.: Department of Health, Education and Welfare, 1965).

11. J. Michael Muller, Deputy Director of the Virginia State Council of Higher Education, quoted in Goldie Blumenstyk's "Manual on College Facilities Updated to Reflect New Priorities, Requirements", Chronicle of Higher Education, (April 28, 1993), A30.

12. Snyder, 120 Years, 90.

13. Blackboards and erasers are gradually becoming obsolete, especially in large classrooms, in the academy. Digital television cameras mounted at lecterns can relay written information to students through a large screen projection system much more effectively than the chalk and blackboard method.

14. Work orders for fabricating a cast for an elephant's leg, and the removal of a whale's carcass from the roof where it was placed to dry out, have been processed by the University of Georgia Physical Plant Division. The latter exercise was compromised by the normal decaying process that produced odors of significant magnitude.