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ABSTRACT

This study examines the capital cost component of higher education. The focus is on data related to the capital stock of the University of California. A conceptual framework is provided as a method for analyzing three types of choices facing university decisionmakers. These choices concern: (1) the relative size of various educational programs by level and discipline; (2) the relative emphasis of instruction and research; and (3) the amount of support capital for administrative and service functions. Chapter two contains definitions of capital and depreciation and provides a conceptual approach to the measurement of capital costs. A theory is developed and applied in a descriptive analysis of measures of capital stock and capital costs based on the Irvine campus of the University of California. (Author/MJM)

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# THE CAPITAL COSTS OF A UNIVERSITY

Frederic D. Winslow

Paper P-9

January, 1971

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## PREFACE

This is one of a continuing series of reports of the Ford Foundation sponsored Research Program in University Administration at the University of California, Berkeley. The guiding purpose of this Program is to undertake quantitative research which will assist university administrators and other individuals seriously concerned with the management of university systems both to understand the basic functions of their complex systems and to utilize effectively the tools of modern management in the allocation of educational resources.

For effective capital management, a university should be aware of the magnitude, composition and use of its capital plant and be able to monitor the allocation of it. This paper presents definitions and a theoretical framework for the development of accounting for capital facilities and their costs. An example of such an allocation is given using the capital facilities records of the Irvine Campus of the University of California.

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# I. INTRODUCTION

The purpose of this study is to examine the capital cost component of higher education. Knowledge of the capital costs associated with the various programs within a university, coupled with information on operating costs, can help a decision maker determine the total cost of higher education and the relative costs of competing higher education programs. This total cost data may help in the analysis of two major decision problems: first, decision makers must make resource allocation choices between instructional and noninstructional programs; and second, decision makers must choose the intensity of activity of each available educational program. One approach to these resource allocation problems is the development and implementation of realistic and comprehensive institutional costs of a university's capital facilities.

In particular, this study focuses on data related to the capital stock of the University of California. Currently the University's capital facilities are allocated to academic departments, research institutes, and campus administration on the basis of traditional criteria such as the number of students and faculty, the magnitude of research funding, and personal persuasion. For this reason one anticipates that the overall magnitude, composition and distribution of the University's capital facilities among users may be very different from what it would be if capital facilities were allocated on a rational basis of cost and benefits to the university. It is in the University's own best interests to allocate its capital resources in an efficient manner, or at least to know the degree of distortion in the

system at present.[1] In addition, it is increasingly evident that future support for capital facilities both from state funds and other sources will be contingent on proof that the University is efficiently utilizing its existing capital stock.

In other words, University decision makers should be able to make the following types of choices, each of which has capital costs which may be currently unknown: (1) the relative size of various educational programs by level and discipline; (2) the relative emphasis of instruction and research; and (3) the amount of support capital for administrative and service functions in the university. This paper provides both a conceptual framework and a method of analyzing these decisions. Chapter II contains definitions of capital and depreciation and provides a conceptual approach to the measurement of capital costs. Chapter III applies the theory developed in Chapter II in a descriptive analysis of measures of capital stock and capital costs based on the Irvine campus of the University of California.

[1] Historically capital budgets are determined by the various campuses' requests for capital which are justified by changes in total enrollment or in disciplinary mix in relation to changes in space available for instructional purposes. This procedure works, after a fashion, as long as the number of students increases on all campuses and as long as the space available for instruction does not decrease. Unfortunately these conditions are no longer prevalent because some campuses are at their enrollment ceilings and because space for instruction tends to decrease as new institutes and small research projects are established. Regression analysis performed by the Office of Analytical Studies has indicated that models in which the size of additions to capital stock are explained by research expenditures as well as enrollments have a greater predictive power than models in which capital stock additions are related to enrollments alone. See: Emanuel, Roger M., Manager - Models and Simulation, Office of the Vice President - Planning and Analysis, University of California. (Memorandum, June 4, 1969.)

## II. CONCEPTS OF IMPROVED MEASURES OF CAPITAL AND CAPITAL COSTS

This chapter provides definitions and a theoretical framework for the development of improved measures of capital and capital costs. The total capital stock of a university is the sum of all land and facilities owned by the university. Physical capital is a major university resource and as such its allocation is an important factor in the efficient management of a university. However, university decision makers need to quantify both the physical attributes and the costs of the capital facilities to include capital explicitly in their analysis. A comprehensive measurement framework for capital or capital costs should include: (1) valuation of capital; (2) institutional or flow costs of capital and user charges; and (3) attribution of capital and capital costs.

### Valuation of Capital

Three generally accepted valuation approaches are book value, depreciated replacement value, and present or market value. Of these, the most common valuation method is to estimate a structure's worth in terms of its book value. The book value of a capital structure is defined here as its original cost plus the costs of any changes or additions to the structure. In other words, book value is the total number of dollars recorded as being invested in the physical structure. However, "economists are in substantial agreement that estimates of wealth in terms of book value, or original cost, are not as meaningful as market or other present-value estimates."[2] This is both true because of the change in cost indexes over time and because this

[2] Measuring the Nation's Wealth, Studies in Income and Wealth, Vol. 29, (New York: National Bureau of Economic Research, 1962), p. 67.

definition neglects depreciation. Therefore, book valuations are inappropriate when discussing the current value or productivity of capital stock.[3]

A second valuation method approximates the replacement value of the structure, where "the replacement value is normally defined as the original cost multiplied by an updating index, such as a ratio of the current year's cost to the original year's cost, plus the updated cost of all capital additions."[4] One problem with this valuation method is that it does not account for either possible variation of capital productivity over time or for possible changes in demand for specialized capital facilities over time.

Current or depreciated replacement value is defined as the replacement value minus depreciation. Depreciation of a university's capital stock results from three conceptually separable processes: (1) technical obsolescence; (2) psychological obsolescence; and (3) functional obsolescence. Technical obsolescence is defined to be the loss in value of capital stock due to natural wear and tear. In the case of a university's capital stock, it is difficult to measure technical obsolescence, which is only indirectly associated with the instructional process. Therefore, indirect measures have to be developed to fit individual situations. This is particularly true in a situation where only the book value has been maintained and parts of the existing body of capital stock are quite old.

Psychological obsolescence is even more difficult to measure because it is evinced in the productivity difference between a converted or modernized old structure and a completely new structure (assuming that both cost the same). It is not necessarily true that psychological depreciation is always

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[3] Another problem with book value is that unless all parts of the capital structure have the same age and all improvements were made at the same time, it is difficult to compare their book values.

[4] Measuring the Nation's Wealth, op. cit., page 74.

negative. South Hall, one of the oldest buildings on the Berkeley campus of the University of California, is an interesting example of this situation. South Hall could have been torn down and replaced by a structure which would have been more efficient in terms of recent developments in the learning process, and a more intensive use of land in a central site. However, for historical reasons, South Hall was not torn down but was modernized at great expense. It could be argued that psychological obsolescence is negative in the case of South Hall because this structure appears to have an aesthetic value which offsets its loss in productivity due to technical depreciation. Because of these difficulties psychological obsolescence will be largely ignored in this discussion.

Finally, functional obsolescence is defined to be the cost of converting a part of the capital stock from one use to another in response to changes in demand for specialized capital facilities. The difficulty with analyzing functional obsolescence lies in attributing costs of improvement in capital stock to changes in demand on the one hand and to technical obsolescence on the other. For the purpose of this discussion, the cost of functional obsolescence will be considered an addition to capital stock.

Two approaches to capital valuation have been discussed thus far, book value and depreciated replacement cost; the third capital valuation method is present value which is generally defined as the discounted benefit of future net income streams expected as a result of demand for a product. "Just as relative market prices of consumer goods represent degrees of satisfaction anticipated by purchasers, so do relative market prices of capital goods reflect present values of the future net income streams expected by the purchasers."[5] However, there are many practical problems in the appli-

[5]Measuring the Nation's Wealth, op. cit., page 68.

cation of this measure to an institution's capital stock. It is very difficult to measure the net worth of, or the demand for, the "product" of a university either in terms of instruction or research. In addition it is difficult to associate these output values with the various components of a university's capital stock. This is a good theoretical definition but it is relatively useless for the purpose of analytically determining the value of an institutions capital stock.

## Annual Institutional Costs and User Charges

Another concept potentially useful in improving measures of capital and capital costs is the distinction between annual user charge and institutional costs of capital. These are the flow costs related to the total valuation concepts of depreciated replacement value and present value. *User charge* is defined as the annual amount of money that a user pays for the use of capital facilities. *Institutional cost of capital* is defined as the sum of the annual loss in value of the capital stock plus the annual cost of maintenance of the capital stock. Maintenance is generally described as the physical care and the operating of the capital stock such as the provision of utilities, custodial work and refuse removal. Institutional charges do not necessarily equal user costs.

When user charges are determined in a competitive market, then a surplus of user charges over institutional costs indicates that the university should continue to provide the facility. Furthermore, an ordering of these positive differences from the largest to the smallest provides a priority listing in case of capital rationing.

An additional consideration is the relation of external markets to university physical capital. Thus, the university should not provide new capital

itself if its internal costs of capital would exceed the external market prices. Likewise, if the university could provide capital stock cheaper than the external market and the bids of its own capital users were lower than external bids, then the university might be able to rent that facility to external users at a user charge greater than its cost.

## Distribution of Annual Capital Costs

Measures of the annual costs of providing capital facilities should be attributed to the user of the capital stock. In this context, we will consider allocating institutional costs of capital to two levels: the departmental levels, and the instructional and research levels. Instructional output is defined in terms of the number of students instructed, not the number of degrees completed. Research output is defined in terms of the number of full time persons performing research. It would be preferable to use direct measures of research output; however, this is infeasible. These output figures will be developed in Chapter III. For now, we will refer to instructional output as the "full time equivalent student instructional load," (FTESIL) and to research output as "full time equivalent researcher," (FTER).

Institutional costs of capital may be attributed to a department in proportion to its measured use of capital facilities. On the departmental level it is computationally convenient to assume that each FTESIL and FTER occupies a certain amount of space, and that the ratio of this amount of space to the total space available in his category represents his share of the departmental capital stock.[6] The cost of this space could vary from

[6] U.S. Department of Health, Education and Welfare, Final Report - Cooperative Research Project No. 2852, Irene H. Butter, Department of Economics, The University of Michigan, Washington, D.C., Eric Clearing House, 1966, p. 30.

discipline to discipline, and if attribution is made on this basis, disciplinary differences in capital share could be reflected. A problem that this scheme does not solve is the division of space which has a joint product (e.g., research and instruction) such as a professor's office space. Identifiable space of this type will be divided for the purposes of this paper in proportion to the average time that the occupants spend on instruction, research and administration.[7]

To summarize, Chapter II has provided a theoretical framework and a set of definitions for improved measures of capital stock and capital costs, including measures such as depreciated replacement value and institutional costs of capital, which approximate total value and annual costs from historical records. Depreciated replacement value can be divided among the departments in proportion to the amount of capital stock that a department utilizes. The departmental capital stock for instructional and research purposes can be further subdivided among the students taught and the researchers involved on the basis of the number of square feet needed in his discipline to support each person.

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[7] Note: The issue of whether, or how, to allocate true joint costs is a classic one of dispute between economists and cost accountants.

# III. ANALYSIS OF THE CAPITAL STOCK AND CAPITAL COSTS ON THE IRVINE CAMPUS OF THE UNIVERSITY OF CALIFORNIA

The capital stock of a university contributes to a university's output of student education and of research. The productivity of capital is accomplished through its use by the professional and administrative staff and students of the university. The most efficient use of capital stock in a particular program in relation to the input of personnel, either student or staff, varies with the program's technology and the relative use of university resources. The value of capital actually utilized and its associated periodic cost is measurable and can be attributed to particular programs of instruction and research. The value of capital and its periodic cost vary over time, between disciplines and with the intensity with which capital facilities are utilized. This chapter will concentrate on the valuation of capital and on the institutional costs of capital as they exist. This will be accomplished by applying the theory developed in Chapter II to the administrative records of the University of California in order to develop estimates of the institutional cost figures and of the relative shares of capital stock used.

This chapter develops the various tools necessary for a decision maker to have a capital accounting system that contains relevant information including the share of capital stock utilized and the periodic costs of that share of capital stock. This presentation will analyze the existing pertinent administrative systems of the University of California while, as far as possible, estimating the amount of capital and the institutional costs of

capital of a few of the University of California's programs. Due to the size and complexity of the University, and hence the data reduction problem, the Irvine campus and Barrows Hall on the Berkeley campus were selected as examples for this discussion. The same methodology presented here could be applied to the rest of the University.

This chapter is divided into the following parts: (1) valuation of the capital stock through the replacement value; (2) development of depreciation, maintenance, and user costs; (3) division of the capital stock and user costs among the departments; and (4) allocation of the departmental share to the measures of departmental output, the FTESIL and FTER. The procedure in each part will be to describe the existing administrative procedures and records, state the qualifications that the records impose, and develop the contents of an ideal data set.

## 1. Replacement Value of Capital Stock

This section is concerned with the valuation of the capital stock in order to develop the replacement value of the capital stock. To best accomplish this it is necessary to examine the valuation methods used by various administrative departments of the University of California. At present there exist four valuation methods: insurance, maintenance, accounting book value, and the project cost files of the Office of Physical Planning and Construction. These will be discussed in order.

For insurance purposes, the University is in the process of determining the replacement values of existing buildings. The proposed method is to hire outside consultants to estimate the values of the more valuable parts of the capital stock. The valuation figures would be the cost to build an equivalent building now. Hence, these figures would be a close

approximation to the replacement value as defined in Chapter II. However, the survey has not been carried out and would only apply to buildings over a certain value, so it is of no use at this time.

For budget purposes, the budget officer attempts to predict the maintenance requirements of the University in accordance with a method developed by W.H. Badgett.[8] The essence of this method is that, "Since building and maintenance costs and building replacement costs vary in nearly direct proportion, maintenance costs may be estimated by taking a percentage of the current building replacement costs."[9] To estimate the replacement costs, the University of California utilizes a table, included as Exhibit 1, in which a building is considered as a particular building type if most of its design use is for that type. Therefore, this table is an oversimplification of the estimating problem and can yield only an approximate answer. However, for reasons which shall become more apparent in the discussion concerning maintenance, this estimating method is of sufficient accuracy for the present maintenance budget purposes.

The third valuation method involves the accounting book values carried in the listing of plant assets of the University's accounting records. The use of book values follows exactly from the earlier discussions. The replacement value is the sum of the original cost multiplied by an updating index and the updated cost of all capital additions. The book values themselves are relatively useless for current decision purposes. The annual listing of plant assets is a computer listing of all University assets.[10] It is divided

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[8] National Association of Physical Plant Administrators of Universities and Colleges, Minutes of Fifty-First Annual Meeting, (Fort Worth, Texas: 1964), pp. 40-48.

[9] Ibid., p. 42.

[10] The University of California Office of the Vice President - Business and Finance, "Annual Listing of Plant Assets," 1969. (Computer Run.)

# EXHIBIT 1: LISTING OF DATA DECKS

## UNIVERSITY OF CALIFORNIA
## INVENTORY OF EXISTING FACILITIES

Estimated Bldg. Value
September 30, 1966

| BUILDING TYPE | $/OGSF[1] | CODE |
|---|---|---|
| PARKING STRUC. (GARAGE) | $ 6.00 | A |
| RESIDENTIAL APTS./HOUSE<br>TEMPORARY STRUCTURES | 18.00 | B |
| SERVICE BLDS. (CORP. YDS.)<br>ATHLETIC/RECREATION FACIL.<br>FARM BLDGS. (ANIMAL)<br>STORAGE BLDS. | 21.80 | C |
| ACADEMIC/RES. (RES. COL.) | 23.75 | D |
| LIBRARY<br>RESIDENCE HALL<br>HEADHOUSE/GREENHOUSE<br>CLASSROOM BLDG. | 26.00 | E |
| ELEMENTARY SCHOOL<br>CLASSROOM & OFFICE BLDG. | 27.75 | F |
| GYMNASIUM<br>OFFICE BUILDING | 30.00 | G |
| LABORATORY - DRY<br>STUDENT UNION/CAFETERIA | 31.75 | H |
| MUSEUM/GALLERY | 33.00 | I |
| DINING FACILITIES | 38.50 | J |
| AUDITORIUM/THEATER<br>MEDICAL (HOSP./CLIN.)<br>CLASSROOM/LAB. | 41.65 | K |
| LABORATORY - WET | 43.75 | L |
| LECTURE HALL | 48.25 | M |
| CENTRAL PLANTS | 142.50 | N |
| MISCELLANEOUS BLDGS. | 38.00 | X |

[1] OGSF = Outside Gross Square Feet
All unit costs shown @ ENR 1100

into several sections: real estate, buildings and structures, general improvements, equipment, and libraries and collections. The general improvements section is the repository of various sub-components of a campus such as the electric systems, water systems, landscape improvements, etc. The annual listing is compiled for ten years, then balanced out, and the balance carried forward to start a new ten year cycle. The present cycle ends June 30, 1970; hence there is a full ten years of data which covers the entire period of the Irvine campus. There is a previous ten year cycle from 1951 to 1960. Before that the account is in a hand-scribed ledger and starts in about 1928 with "estimates" as to building worth apparently based on construction funding. Hence, the initial cost of all buildings older than 1928 is subject to an unknown error. One of the reasons Irvine was chosen as the example is because the entire Irvine campus was built recently and is contained in the same ten year cycle.

A problem with these records is the assigning of the sub-components listed in general improvements and equipment. Neither the equipment nor the general improvements section has consistently labeled the location of an item or the time of installation or construction. For this discussion, when the use cannot be identified directly as support of a particular structure, it has been considered general campus capital support. A page of the capital improvements section of the annual listing of plant assets is appended as Exhibit 2 to exemplify this problem. The support documents behind a ledger such as this are destroyed approximately five years after they are entered. For accounting purposes the information in the support documents is superfluous.

These accounts do include the capital additions since the construction of a building was completed, but there are two problems with the form in

EXHIBIT 2: PAGE OF GENERAL LEDGER: ANNUAL LISTING OF PLANT ASSETS, GENERAL IMPROVEMENTS SECTION

| Annual Listing of Plant Assets, July 1, 1960-June 30, 1969 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Improvements | | | | | | | | | | | | Debit | Credit | Balance |
| 9 | 101802 | 01999 | 0 | 9635 | SURFACE PARKING | 909088 | 53 | 13095 | 06 | 30 | 7 | 9,447.51 | | |
| 9 | 101802 | 01999 | 0 | 9635 | RES APTS I | 900001 | 53 | 13095 | 06 | 30 | 7 | 161,063.44 | | |
| 9 | 101802 | 01999 | 0 | 9635 | UTILITY & SITE 64/ | 909027 | 53 | 13095 | 06 | 30 | 7 | 187,592.15 | | |
| 9 | 101802 | 01999 | 0 | 9635 | UTILITY & SITE 65/ | 909029 | 53 | 13095 | 06 | 30 | 7 | 228,844.85 | | |
| 9 | 101802 | 01999 | 0 | 9635 | 67/68 CAP 909027 | | 53 | 12235 | 06 | 30 | 8 | 2,566.54 | | |
| 9 | 101802 | 01999 | 0 | 9635 | 67/68 CAP 900000 | | 53 | 12235 | 06 | 30 | 8 | 34,904.00 | | |
| 9 | 101802 | 01999 | 0 | 9635 | 67/68 CAP 909088 | | 53 | 12235 | 06 | 30 | 8 | 1,098.14 | | |
| 9 | 101802 | 01999 | 0 | 9635 | 67/68 CAP 909029 | | 53 | 12235 | 06 | 30 | 8 | 7,781.76 | | |
| 9 | 101802 | 01999 | 0 | 9635 | 68/69 CAP 909030 | | 53 | 12336 | 06 | 30 | 9 | 134,726.58 | | |
| 9 | 101802 | 01999 | 0 | 9635 | 68/69 CAP 929000 | | 53 | 12336 | 06 | 30 | 9 | 16,375.50 | | |
| 9 | 101802 | 01999 | 0 | 9635 | 68/69 CAP 909092 | | 53 | 12336 | 06 | 30 | 9 | 21,399.00 | | |
| | | | | 9635 | TOTAL | | | | | | | 847,772.02 | 8,405.00- | 839,367.02 |

which this information is included. First, the date when the addition to the asset account is recognized is quite often at the completion of the entire project which may be several years after the completion of a particular item, and the date of "construction" is not consistently included in the entry. The second problem is that there is no differentiating of capital additions offsetting depreciation from actual capital improvement; especially in the older buildings, it is suspected that a portion of the capitalized figure represents what is technically depreciation in the context of this discussion.

While these accounts have some undesirable characteristics, they are the University's most complete set of cost records available. In addition, the Engineering News Record (ENR) index is used to update the data contained in these accounts because it reflects the changing costs in the construction industry. This index is appended as Exhibit 3.

The fourth valuation method used within the University of California is the cost estimates made by the Office of Physical Planning and Construction. The purpose of these is to forecast the cost of construction of new buildings and major alterations on the various campuses. For the buildings where they exist, these estimates are accurate and complete; in addition they are developed at a particular ENR index, so updating is not a problem. These cost estimates are broken down into the various functions that go into construction such as utilities, site development, construction, etc. As an example, the cost estimate for the Library Unit I of the Irvine campus is appended as Exhibit 4. The major problem with this data for overall valuation purposes is that it includes only recent construction and only the major structures and alterations. For example, general landscaping and other external capital costs are not included.

# EXHIBIT 3

## ENGINEERING NEWS RECORD

## CONSTRUCTION COST INDEXES - 1913 = 100

| | JAN. | FEB. | MAR. | APRIL | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | AVER. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1945 | 302.5 | 303.7 | 304.5 | 306.4 | 307.4 | 309.0 | 309.0 | 309.1 | 309.3 | 309.3 | 309.3 | 313.5 | 307.8 |
| 1950 | 434.7 | 484.9 | 488.4 | 491.9 | 496.6 | 506.9 | 512.7 | 521.4 | 531.0 | 536.2 | 530.0 | 530.8 | 509.6 |
| 1955 | 643.7 | 645.2 | 645.7 | 647.5 | 653.3 | 656.0 | 660.1 | 672.2 | 672.7 | 673.9 | 673.2 | 673.1 | 659.9 |
| 1956 | 676.4 | 680.2 | 680.2 | 688.3 | 688.4 | 692.1 | 694.8 | 696.3 | 704.9 | 703.9 | 704.1 | 703.8 | 692.4 |
| 1957 | 707.9 | 710.1 | 708.6 | 709.3 | 715.7 | 721.4 | 724.2 | 738.6 | 737.8 | 737.1 | 737.4 | 738.1 | 723.9 |
| 1958 | 743.4 | 743.8 | 744.4 | 745.8 | 751.6 | 757.3 | 762.5 | 764.4 | 773.5 | 775.3 | 774.1 | 773.8 | 759.2 |
| 1959 | 778.3 | 778.8 | 781.4 | 784.4 | 790.4 | 795.2 | 806.7 | 811.2 | 812.6 | 811.4 | 809.8 | 808.6 | 797.4 |
| 1960 | 812.0 | 812.9 | 813.5 | 813.6 | 820.2 | 826.2 | 829.3 | 830.2 | 830.9 | 829.6 | 830.1 | 830.2 | 823.6 |
| 1961 | 834.3 | 834.3 | 834.2 | 837.6 | 847.3 | 850.4 | 853.6 | 854.1 | 854.0 | 854.5 | 855.4 | 855.0 | 847.1 |
| 1962 | 855.4 | 858.5 | 861.5 | 863.2 | 871.6 | 872.9 | 877.1 | 881.4 | 880.6 | 880.2 | 879.9 | 879.9 | 871.8 |
| 1963 | 882.7 | 883.0 | 834.2 | 884.8 | 894.3 | 899.1 | 903.9 | 914.3 | 913.8 | 915.5 | 913.5 | 914.7 | 900.7 |
| 1964 | 916.9 | 918.1 | 920.1 | 924.0 | 927.4 | 931.5 | 945.0 | 947.9 | 947.4 | 947.5 | 948.3 | 948.1 | 935.2 |
| 1965 | 947.6 | 957.4 | 957.7 | 957.4 | 957.9 | 971.1 | 977.1 | 984.8 | 986.3 | 986.3 | 985.0 | 987.7 | 971.4 |
| 1966 | 987.9 | 997.4 | 998.3 | 1006.1 | 1014.0 | 1028.7 | 1034.3 | 1037.1 | 1038.6 | 1037.3 | 1036.6 | 1037.5 | 1021.2 |
| 1967 | 1043.2 | 1044.9 | 1047.5 | 1047.6 | 1063.3 | 1072.0 | 1082.7 | 1093.3 | 1096.7 | 1100.9 | 1101.3 | 1103.0 | 1074.7 |
| 1968 | 1111.1 | 1114.5 | 1117.2 | 1121.9 | 1141.7 | 1154.2 | 1157.8 | 1171.1 | 1185.6 | 1190.5 | 1190.7 | 1200.8 | 1154.8 |
| 1969 | 1216.1 | 1229.6 | 1238.1 | 1248.9 | 1258.3 | 1285.0 | 1282.8 | 1292.2 | 1285.3 | 1299.3 | 1305.2 | 1305.7 | 1270.5 |
| 1970 | 1308.6 | | | | | | | | | | | | |

Note: All values for 1962 were revised by an additional .10 due to an error in reporting current prices.

# EXHIBIT 4

## Cost Estimate--Library Unit I

Campus I R V I N E

Facility Library Unit I

Architect Associated Architects

Date of Bid 10/31/63 ENR 915.49

Struc. Engineer Brandow & Johnson

Date of Completion

Mech. Engineer Ralph E. Phillips, Inc.

Gen. Const. Contractor Robert E. McKee General Contractor, Inc.

### Description of Facility

Frame Reinforced Concrete
Facing Precast Concrete Panel
Roof Clay Tile
Stories Five
Other

| Size of Structures | Unit | Quantity | Ratios | |
|---|---|---|---|---|
| Outside, Gross | Sq.ft. | 83,488 | 100 | 1.35 |
| Assignable | Sq.ft. | 61,411 | .73 | 100 |

Based on Bids Received:

| Code | Item | Breakdowns | Cost - $ | $/o.g.f. | Assignable | % |
|---|---|---|---|---|---|---|
| | General Construction | 945,170 | | 11.32 | 15.39 | 48.45 |
| | Ventilating, Air Conditioning and heating | 149,930 | | 1.80 | 2.44 | 7.68 |
| | Plumbing | 63,700 | | 0.76 | 1.04 | 3.26 |
| | Electrical | 156,000 | | 1.87 | 2.54 | 8.00 |
| | Elevators | 61,500 | | 0.74 | 1.00 | 3.15 |
| | Site Work | 26,900 | | 0.32 | 0.44 | 1.38 |
| 1. | Total Bldg. Cost | | 1,403,200 | 16.81 | 20.55 | 71.92 |
| 2. | External Utilities | | 210,000 | 2.51 | 3.41 | 10.78 |
| 4. | Landscape, Roads, Walks | | 48,000 | 0.57 | 0.78 | 2.46 |
| 5. | Fees | | 88,000 | 1.05 | 1.43 | 4.51 |
| 6. | A & E Costs | | 67,000 | 0.80 | 1.09 | 3.43 |
| 7. | Field Survey, Mimeo & B/R Lab tests and Boring | | 16,000 | 0.19 | 0.26 | 0.82 |
| 8. | Special items | | 20,000 | 0.23 | 0.32 | 1.03 |
| 9. | Contingency (a) | | 62,000 | 0.74 | 1.00 | 3.18 |
| | (b)Change Order Contingency | | 36,800 | 0.44 | 0.59 | 1.89 |
| Total Project Cost without Group 2&3 | | | $1,951,000 | 23.34 | 29.43 | 100 % |

Remarks:

Prepared by Elsie Epp, UCI/AE

Date 8-31-64

Of the four valuation methods discussed--insurance estimates, maintenance projections, book value, and construction cost estimates--only the last two possess the completeness and detail desirable in this project. The capital stock of the Irvine campus was valued using both methods, and a comparison of the results is presented in Figure 1. Figure 2 is an example of the calculation method used in developing columns 1 and 5 of Figure 1 for Barrows Hall on the Berkeley campus. Essentially, the amount of money spent on the structure in each year was taken from the annual listing of plant assets, multiplied by the necessary ENR ratio and totaled to give the replacement value of the structure. The initial year funding of the building, column 1, was then compared with the building construction cost estimates, column 2. As can be seen in Figure 1, the differences were with one exception under ten percent and averaged quite close to five percent.

Some of the general improvements on the Irvine campus could be separated out for the initial years (see Exhibit 2). These were updated appropriately and added to the original building costs. A comparison of the updated total replacement value figures (column 5, Figure 1) with the updated total construction cost estimates (column 4) shows total construction cost estimates to be generally quite a bit higher. It is surmised that this is because the accounting system did not identify all general improvements with the particular structure involved, and hence the capital value of some general improvements are lost in the general improvement account. The magnitude of this error can be noted in lines 26 to 29 of Figure 1 where the general improvements are listed. The general improvements section of the general ledger was updated with the ENR and considered to be support capital stock. However, an attempt was made to subtract part of this support capital out

FIGURE 1: VALUATION ESTIMATES FOR UNIVERSITY OF CALIFORNIA, IRVINE, EXCLUDING BUILDING DEPRECIATION (Figures in ENR 1270)

| BUILDING, ASSET NO. | (1)[f] Updated Cost from Asset Account-Original Building Only | (2)[g] Building Cost-Cost Estimate | (3) Percent Diff. (1) - (2) / (1) | (4)[g] Total Project Cost-Cost Estimate | (5)[f] Replacement Total Value of Structure Inc. Cap. Add. from Asset Acc't. | (6)[e] Necess. Amt. to Bal. Out Later Bldgs. | (7) Total Valuation in Instr., Adm., & Research |
|---|---|---|---|---|---|---|---|
| 1. Library #1, 9001 | $ 2,095,226 | $ 1,950,448 | 6.9% | $ 2,711,890 | $ 2,480,540 | | |
| 2. Cafeteria, 9002 | 1,118,095 | 1,050,006 | 6.0% | 1,455,191 | 1,480,157 | | |
| 3. Soc. Sci. & Humanities, 9025<br>4. Fine Arts, 9030 | 3,187,196 | 2,970,152 | 6.8% | 4,119,960 | 3,754,825 | | $ 3,754,825 |
| 5. Head House, 9026 | 224,243 | 212,299 | 5.3% | 278,663 | 226,114 | | 226,114 |
| 6. Student Center in Fine Arts, 9020 | 53,437 | 51,979 | | 69,845 | 53,437 | | |
| 7. Bio. Sciences, 9075<br>8. Sci. Lec. Hall, 9078 | 4,384,036 | 3,953,855 | 9.8% | 5,483,689 | 5,052,546 | | 5,052,246 |
| 9. Phys. Sci. #1, 9100 | 6,686,308 | 7,276,940 | -8.8% | 8,779,760 | 6,686,308 | [e]+$ 1,215,440 | 7,901,748 |
| 10. Interim Off., 9225 | 166,668 | 165,663 | .6% | 200,400 | 166,668 | [e]+ 13,692 | 180.360 |
| 11. Fac. Res. Facil., 9226 | 266,197 | 262,826 | 1.2% | 278,000 | 288,982 | | 288,982 |
| 12. Main Yard, 9227 | 436,127 | 412,566 | 5.4% | 484,785 | 453,319 | | |
| 13. Green House Minor, 9228 | 35,335 | | | | 35,335 | | |

FIGURE . (Continued)



| | (1)[f] Updated Cost from Asset Account-Original Building Only | (2)[g] Building Cost-Cost Estimate | (3) Percent Diff. (1) - (2) / (1) | (4)[g] Total Project Cost-Cost Estimate | (5)[f] Replacement Total Value of Structure Inc. Cap. Add. from Asset Acc't. | (6)[e] Necess. Amt. to Bal. out Later Bldgs. | (7) Total Valuation in Instr., Adm., & Research |
|---|---|---|---|---|---|---|---|
| 14. Multipurpose #1, 9300 | $ 2,401,138 | $ 2,408,652 | -.3% | $ 2,735,160 | $ 2,408,6. ? | | $ 2,408,652 |
| 15. Univ. House, 9301 | 99,075 | | | | 103,371 | | |
| 16. Central Plant #1, 9302 | 1,335,907 | | | | 1,351,471 | | |
| 17. Ground Main Bldg., 9303 | 15,000 | | | | 15,000 | | |
| 18. Rec. Facil., 9669 | 43,126 | | | | 43,126 | | |
| 19. Boat House, 9670 | 18,526 | | | | 18,526 | | |
| 20. Student Health #1,9201 | 717,264 | 668,316 | 6.8% | 898,788 | 717,264 | | |
| 21. Resid. Hall, Unit #1 | 2,573,465 | 2,382,512 | 7.4% | 3,014,858 | 2,601,519 | | |
| 22. Resid. Hall, Unit #2 | 2,880,485 | 2,705,708 | 6.0% | 3,299,524 | 2,928,344 | | |
| 23. Resid. Apt., Unit #1 | 1,319,093 | 1,230,812 | 6.6% | 1,670,312 | 1,339,467 | | |
| 24. Resid. Apt., Unit #2 | 1,335,402 | 1,133,664 | 15.1% | 1,598,200 | 1,357,720 | | |
| 25. Miscellaneous | 31,044 | | | | 31,797 | | |
| 26. Misc. Univ. Improvement | | | | | 1,616,466 | | |
| 27. Util. & Site Improvement | | | | | 7,356,852 | [e] $-1,229,132 | |
| 28. Parking Improvement | | | | | 286,893 | | |
| 29. Landscape | | | | | 231,661 | | |
| 30. Resid. Halls & Apt. Imp. | | | | | 387,402 | | |
| | | | Average 9.9% | | | | |

FIGURE 1 (Continued)

| TOTALS: | Amount: | Percent of Total: |
|---|---|---|
| Land | 11,315,713 | 19.3% |
| Instruction, Administration & Research [b] | 19,848,262 | 33.9% |
| Support Capital Stock [c] | 21,144,390 | 36.1% |
| Library [d] | 6,200,544 | 10.7% |
| Total[h] → | $58,508,909 | 100.0% |

[a] See text for source, original unupdated figure ($7,862,909) obtained from land account of asset ledger, Office of the Vice President Business and Finance, University of California.

[b] Total of column 7.

[c] Total of column 5 minus column 7 and minus cost of library (line 1).

[d] Library, line 1, column 5, plus asset ledger value of libraries and collection, Irvine campus ($3,720,004). Office of the Vice President Business and Finance, University of California.

[e] Facilities under capitalized by general improvements account and in instruction, research and administration category. Amount in column 6 modified column 5 and brings items #9 and #10 up to 90% of column 4.

[f] Columns 1 and 5 obtained from updating asset ledger, Irvine campus, with ENR cost index in the manner of Figure 2. Office of the Vice President Business and Finance, University of California.

[g] Columns 2 and 4 obtained from updating building cost estimated obtained from Office of the Vice President Physical Planning and Construction, University of California.

[h] Note this does not include equipment.

FIGURE 2

EXAMPLE OF CALCULATING THE REPLACEMENT VALUE OF BARROWS HALL, UNIVERSITY OF CALIFORNIA, BERKELEY CAMPUS, EXCLUDING BUILDING DEPRECIATION

| YEAR | Asset Account[a] | | ENR Cost Index | | Total in ENR 1969-1270 |
|---|---|---|---|---|---|
| 1965 | $ 4,306,176 | X | $\frac{1270}{971}$ | = | $ 5,632,176 |
| 1966 | 63,960 | X | $\frac{1270}{1021}$ | = | 79,558 |
| 1967 | 1,133 | X | $\frac{1270}{1075}$ | = | 1,338 |
| 1968 | 11,495 | X | $\frac{1270}{1155}$ | = | 15,012 |
| 1969 | 634 | X | $\frac{1270}{1270}$ | = | 634 |
| 1969 Replacement Value | | | | | $ 5,728,718 |

[a]Data obtained, by year, from asset ledger, Buildings and Structures Account, Office of the Vice President - Business and Finance, University of California.

and add it to the structure on the basis of the construction cost estimates (lines 9 and 10), in two cases where the cost estimates deviated considerably from the accounting total replacement value. Although the proportion added is somewhat judgmental, it is an attempt to identify the costs associated with the various buildings in a manner consistent with the early portions of the capital improvements account. This correction was only performed where columns 4 and 5 were radically different, and when the final result would influence the instruction, administration, and research totals. This had to be done to compare the early buildings with the later buildings in a consistent manner[11] and to attempt to keep the unallocable support capital stock from becoming too large a figure. The result of these manipulations is column 7 in Figure 1 which is the updated valuation of the capital stock of the Irvine campus directly related to instruction, administration and research; the total of this column is labeled instruction, administration and research. The remainder of the capital stock shown in column 5 is labeled support capital stock which includes recreation facilities, power plants, and residential halls and apartments which supports University operations as a whole, but whose usage is not allocable to either instruction, administration or research. Basically, the only part of the capital stock which can be directly associated with departments and departmental output is the instruction, administration, and research accounts.

The equipment section of the asset accounts in its present form cannot be used for allocation because the physical location of the equipment is

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[11] In the early years the general improvements account was labeled sufficiently to associated improvements with buildings and this was done. For later buildings this was not possible.

unidentified; hence, another summary of this category was necessary. Fortunately, the University maintains equipment inventory records by department and campus which are more relevant for the purposes of this project.[12] This inventory is maintained in a price adjusted form using the equipment price index which is published by the U.S. Department of Labor; this index is included as Exhibit 5. The University maintains this record to compare the capital equipment requests of the various departments on different campuses on the basis of dollars in equipment per assignable square feet. This departmental asset record will be used in part 3 of this chapter to divide the capital stock among the various departments. One disadvantage of data in this form is that the functional use of the equipment is not differentiated between research, instruction or administration.

The problem of the land account is critical to the question of valuation and allocation of resources due to the large percentage of capital invested in land. Currently there is no acceptable way to value land except at market value which would include the improvements that the University has made. Because land is a specialized case, there are no generally applicable price indexes to use to update its value. For this analysis we will assume that land values appreciate at a steady 8% per year. This gives a 1970 land value to the Irvine campus of $11,315,713 which is listed in the totals of Figure 1.

The last account in the annual listing of plant assets is the libraries and collections account. This account contains the book value of what nom-

[12] University of California, Equipment Cost per Assignable Square Foot in University Departments, (The University of California Office of the Vice President - Physical Planning and Construction, 1970).

EXHIBIT 5

U.S. DEPARTMENT OF LABOR
EQUIPMENT PRICE INDEXES - 1913 = 100

| | JAN. | FEB. | MAR. | APRIL | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | AVERAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1952 | 547.62 | 548.10 | 546.38 | 546 33 | 546.00 | 545.38 | 545.66 | 545.95 | 546.47 | 546.19 | 546.52 | 546.76 | 546.43 |
| 1953 | 549.05 | 549.52 | 551.44 | 553.82 | 555.73 | 557.16 | 559.54 | 560.50 | 561.45 | 561.45 | 561.93 | 561.93 | 552.36 |
| 1954 | 567 08 | 567.03 | 567.94 | 569.23 | 568.66 | 568.99 | 568.99 | 569.28 | 569.32 | 569.99 | 570.61 | 571.90 | 569.03 |
| 1955 | 565.27 | 565.94 | 565.75 | 566.51 | 566.89 | 568.37 | 571.61 | 577.96 | 583.68 | 586.07 | 588.36 | 591.70 | 574.86 |
| 1956 | 595.03 | 596.47 | 597.47 | 599.95 | 601.86 | 602.14 | 603.48 | 608.68 | 616.41 | 620.60 | 623.37 | 623.99 | 607.63 |
| 1957 | 633.48 | 633.48 | 634.44 | 634.44 | 635.87 | 636.82 | 644.52 | 644.45 | 646.84 | 648.75 | 650.18 | 650.66 | 640.64 |
| 1958 | 646.36 | 644.93 | 644.93 | 644.93 | 644.35 | 644.21 | 644.83 | 644.93 | 644.74 | 644.98 | 646.41 | 647.94 | 645.31 |
| 1959 | 640.11 | 649.03 | 649.37 | 648.75 | 649.61 | 649.42 | 654.81 | 650.70 | 651.28 | 651.66 | 652.47 | 652.23 | 649.51 |
| 1960 | 674.98 | 676.41 | 676.41 | 676.89 | 676.41 | 675.46 | 675.94 | 676.41 | 676.41 | 676.41 | 676.89 | 676.89 | 676.41 |
| 1961 | 656.52 | 656.76 | 656.71 | 656.28 | 655.71 | 655.66 | 661.10 | 661.44 | 662.06 | 662.39 | 663.30 | 664.44 | 659.38 |
| 1962 | 657.95 | 658.67 | 658.38 | 656.9 | 654.38 | 656.90 | 656.67 | 656.76 | 656.43 | 658.05 | 658.24 | 658.48 | 657.33 |
| 1963 | 658.0 | 657.86 | 657.76 | 657.48 | 658.0 | 658.8 | 658.3 | 658.3 | 658.8 | 659.7 | 660.7 | 661.1 | 658.8 |
| 1964 | 661.54 | 661.93 | 662.1 | 662.1 | 662.6 | 661.6 | 663.1 | 663.1 | 665.0 | 663.5 | 666.4 | 666.4 | 663.3 |
| 1965 | 660.7 | 661.1 | 661.6 | 670.2 | 670.7 | 671.2 | 671.2 | 669.7 | 670.7 | 671.2 | 673.6 | 674.5 | 668.87 |
| 1966 | 675.9 | 677.4 | 678.5 | 684.0 | 684.0 | 685.5 | 686.9 | 687.9 | 688.8 | 691.7 | 697.4 | 698.8 | 686.1 |
| 1967 | 700.7 | 701.7 | 702.4 | 703.9 | 703.9 | 704.4 | 704.8 | 706.1 | 707.5 | 711.0 | 713.5 | 715.5 | 706.2 |
| 1968 | 718.7 | 720.1 | 721.7 | 723.5 | 723.5 | 723.5 | 723.1 | 725.1 | 727.6 | 730.9 | 732.6 | 733.8 | 725.4 |
| 1969 | 734.8 | 735.5 | 736.4 | 739.8 | 739.8 | 741.4 | 743.4 | 744.3 | 747.6 | 751.5 | | | |

inally is the property of the library. As was the case with equipment or land, a separate updating price index should be used. However, because of the unique quality of books as assets and because of its recent acquisition, the balance figure of the account, $3,720,004, will be considered to equal its present replacement value. In addition, the replacement value of the library, shown on line 1 of Figure 1, has been added to libraries and collection value with the sum shown in the totals of Figure 1.

Therefore, the totals shown in Figure 1 represent the 1969 value of the capital stock of the Irvine campus with the exception of equipment. These figures divide the capital stock between direct use and supporting use. The original accounts of the annual listing of plant assets--land, buildings and structures, general improvement, equipment, and libraries and collections--have been modified and combined in two ways. First, the costs in various years have been made directly comparable by updating the various figures for price increases. Second, the items have been grouped into four accounts: (1) instruction, administration and research capital stock; (2) support capital stock; (3) land; and (4) library. The first category is directly assignable to a particular department, while the latter categories are not directly assignable to a department. The total capital stock, without equipment, has a current (1969) value of $58,508,909. This figure compares favorably with the accounting book value of $50,555,395 as shown in the annual listing of plant assets.[13] Conceptually, this same methodology could be applied to any campus.

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[13]The University of California Office of the Vice President - Business and Finance, "Annual Listing of Plant Assets," 1969. (Computer Run.)

A general note on accuracy seems appropriate here before this data is modified in the next three sections of this chapter. First, the material here and in the remaining sections has been collected from different surveys conducted at differing points in time. The data in the annual listing of plant assets was collected for June 30, 1969, and the rest of the data has been updated or is current to within six months of the above date. This produces an error in the final figure, but we assume that this error is no larger than the errors already made in the assumptions of this section on valuation.

This completes the discussion of the replacement value of capital stock, and the major results are shown in Figure 1 subject to the assumptions and caveats presented in the foregoing paragraph. From this discussion we conclude that an ideal data base should include costs identified with the relevant structure, and price adjusted in a consistent manner. The asset account of the University's accounting system is quite complete. However, the general improvements account and the capital equipments account should be associated with the relevant structures. Price updating is not performed for accounting functions at all, however this is purely a mechanical process once the accounts are uniquely identified and a price index is agreed upon. Essentially, the purpose of this section has been to allocate to specific disciplines that portion of the capital stock directly attributable to disciplinary activity and to allocate to support capital all of the capital stock not directly attributable to institutional activities. These new accounts are stated in dollars of replacement value both for direct comparison purposes and for further developments in the subsequent sections.

## 2. Development of Depreciation, Maintenance and User Costs

The critical aspect of the replacement value is the operational definition and measurement of depreciation. Conceptually, depreciation contains an implied quality standard both in terms of output and in terms of capital stock. Quality of output will be considered constant and will not be discussed further in this report. On the other hand, one measure of the quality of capital stock is the degree of its depreciation. In most general terms, depreciation is the dollar value of the loss in productivity associated with the use and aging of the capital stock. However, for a process as indirect and non-uniform as instruction or research in a university there is no easy method to measure a degradation of productivity. As mentioned earlier, this loss of productivity of capital may be categorized as technical obsolescence, psychological obsolescence, or functional obsolescence. This difficult problem of matching an unknown productivity loss to a dollar value figure is greatly simplified by assuming that the university attempts to maintain the quality of its capital stock at the same level from year to year. The university could accomplish this by investing in the capital stock to counter the technical, psychological, and any applicable portion of functional obsolescence. Hence, the sum of all funds invested in the capital stock subsequent to initial constrictions except explicit capital improvement or ordinary maintenance, would approximate the depreciation of the university's capital stock if the University were able to implement such a policy. The major problems with this simplifying assumption are that it does not account for psychological obsolescence as illustrated by an old building that is well maintained but does not include the advantages of new developments in educational environment; and that the needed funds may not be allocated to implement the policy. This assumption also implies that the change in capital stock is continuous over time.

This assumption is violated when there is a change in stipend from one year to the next and the increase in repairs to mitigate capital depreciation lags significantly.

This section takes the replacement values developed in section 1 and depreciates them to derive depreciated replacement values of the capital stock. Furthermore, the interrelationships of depreciation and maintenance should enable us to develop the institutional costs of capital stock. This analysis may reveal whether the university currently allocates its resources in the same pattern that would result from explicitly recognizing institutional costs.

However, the University of California maintains no records of the maintenance or the repair of any individual part of the capital stock. Totals for entire campuses are known, but entire campus figures are of little value in capital allocations between departments on a campus.[14] It follows from this that the University of California does not know either the depreciation of capital stock or the institutional costs of capital. This is not wholly irrational for a university because the usual business use of depreciating information is to determine the modification of cash income flow and the resultant effect on taxes, which are one item that universities usually do not worry about. Nevertheless, depreciation data and institutional costs must be formulated if a university is to allocate its internal resources efficiently.

To provide this depreciation data, several procedures should be followed by a university administration: (1) divide all capital stock and maintenance expenditures into consistent accounts for maintenance, technical obsolescence, functional obsolescence, and addition to capital; (2) maintain the capital stock at the original quality level so

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[14] University of California, Report on Operations: Financial Schedule 1968-1969, (University of California: Berkeley, 1969), pp. 15-16, 46.

that the basic quality assumption is valid; and (3) disaggregate the above accounts among the campus users. These procedures would provide an ideal data base from which to calculate user costs and all depreciation except psychological obsolescence.

These three criteria are approximately met by the University of California administrative records and procedures and provide the basis for further analysis. The maintenance expenditures can be divided among the appropriate accounts by using the University Operation and Maintenance of the Physical Plant records. Figure 3 is the 1968-69 Operation and Maintenance record for the Berkeley campus and Figure 4 is the 1968-69 Operation and Maintenance record for the Irvine campus, both of which were taken from the 1968-69 Financial Report of the University of California.[15] Figure 4 shows that all the original categories on the Irvine campus can be defined as capital maintenance with the exception of the Town Center Leased Space and Major Repairs and Alterations. The former is rent for space owned by the city of Irvine and used by various University departments. The capital value of this space is prorated to the departments concerned in section 4 of this chapter. The Major Repairs and Alterations section is further subdivided into building, equipment, general improvements and miscellaneous. The further definition of these subsections requires an examination of Exhibit 7 which is a copy of University Business and Finance Bulletin number A-44 entitled, "Capitalization of Expenditures for Capital Additions." The procedures listed in Exhibit 7 define and delineate the differences between repairs to capital and additions to capital. The latter would appear in the capital outlay

[15] Report on Operations: Financial Schedule 1968-1969, op. cit.

FIGURE 3 - CURRENT FUNDS EXPENDITURES BY DEPARTMENT

Berkeley
1968-69

Schedule 1 - C

| | Current Funds | | | Distribution | | |
|---|---|---|---|---|---|---|
| | Total | General | Restricted | Salaries and Wages | Other Expenditures | Less: Transfers |
| OPERATION AND MAINTENANCE OF PHYSICAL PLANT | | | | | | |
| Administration | 305,261 | 305,261 | ------ | 273,337 | 31,924 | ------ |
| Bodega marine laboratory--maintenance | 45,637 | 41,130 | 4,507 | 20,566 | 25,071 | ------ |
| Building Maintenance | 1,469,498 | 1,417,071 | 52,427 | 72,165 | 1,397,333 | ------ |
| Grounds Maintenance | 719,114 | 717,959 | 1,155 | 14,916 | 704,198 | ------ |
| House Maintenance - Chancellor | 4,500 | 4,500 | ------ | ------ | 4,500 | ------ |
| House Maintenance - President | 27,185 | 15,000 | 12,185 | ------ | 27,185 | ------ |
| Janitorial Service | 2,168,846 | 2,168,846 | ------ | 2,201,197 | 137,170 | 169,521 |
| Plant Service | 17,271 | 17,271 | 3,385,184 | 3,385,184 | 1,328,458 | 4,696,371 |
| Police | 965,540 | 965,540 | ------ | 718,677 | 394,457 | 147,594 |
| Refuse Disposal | 171,898 | 171,846 | ------ | ------ | 192,995 | 21,097 |
| Steam | 554,898 | 554,898 | ------ | ------ | 694,501 | 139,603 |
| Utilities | 1,134,854 | 1,133,703 | 1,151 | 14,556 | 1,494,155 | 373,857 |
| White Mountain Research Station -- Maintenance | 41,861 | 41,861 | ------ | 32,079 | 9,782 | ------ |

FIGURE 3 (Continued)

| | Current Funds | | | Distribution | | |
|---|---|---|---|---|---|---|
| | Total | General | Restricted | Salaries and Wages | Other Expenditures | Less: Transfers |
| OPERATION AND MAINTE-NANCE OF PHYSICAL PLANT (Con't) | | | | | | |
| Major Repairs and Alterations -- | | | | | | |
| Buildings and Structures | 243,977 | 222,589 | 21,388 | ------ | 243,977 | ------ |
| Equipment | 2,833 | 2,833 | ------ | ------ | 2,833 | ------ |
| General Improvements | 190,170 | 78,900 | 111,270 | ------ | 190,170 | ------ |
| Miscellaneous | 38,135 | 10,581 | 27,554 | ------ | 38,135 | ------ |
| Staff Benefits | 627,484 | 627,484 | ------ | ------ | 627,484 | ------ |
| TOTAL→ | 8,728,910 | 8,497,273 | 231,637 | 6,732,677 | 7,544,276 | 5,548.043 |

FIGURE 4 - CURRENT FUNDS EXPENDITURES BY DEPARTMENT

IRVINE
1968-69

Schedule 3 - C

| | Current Funds | | | Distribution | | |
|---|---|---|---|---|---|---|
| | Total | General | Restricted | Salaries and Wages | Other Expenditures | Less: Transfers |
| OPERATION AND MAINTENANCE OF PHYSICAL PLANT | | | | | | |
| Administration | 79,232 | 79,232 | ------ | 68,688 | 11,373 | 829 |
| Building Maintenance | 228,790 | 228,790 | ------ | 25,129 | 211,684 | 8,023 |
| Custodial Maintenance | 260,664 | 260,466 | 198 | 72,900 | 221,078 | 33,314 |
| Fire Department | 40,000 | 40,000 | ------ | ------ | 40,000 | ------ |
| Grounds Maintenance | 196,979 | 196,022 | 957 | 191,569 | 62,222 | 56,812 |
| House Maintenance - university | 1,655 | 1,655 | ------ | ------ | 1,655 | ------ |
| Plant Service | 6,642 | 5,866 | 766 | 304,170 | 161,884 | 459,412 |
| Police | 130,122 | 129,221 | 901 | 122,457 | 16,002 | 8,337 |
| Refuse Removal | 32,298 | 32,298 | ------ | ------ | 48,644 | 16,346 |
| Town Center - Leased space | 40,402 | 40,402 | ------ | ------ | 40,402 | ------ |
| Utilities | 333,092 | 333,092 | ------ | 105,349 | 337,979 | 110,236 |
| Major Repairs & Alterations -- | | | | | | |
| Building | 10,030 | 10,030 | ------ | ------ | 10,030 | ------ |
| Equipment | 233 | 233 | ------ | ------ | 233 | ------ |
| General Improvements | 2,108 | 2,108 | ------ | ------ | 2,108 | ------ |
| Miscellaneous | 571 | 531 | 40 | ------ | 571 | ------ |
| Staff Benefits | 77,164 | 77,164 | ------ | ------ | 77,164 | ------ |
| TOTAL→ | 1,439,982 | 1,437,110 | 2,872 | 890,262 | 1,243,029 | 693,309 |

EXHIBIT 6

Number A-44

University of California
Office of the Vice-President--Business and Finance



BUSINESS AND FINANCE BULLETINS

| Effective Date: 6/30/68 | TITLE: CAPITALIZATION OF EXPENDITURES FOR CAPITAL ADDITIONS | University-Wide File References: 235-60-1 |
|---|---|---|
| Authorized by Roy C. Fredrickson | | Local File References |

REFERENCES:

Letter from Controller Kettler to Campus Accounting Officers, dated April 29, 1957, File 235-60-1.

INTRODUCTION

The purpose of this bulletin is to set forth the policy and procedures for the capitalization of expenditures for capital additions charged to current funds. Although similar considerations are involved, capitalization of "capital outlay" projects is not governed by the following procedures.

PROCEDURES

General

The range of expenditures that properly should be treated as capital additions is so varied as to preclude explicit guidelines. Careful judgment is required, and occasionally the distinction between non-capital and capital expenditures is arbitrary. Nevertheless, there are general requirements that decisions to capitalize additions be consistent, that the additions be material, and that the additions benefit future periods. Care should be exercised to avoid materially the overstatement or understatement of plant asset values.

Major Improvements normally occur in capital outlay projects, and are not a topic for this Bulletin.

Improvements or betterments, in the context of this bulletin, to be capitalized are significant alterations or structural changes to plant assets which increase the usefulness, efficiency, or asset life or property, or reduce costs.

Repairs usually refer to normal, regularly recurring disbursements which keep property in an efficient operating condition, neither adding to the value of the property nor appreciably prolonging its life. This type of expenditure should not be capitalized.

EXHIBIT 6 (Continued)



Replacements of component parts of buildings or structures that do not significantly lengthen the life of the entire asset should not be capitalized.

The reconditioning of a newly acquired plant is assumed to be a rehabilitation of the asset for improved operating efficiency, and it is further assumed that the purchase price reflected the poor condition of the asset. Such reconditioning expenses designed to bring the acquisition to a satisfactory operating condition should be capitalized.

Current fund expenditures which are otherwise determined to be of a capital nature will be capitalized when the amount of each job equals or exceeds $5,000. An exception to this rule is the case in which a new building or structure has resulted, and it is necessary to establish the asset on plant records for the first time. In such an exception, the expenditure will be capitalized without regard to the $5,000 minimum stated above.

Accounting

An analysis will be made at the time a requisition or purchase order is issued to determine the nature of the work that is contemplated. When the work is of a capital nature, as defined above, the requisition or purchase order will be assigned an object code 9700, "Expenditures for Facilities to be Capitalized," in the object field. At the end of each fiscal year, a listing of object code 9700 expenditures will be prepared under the Closing Schedule to provide the necessary information for use in the capitalization of such expenditures.

The following financial journal entry is to be made at the end of the fiscal year to capitalize current fund expenditures:

Dr. Individual Asset Accounts
Cr. Invested in Plant

The journals should include adequate descriptive data to support the entries, including information as to the origins of the expenses and sources of funds.

Responsibilities

It is the responsibility of the accounting office to determine those items which constitute capital additions. This determination is to be based on an analysis of expenditures and/or by consultation with the Campus Buildings and Grounds Department or the Campus Physical Planning and Construction Office.

projects and hence would already be counted in the annual listing of plant assets and repairs. Quoting from page 1 of Exhibit 7: "Repairs usually refer to normal, regularly recurring disbursements which keep property in an *efficient operating condition,* neither adding to the value of the property nor appreciably prolonging its life," (italics mine). This definition is a good approximation of the intent of technical obsolescence. Reading between the lines of this and other University instructions indicates that the administration would like and intends to maintain the capital quality standard of the University.[16] This satisfies the second point of the ideal data base. The fact that the account label includes "and alterations" does not appear to match the intent of the present supporting instructions.[17] The category "general improvement" is meant to cover small capital improvement projects which are less than $50,000 in scope and which would not be economical administratively to include in the major capital outlay program. General improvements should be added to the results of section 1 except that they are generally so small as to be negligible when compared to some of the other errors inherent in this data. This discussion has covered all the categories under the first and second points of an ideal data base with the exception of functional obsolescence.

Functional obsolescence appears only in some of the major capital outlay projects. However, major capital outlay projects, especially those titled renovation or conversion, also include significant amounts for technical obsolescence and psychological obsolescence. (South Hall's

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[16]Elmo R. Morgan and E.R. Kettler, "Finance Bulletin Number B-5," (University of California Office of the Vice President - Finance: 1962), p. 3.

[17]State of California, Department of General Services, State Administrative Manual, para. 6220, Rev. 7/66.

renovation is an example of this.) Projects of this nature can be considered from two viewpoints. One viewpoint is that such a project should be strictly construed and the costs should be divided and appropriately charged against depreciation or additions to capital. The other view is that essentially a new structure has been built and the entire cost plus the depreciated value of the old structure should begin as a new asset. The present accounting system procedure of the University of California is simply to add the original book cost to the cost of renovation. On the Irvine campus this is a moot point because the problem is still several years away. However, the recommendation of this study is to follow the second viewpoint because of its simplicity.

The third point of an ideal data base is the disaggregation of the operation and maintenance accounts among the campus users. As shown in both Figures 3 and 4, disaggregation is along functional lines such as utilities, custodial maintenance, etc. There is no further disaggregation on a campus of any of these accounts down to particular buildings let alone down to the departmental level. One reason is that such information has never been requested of the maintenance department. However, there are other practical reasons. The installation of departmental meters of utilities would be quite expensive and burdensome both in initial cost and upkeep. The proration of refuse removal, police and fire protection is also a difficult problem. Because utility and other services are handled in this fashion, a gross projection of the type outlined in section 1 would suffice for the projection of plant operation and maintenance funding.

The result of the lack of disaggregation is that institutional costs and depreciation can be calculated only as a campus wide figure. Further-

more, depreciation must be calculated on a yearly basis and subtracted from the entire capital stock existing that year. In the past, capital has been essentially a "free good" among the users in the campus community and the allocation of capital has proceeded entirely from other considerations. This does not mean that the other considerations are not valid, but only to point out that the cost of the use of capital cost has been essentially neglected.

The University administration is aware of its lack of control in this area and commissioned a management consultant study. The following quotation from the report of that study indicates both the state of maintenance controls and the desires of administrators. "During the conduct of the study it became apparent that some personnel in physical planning administration were desirous of achieving refined sophisticated control prior to implementation of basic control."[18] To further back up this contention, we quote that the "prime purpose and use of these reports is to compare budgeted with actual costs and to determine soon enough if a variance is going to exist so that corrective action can be taken."[19] The recommendations of the Kearny study, if implemented, would eventually supply sufficient data for the administration to determine institutional costs of capital and depreciation using the methodology developed in this report.

For present analyses, aggregated figures will have to suffice. Under the methodology advanced, depreciation equals the sum of the building and miscellaneous portions of the major repairs and alteration section of Figures 3 and 4 for 1968-69. Figure 5 shows depreciation and maintenance

[18]A.T. Kearney & Co., Inc., Report of the Company to R.T. Evans, Acting Vice President - Physical Planning and Construction, (University of California: 1968), pp. I-5.

[19]Ibid., pp. V-1.

FIGURE 5: INSTITUTIONAL COST OF CAPITAL AND DEPRECIATION CALCULATIONS

| IRVINE | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| YEAR | Depreciation | Maintenance | Inst. Cost (1) + (2) | Book Build Value | Updated Bldg. & G'nl. Imp. | % Depreciation (1) + (4) | % Inst. Cost (3) ÷ (5) |
| 1968-69 | $ 10,601 | $2,077,967 | $2,088,568 | $31,377,455[a] | $40,992,652[b] | 0.033% | 5.09% |
| 1967-68 | 13,774 | 1,538,528 | 1,552,352 | | | | |
| 1966-67 | 13,805 | 1,279,835 | 1,293,640 | | | | |
| 1965-66 | 15,906 | 853,383 | 869,289 | | | | |
| 1964-65 | --- | 121,069 | 121,069 | | | | |
| TOTAL | $ 54,086 | | | $31,377,455 | | % Accumulated Depreciation (1) ÷ (4) | |
| | | | | | (5) Book:Bldg.+ G'nl Imp. + Land Value | .131% | |
| BERKELEY | | | | | | | |
| 1968-69 | $282,112 | $13,709,840 | $13,991,952 | $182,788,093 | $218,972,799 | .15% | 6.38% |

[a]Asset ledger, Office of the Vice President, Business and Finance, University of California.

[b]Sum of total support capital stock total and instruction, administration, and research total from Figure 1.

figures for both the Irvine campus and the Berkeley campus. The maintenance figure used for the Irvine campus is the entire maintenance and operation of plant account less the town-center leased space and the major repairs and alterations account. To represent the entire sum, recharges to other university accounts are added back in. The institutional cost data in Figure 5 is the sum of depreciation and maintenance. The percentages in the last column of Figure 5 were calculated to check the reasonableness of the observations.

Mechanically, the total depreciation over the five years should be subtracted from the capital stock value figures from section 1. However, because of their extremely small size, the depreciation figures for the Irvine campus will be neglected. The Berkeley figures for depreciation are presented for comparison. The small size of these figures can be explained by two factors.

The first part of the explanation of the small size of the depreciation figure is the recent construction of the Irvine structures and the lack of a well organized maintenance department in this period of Irvine's rapid growth. The second part of the explanation for the generally low depreciation figures for both the Berkeley and Irvine campuses is any combination of several possible causes. The quality standard of the capital structure may not be maintained either knowingly because of monetary restraints or unknowingly because of poor quality control on the part of maintenance personnel. Another cause might be that repairs to counter technical obsolescence are hidden in other accounts. The most suspect account in this regard is the building maintenance account, where the guidelines to the maintenance personnel are imprecise and inadequate. Acceptance of this explanation would be confirmed by the intuitively

appealing institutional cost figures shown in Figure 5. These are realistic because institutional costs include the total of maintenance and depreciation and thus the actual repairs covering depreciation would have to be included in the institutional costs of capital figures. A related cause in this area would be that the academic departments directly fund the most needed repairs out of current operating funds because of either administrative ease or the difficulty of obtaining University financial support. If building maintenance from Figures 3 and 4 is summed with depreciation the resulting percentage for Irvine is 0.76% and for Berkeley is 0.95%. These figures seem intuitively more reasonable.

The third possible cause for the low depreciation figures on the Irvine campus involves the part that psychological obsolescence plays in total depreciation. If this is true, both depreciation and institutional costs are significantly understated. One way to prove this assertion would be to obtain outside insurance estimates and compare them with the fully depreciated replacement value. If fifty years is a reasonable lifespan for a building, then the straight line depreciation would be two percent per year. Using the data in Figure 5, this would seem to indicate that the psychological obsolescence portion of depreciation is roughly one and one half percent. Unfortunately, without other estimates of the fully depreciated replacement values, it is beyond the scope of this study to proceed further in this direction.

Another possible cause of low figures is the assumption that the structure technically depreciates at a constant value per time period. A different way of viewing this is to examine the assumption behind straight line depreciation. One reasonable prediction is that buildings may depreciate in accordance with Figure 6. This would indicate that the

maximum rate of technical depreciation occurs towards the middle and the end of the lifespan of the structure. This pattern of depreciation would

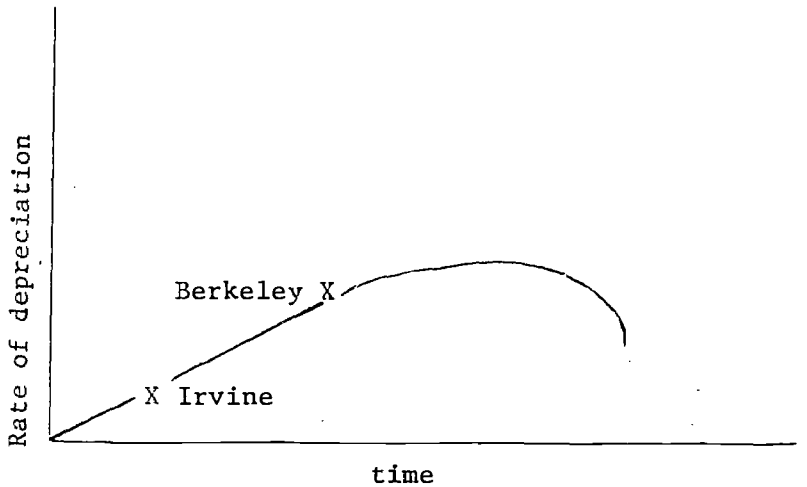


FIGURE 6

explain the low depreciation rates for the Irvine campus. This explanation also supports the low depreciation figure associated with the Berkeley campus. Berkeley has expanded rapidly in recent years, consequently a large proportion of the book value is in structures which are relatively new. Therefore, the addition of all the curves like Figure 6 for each structure on the Berkeley campus may result in a low aggregated depreciation as shown in Figure 6. Acceptance of this explanation would suggest that repairs to Berkeley's capital stock may dramatically increase in the near future. This contention is supported by an examination of the financial reports for the Berkeley campus. Still another cause of the low figures revolves around the accounting for the technical obsolescence portion of functional obsolescence. If this is large and is capitalized in error, then the depreciation figures as calculated here would tend to be relatively low.

In summary, section 2 of Chapter II developed the requirements for an ideal data base which would enable administrators to calculate depreciation and institutional costs. This data base consists of: (1) division of all capital stock and maintenance expenditures into consistent accounts for technical obsolescence and maintenance; (2) University willingness and desire to maintain the quality of the existing capital stock; and (3) accounts not only meeting the requirements of (1) above but also disaggregated to such an extent that costs can be divided fairly among the departments on the basis of use. This data base was then compared to University Administrative records. The comparison indicated that University records basically conform to points (1) and (2). However, point (3) simply does not exist. As a result, the University cannot allocate its capital resources with appropriate consideration given to capital share and to institutional costs of capital. For the purpose of this study, the only available campus wide figures were calculated and shown from the data of Figures 3 and 4 in Figure 5. The calculated depreciation percentages seemed surprisingly small and hence this chapter closed with a discussion of possible reasons why this is true, including:

a) non-maintenance of the quality standard of capital stock;
b) technical obsolescence hidden in other accounts such as building maintenance;
c) departments fund physical repairs out of operating funds out of convenience;
d) a possibly greater role of the unmeasurable psychological obsolescence;
e) portions of depreciation funded out of capital improvement;
f) depreciation patterns that are nonlinear as illustrated in Figure 6.

## 3. Division of the Capital Stock and User Costs Among the Departments

This section presents the methodology for allocating the dollar value of capital stock and institutional costs among the departments of the University. The examples used will be the Irvine campus and the Schools of Business Administration in Barrows Hall on the Berkeley campus. Because of the small size of the depreciation figures derived in section 2, the value of capital stock in Figures 1 and 2 will be assumed to be depreciated replacement values. This introduces an error of the size of depreciation which was calculated to be about one percent. An error of this size seems reasonable in relation to the assumptions inherent in sections 1 and 2. This methodology should be applied to both institutional costs and capital share figures; however, the examples will focus only on share of capital stock considerations because of the inability to disaggregate the institutional cost figures. The allocation of the value of capital stock will provide (to the extent possible in view of problems of jointness of use) three use categories at the departmental level: administrative capital share; instructional capital share; and research capital share. Also, the equipment portion of the capital stock will be distributed to the departments. First, the assumptions necessary to use available data will be presented with sample calculations. Then actual results for the Irvine campus will follow. This section then concludes with remarks on the distribution to the departmental level of classroom capital, general academic capital, indirect support capital, and the data base necessary to optimally carry out this methodology.

The basic assumption of this methodology is that the capital stock and institutional costs of capital allocated to a department are proportional to the amount of space assigned to that department. The space a

department occupies either for instruction, administration, or research is called direct usable capital stock. The support capital stock imputed to a department as its share of the total support capital stock is called indirect capital stock. The problem of allocating indirect support capital will be considered at the end of this section.

The respective shares of direct capital stock can be measured if the depreciated replacement value of the capital stock is known and "ownership" records are kept in sufficient detail. The depreciated replacement value has been discussed previously in this report; the ownership records are maintained by the University administration in the space survey reports.[20] These space survey reports include the type of room, location, assignable square feet (ASF), and departmental responsibility. The additional unassignable space in a structure is not listed, and in this discussion the cost of this space will be considered to be allocated in proportion to the assignable space in the structure. Space is additionally classified as capacity or noncapacity space where capacity space is used for instruction and noncapacity space is assigned to administration or research. Both the nature of the task and the type of records suggest several steps in the disciplinary allocation of capital costs: (1) determine the square foot value of each room of each building; (2) determine the value assignable to departments in accordance with what facilities a department uses; and (3) allocate the cost of the capital equipment used by each department.

The first task is extremely difficult and has never been undertaken by the University administration. As shown in Exhibit 4, formal cost

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[20] The University of California, Office of the Vice President - Physical Planning and Construction, "University of California Types of Rooms, Standard Abbreviations and Definitions of Specific Types of Instructions Codes (Interim Listing)," (Berkeley: 1968). (Mimeographed.)

estimates are developed for the functional trades necessary to build a building, and the cost per ASF for the entire structure is calculated for comparison purposes. However, the percentage of costs attributable to various rooms or types of rooms within a building has never been calculated, largely because no one has ever requested it. Nevertheless, it is obvious that within campus buildings the cost of classrooms differs from that of offices, laboratories, and other space. It is also clear that the mix of costs will vary from building to building with advances in construction techniques and with changes in the quality and type of structure, such as all classrooms or all offices. The solution to this problem is beyond this study; however, for the purposes of this analysis the following simplified weighting scheme is adopted. Classrooms are weighted as 1.0, offices, other small spaces and dry laboratories are weighted 1.2, and wet laboratories are weighted 1.7.[21] These weights are applied to all room types listed in the University of California Types of Rooms[22] and the results are included as Figure 7. In particular, Figure 8 is an example of applying this method of pricing out a structure to Barrows Hall on the Berkeley campus. This same method was used to calculate the weighted ASF for all the structures on the Irvine campus, and the results will be discussed later.

The second step of capital assignment applies the weighted ASF values to the direct capital stock occupied by the departments and further classifies this space into the three use categories of instruction, administration

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[21]These values are judgmental and were chosen to reflect the difference in cost assignable to various types of space in a structure. The following reference was discovered after the calculations and confirms the values in greater detail. Donovan Smith, "Cost Index for Each General Type of Building Space for the Academic Departments of a University," (University of California: Office of Analytical Studies, April 17, 1967).

[22]"U.C. Types of Rooms, Standard Abbreviations and Definitions of Specific Types of Instruction Codes, Interim Listing," op. cit.

FIGURE 7: JUDGMENTAL ASSIGNMENT OF WEIGHTS AND CATEGORIES TO TYPES OF ROOMS[a]

| Room Type # | DESCRIPTION OF ROOM | WEIGHT | USAGE CATEGORY |
|---|---|---|---|
| 110 | Classroom | 1.0 | Instruction |
| 120 | Classroom Service | 1.0 | Administration |
| 130 | Seminar | 1.0 | Instruction |
| 141 | Classroom Lab LD | 1.0 | Instruction |
| 142 | Classroom Lab LD | 1.0 | Instruction |
| 144 | Classroom Lab UD | 1.2 | Instruction |
| 145 | Classroom Lab UD | 1.2 | Instruction |
| 146 | Classroom Lab G | 1.2 | Instruction |
| 150 | Classroom Lab Service | 1.0 | Administration |
| 160 | Clinic | 1.0 | Administration |
| 170 | Language Laboratory | 1.2 | Instruction |
| 182 | Music Studio | 1.2 | Instruction |
| 184 | Music Practice Room | 1.2 | Instruction |
| 212 | Graduate Research Office | 1.2 | Research |
| 214 | Research Lab Office | 1.2 | Research |
| 215 | Graduate Lab Office | 1.2 | Research |
| 220 | Research Lab Service | 1.2 | Research |
| 230 | Animal Quarters | 1.2 | Administration |
| 240 | Greenhouse | 1.0 | Administration |
| 310 | Academic Office | 1.2 | Special |
| 315 | Graduate Office | 1.2 | Instruction |
| 320 | Other Office | 1.2 | Administration |
| 330 | Office Service | 1.2 | Administration |
| 340 | Conference | 1.0 | Instruction |
| 410 | Study Hall | 1.0 | Instruction |
| 420 | Carrel | 1.0 | Instruction |

FIGURE 7 (Continued)

| Room Type # | DESCRIPTION OF ROOM | WEIGHT | USAGE CATEGORY |
|---|---|---|---|
| 430 | Open Stack | 1.0 | Instruction |
| 440 | Stack | 1.0 | Administration |
| 450 | Library Service | 1.2 | Instruction |
| 460 | Museum | 1.2 | Administration |
| 510 | Auditorium | 1.7 | Administration |
| 520 | Gymnasium | 1.7 | Administration |
| 530 | Armory | 1.2 | Administration |
| 610 | Food Facility | 1.2 | Administration |
| 612 | Food P&S | 1.7 | Administration |
| 614 | Dining Room | 1.2 | Administration |
| 616 | Kitchenette | 1.7 | Administration |
| 618 | Vending | 1.2 | Administration |
| 620 | Health Service | 1.7 | Administration |
| 630 | Commons | 1.2 | Administration |
| 632 | Recreation | 1.2 | Administration |
| 640 | Merch Service | 1.2 | Administration |
| 650 | Locker | 1.0 | Administration |
| 662 | Audio-Visual General | 1.2 | Administration |
| 664 | Audio-Visual TV | 1.7 | Administration |
| 620 | EDP- Computer | 1.2 | Administration |
| 710 | Shop | 1.2 | Administration |
| 720 | Storage | 1.0 | Administration |
| 730 | Field Building | 1.0 | Administration |
| 740 | Miscellaneous | | Administration |

FIGURE 8: BARROWS HALL, ASSET #1761, BERKELEY CAMPUS

| WEIGHT | ROOM TYPE NUMBER | TOTAL ASF IN THIS ROOM TYPE (SPACE SURVEY) | |
|---|---|---|---|
| | | 1.0 | 1.2 |
| 1.0 | 110 | 7509 | |
| 1.0 | 130 | 2581 | |
| 1.0 | 142 | 2828 | |
| 1.2 | 144 | | 5691 |
| 1.2 | 146 | | 1755 |
| 1.0 | 150 | 2374 | |
| 1.2 | 212 | | 7011 |
| 1.2 | 214 | | 577 |
| 1.2 | 220 | | 892 |
| 1.2 | 310 | | 43514 |
| 1.2 | 315 | | 444 |
| 1.2 | 320 | | 16438 |
| 1.2 | 330 | | 2570 |
| 1.0 | 340 | 3354 | |
| 1.0 | 410 | 400 | |
| 1.2 | 610 | | 162 |
| 1.2 | 630 | | 6686 |
| 1.0 | 650 | 225 | |
| 1.2 | 662 | | 945 |
| 1.0 | 720 | 1760 | |
| | | 21231 | 86685 |

Bldg. Cost According to Figure 2 = $5,728,718

Cost Per ASF 1.0 => $\frac{\$5,728,718}{125253}$ = $45.74

1.2 => 1.2 X 45.74 = $54.88

TOTAL WEIGHTED ASF = 21231 X 1.0 + 86685 X 1.2

= 21231 + 104022

= 125253

and research. An examination of "University of California Types of Rooms" showed that the space can be easily divided into one of the three use categories with support rooms such as classroom service rooms and kitchenettes assigned to the administrative category.[23] The results of this assignment are included in the right column of Figure 7. The room type 310--Academic Office requires special attention because this category "generally includes all offices of instructional departments and research organizations, except the office space of chairman (dean or director) and his administrative and other nonacademic staff."[24] While this definition excludes purely administrative offices, some research space is still included and faculty members divide their time among all three use categories. However, the University of California "Faculty Effort and Output Study" observed that in total, the faculty divide their time inputs approximately 50% to instruction, 32% to research, and 18% to administration.[25] (The same study showed, however, a significant amount of jointness of faculty outputs; approximately 70% of faculty time was spent in activities which constituted singly or jointly to instruction. This illustrates some of the hazards of making an allocation of space to mutually exclusive categories.) Although this differs from discipline to discipline and campus to campus, the aggregate percentages were used to prorate academic office space and costs among the three use categories because the disaggregated data was unavailable. Full time research is ignored both because it is included in a separate category of research office, and because there is no other information to illuminate the matter.

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[23] "U.C. Types of Rooms, Standard Abbreviations and Definitions of Specific Types of Instructions Codes, Interim Listing," op. cit.

[24] Ibid.

[25] The University of California, Office of the President, "Faculty Effort and Output Study," (Berkeley: 1970), p. 11 (Mimeographed.)

Clearly, the validity of this methodology depends upon the accuracy of the space survey, upon departmental interpretations of the room descriptions, and upon the results of the faculty time study. For the purposes of this study, these instruments are assumed accurate and the capital stock is allocated to the departments. Figure 9 shows this methodology applied to the School of Business Administration in Barrows Hall on the Berkeley campus. The Business School is a good example since it is contained entirely in one building. Figure 9 shows the large amount of departmental space used as academic offices, and hence the importance of accurately knowing the proper allocation of staff time. One caveat is that the Business School is different in that the department is administratively assigned the classrooms it utilizes whereas classrooms are usually assigned to a General Academic pool and are scheduled by the campus administration each term. However, this difference does not affect the sample calculations.

The task of prorating the capital equipment within a department into the three use categories is currently difficult. As explained in section 1, an index of updated equipment records is maintained by the University with detail down to the department level.[26] The resulting problem is how to divide the departmental total among the use categories. The equipment was prorated in accordance with the fraction of capital stock in each usage category because the use categories reflect the space occupied and, through the weighting, the complexity of that space. Figure 10 shows the results of this calculation for the School of Business Administration in Barrows Hall. The equipment information is based on fall 1968 records and hence is over six months out of date. Because this bias would affect all departments in the Irvine campus example approximately equally, this six months

[26] The University of California, Equipment Cost Per Assignable Square Foot in University Departments, (The University of California Office of the Vice President - Physical Planning and Construction, Berkeley: 1970).

FIGURE 9: SCHOOL OF BUSINESS ADMINISTRATION, ALLOCATION OF BARROWS HALL, BERKELEY CAMPUS

| Room Type Number | Weight | Use Category | Business School ASF (Space Survey) | | Value |
|---|---|---|---|---|---|
| 142 | 1.0 | I = Instruction | 2828 X $45.74[a] = | | $128,986.80 |
| 144 | 1.2 | I | 3405 X $54.88[a] = | | 186,866.40 |
| 146 | 1.2 | I | 1755 | | 96,314.40 |
| 150 | 1.0 | A = Administration | 1154 | | 52,783.96 |
| 212 | 1.2 | R = Research | 2652 | | 145,541.76 |
| 214 | 1.2 | R | 577 | | 31,541.76 |
| 220 | 1.2 | R | 162 | | 8,665.76 |
| 310 | 1.2 | I .5 | (17222) | 8611 | 472,571.68 |
| | 1.2 | R .32 | | 5511 | 302,443.68 |
| | 1.2 | A .18 | | 3100 | 170,128.00 |
| 315 | 1.2 | I | 444 | | 24,366.72 |
| 320 | 1.2 | A | 6380 | | 350,134.84 |
| 330 | 1.2 | A | 968 | | 53,123.84 |
| 340 | 1.0 | A | 640 | | 29,273.60 |
| 410 | 1.0 | I | 400 | | 18,296.00 |
| 610 | 1.2 | A | 162 | | 8,890.56 |
| 630 | 1.2 | A | 4901 | | 268,966.88 |
| 662 | 1.2 | A | 945 | | 51,861.60 |
| 710 | 1.0 | A | 997 | | 45,602.78 |
| | | | 45,592 | | 2,446,709.38 |

TOTAL I = $ 927,402.00

TOTAL R = $ 488,541.76

TOTAL A = $1,030,765.62

Percentage of value of Barrows Hall used by School of Business Administration = $\frac{2,446,709}{5,728,718} = .427$

[a]Values of 1.0 Space and 1.2 Space, respectively, from Figure 8.

Figure 10: DIVISION OF EQUIPMENT IN SCHOOL OF BUSINESS ADMINISTRATION, BARROWS HALL, BERKELEY

| | | | | |
|---|---|---|---|---|
| I | $\frac{927,402.00}{2,446,709.38}$ X 467,470[a] = | 177,184 | 177,184 + 927,402 = | 1,104,586 |
| R | $\frac{388,541.76}{2,446,709.38}$ X 467,470 = | 93,361 | 93,361 + 388,541 = | 481,902 |
| A | $\frac{1,030,765.62}{2,446,709.38}$ X 467,470 = | 196,925 | 196,925 + 1,030,765 = | 1,227,690 |
| | | 467,470 | | 2,814,178 |

TOTAL INSTRUCTIONAL CAPITAL = 1,104,586

TOTAL RESEARCH CAPITAL 481,902

TOTAL ADMINISTRATIVE CAPITAL = 1,227,690

TOTAL DEPARTMENTAL CAPITAL STOCK = 2,814,178

[a] $ of equipment assigned to the School of Business Administration

Note: The allocation between "instructional capital" and "research capital" was based on the average percentage distribution of faculty time inputs, ignoring jointness of outputs.

lag behind the rest of the data was ignored. A more serious problem is that the equipment records for the Irvine campus are not complete. Where the department totals are missing, the equipment dollar per ASF for the University as a whole was used along with the ASF assigned to that department. A comparison of both actual departmental equipment capital totals (where they exist) and projected equipment capital amounts based on University averages indicates an error of at most 10%. Most departments where the figures do not exist are relatively small, hence the implications of this assumption appear to be minor.

This completes the methodology of dividing the direct capital stock among the departments in the use categories. The results of the costing out of the buildings on the Irvine campus is shown in Figure 11. The Space Survey number AE080-82 for fall 1969 was used along with Figures 1 and 7. Values have been rounded off to the nearest dollar for convenience. The town center figure is a rental amount, and hence it will be kept separate (for the time being). The large variation in capital value per ASF between different buildings is a good argument for more accurately determining the actual cost of room types within the various structures. The weighting scheme used here provides a rough but practical approximation.

The capital value per ASF shown on Figure 11 was combined with Figure 7 and Space Survey AD 080-1R2 of fall 1969 to determine the use category allocations and the results are shown in Figure 12. Several problems were encountered in this proration. Like the Business School in Berkeley, the Irvine Biological Sciences department administratively controls a number of classrooms. To make the departments comparable, these classrooms were not included directly with the departmental capital stock but were included in the classroom fraction figure. The classrooms for the rest of the campus are in the general academic category, and the allocation of the classroom

FIGURE 11: COSTING OF THE INSTRUCTIONAL-RESEARCH BUILDINGS

ON THE IRVINE CAMPUS

| BUILDING | ASSET # | COST FROM FIG. 2 | WEIGHT | VALUE/ASF |
|---|---|---|---|---|
| Library #1 | #9001 | $ 2,480,540 | 1.0 | $20 |
| | | | 1.2 | $24 |
| Humanities & | #9025 | 3,754,825 | 1.0 | $56 |
| Social Sciences, | #9030 | | 1.2 | $67 |
| Fine Arts | | | | |
| Greenhouse #1 | #9026 | 226,114 | 1.0 | $29 |
| | | | 1.2 | $35 |
| Greenhouse Minor | #9078 | 35,335 | 1.0 | $11 |
| Bio. Sciences | #9075 | 5,052,246 | 1.0 | $48 |
| Sci. Lec. Hall | #9078 | | 1.2 | $57 |
| | | | 1.7 | $81 |
| Physical Sci. #1 | #9100 | 7,901,748 | 1.0 | $61 |
| | | | 1.2 | $74 |
| | | | 1.7 | $104 |
| Interim Office | #9225 | 180,360 | 1.0 | $21 |
| | | | 1.2 | $25 |
| Fac. Res. Facil. | #9226 | 288,982 | 1.2 | $26 |
| | | | 1.7 | $37 |
| Crawford Hall | #9300 | 2,408,652 | 1.0 | $35 |
| | | | 1.2 | $42 |
| | | | 1.7 | $59 |
| | | TOTAL→ $22,328,302 | | |
| Town Center Rental (1867-1969) | #9999 | $ 40,402 | 1.2 | $ 5 |

FIGURE 12: ALLOCATION OF CAPITAL IN INSTRUCTION/RESEARCH STRUCTURES TO DEPARTMENTS ON THE IRVINE CAMPUS

| | (1) General Academic (Classrooms) | (2) Bio. Sciences | (3) Chemistry | (4) Physics | (5) Math | (6) Eng. Sciences | (7) Phy. Sciences |
|---|---|---|---|---|---|---|---|
| Total ASF | | 80949 | 38050 | 31142 | 14655 | 8332 | 11714 |
| Support | | 721438* | 347236 | 344797 | 288539 | 5994[TC] | 630286 |
| Equipment | | 299187 | 79562 | 54187 | 37062 | | 182504 |
| Total Support | | 1020625 | 426798 | 398984 | 325601 | | 812790 |
| Instruction | | 450073 | 354523 | 260543 | 179450 | 4552[TC] | 93113 |
| Lower Division (LD) | | 64800 | 204388 | 199282 | 159618 | | |
| Upper Division (UD) | | 98010 | 261812 | 159174 | 97680 | | |
| Graduate (G) | | 39042 | | | | | |
| Equipment | | 270370 | 187586 | 97785 | 56187 | | 26942 |
| Total Instruction | | 922294 | 1008309 | 716784 | 492935 | | 120055 |
| Research | | 1930402 | 1296060 | 2527144 | 110384 | 102194 | 62661 |
| Graduate (G) | | 119989 | 69856 | 222740 | 189292 | 16509[TC] | |
| '220' (See text) | | 38931 | 287490 | 218966 | | 1440[T] | 22422 |
| Equipment | | 866478 | 379054 | 469621 | 38513 | | 24599 |
| Total Research | | 2955800 | 2032460 | 3438471 | 338189 | | 109682 |
| Total Equipment | 1920[T] | 1618980 | 646850 | 622840 | 131895 | | 234280** |
| TOTAL | 1703805 | 4898719 | 3467567 | 4554239 | 1156725 | | 1042527 |
| Total $/ASF | | 60.5 | 91.1 | 146.2 | 78.9 | | 88.9 |
| Research % | | 60.3 | 58.6 | 75.5 | 29.2 | | 10.5 |
| Allocation of General Academic (1) among Depts. | | | | | | | |
| Weekly Classroom Hours (WCH) | | 20 | 13 | 14 | 96 | 90 | |
| Classroom Fraction | | 754459 ** | 20433 | 22008 | 150890 | 141460 | |

FIGURE 12 (Continued)

| | (8) Social Science | (9) Social Science Psychology | (10) Social Science Anthropology | (11) Social Science Geography | (12) Social Science Comp. Cult. | (13) Social Science History |
|---|---|---|---|---|---|---|
| Total ASF | 6487 | 8446 | 952 | 550 | 1190 | 2712 |
| Support | 153867 | 30451 | 8949 | 5186 | 9156 | 60996 |
| Equipment | 22938 | 6689 | 466 | 624 | 2665 | 5342 |
| Total Support | 176805 | 37140 | 9415 | 5809 | 11821 | 66338 |
| Instruction | 62980 | 162437 | 24857 | 14405 | 11832 | 57017 |
| LD | | 44756 | | | | |
| UD | | 80080 | | | | |
| G | 840[T] | 120[T] | | 120[T] | | 360[T] |
| Equipment | 9341 | 63547 | 1296 | 1732 | 3448 | 5003 |
| Total Instruction | 72321 | 350820 | 26153 | 16137 | 15280 | 62020 |
| Research | 87073 | 47415 | 29978 | 9219 | 7572 | 36491 |
| G | 44086 | 9925 | | | | |
| '220' | 240[T] | 83013 | | | | |
| Equipment | 19513 | 31013 | 1562 | 1105 | 2207 | 3200 |
| Total Research | 150670 | 171366 | 31540 | 10324 | 9779 | 39691 |
| Total Equipment | 51896 | 101352 | 3332 | 3465 | 8330 | 13560 |
| TOTAL | 399797 | 559326 | 67108 | 32270 | 36880 | 168049 |
| Total $/ASF | 61.6 | 66.2 | 70.5 | 58.7 | 30.9 | 61.9 |
| Research % | 37.7 | 30.6 | 47.0 | 32.0 | 26.5 | 23.6 |
| Allocation of (1) among Depts. | | | | | | |
| WCH | 83 | 12 | 3 | 9 | | 68 |
| Classroom Fraction | 130456 | 18861 | 4715 | 14145 | | 106880 |

FIGURE 12 (Continued)

| | (14) Humanities | (15) Philosophy | (16) Classics | (17) English | (18) French - Italian | (19) Span - Port. | (20) German-Russian |
|---|---|---|---|---|---|---|---|
| Total ASF | 2465 | 2857 | 946 | 4471 | 1854 | 1644 | 1288 |
| Support | 105056 | 107234 | 9769 | 77401 | 19060 | 41178 | 12639 |
| Equipment | 11595 | 6120 | 954 | 5597 | 2595 | 4861 | 1298 |
| Total Support | 116651 | 113444 | 10723 | 82998 | 21655 | 46039 | 13937 |
| Instruction | 9313 | 41475 | 27135 | 103272 | 34706 | 22445 | 35108 |
| LD | | | | | | | |
| UD | 35840 | | | | | | |
| G | | 240[T] | | 840[T] | 720[T] | 480[T] | 120[T] |
| Equipment | 4986 | 2360 | 2649 | 7475 | 4734 | 2642 | 3696 |
| Total Instruction | 50139 | 43835 | 29784 | 110747 | 39440 | 25087 | 38714 |
| Research | 5960 | 26542 | 17366 | 66094 | 22212 | 14365 | 22469 |
| G | | | | | | | 120[T] |
| '220' | | | | | | | |
| Equipment | 656 | 1510 | 1690 | 4775 | 3032 | 1694 | 2301 |
| Total Research | 6616 | 28052 | 19056 | 70869 | 25243 | 16059 | 24770 |
| Total Equipment | 17255* | 10000 | 5298 | 17884 | 10382 | 9206 | 7213 |
| TOTAL | 173406 | 185341 | 59563 | 264614 | 86338 | 87184 | 77421 |
| Total $/ASF | 70.4 | 64.9 | 62.9 | 59.2 | 46.6 | 53.0 | 60.1 |
| Research % | 3.8 | 15.1 | 32.0 | 26.8 | 29.2 | 18.4 | 32.0 |
| Allocation of General Academic (1) among Depts. | | | | | | | |
| WCH | | 38 | | 204 | | 306 | |
| Classroom Fraction | | 59727 | | 320642 | | 480693 | |

FIGURE 12 (Continued)

| | (21) Info-Comm. | (22) Fine Arts | (23) Art | (24) Music | (25) Drama | (26) Dance |
|---|---|---|---|---|---|---|
| Total ASF | | 1615 | 8798 | 2445 | 1890 | 2810 |
| Support | 600[T] | 108205 | 260502 | 7405 | 34100 | 159031 |
| Equipment | | | 16469 | 1485 | 3095 | 18725 |
| Total Support | | | 276971 | 8890 | 37195 | 177756 |
| Instruction | 1560[T] | | 71455 | 20569 | 27637 | 4824 |
| LD | | | 32981 | | | |
| UD | | | 118810 | 122677 | 45225 | |
| G | | | | | | |
| Equipment | | | 14125 | 28848 | 6622 | 550 |
| Total Instruction | | | 227371 | 172094 | 79484 | 5374 |
| Research | | | 16509 | 13164 | 17688 | 3087 |
| G | 240[T] | | | | | |
| '220' | | | | | | |
| Equipment | | | 1045 | 2640 | 1599 | 350 |
| Total Research | | | 17554 | 15804 | 19287 | 3441 |
| Total Equipment | | 11305* | 31672 | 33007 | 11340 | 19670* |
| TOTAL | | 119510 | 531896 | 196788 | 135966 | 186571 |
| Total S/ASF | | 74.0 | 60.5 | 80.5 | 71.9 | 66.4 |
| Research % | | | 3.3 | 8.0 | 14.2 | 1.8 |
| Allocation of General Academic (1) among Depts. | | | | | | |
| WCH | | | 23 | 61 | 9 | 8 |
| Classroom Fraction | | | 36150 | 95878 | 14145 | 12574 |

FIGURE 12 (Continued)

| | (27)[a] Physical Education | (28)[a] Library | (29)[a] Administration | (30)[a] Computer Center |
|---|---|---|---|---|
| Support Capital | 1914131 | 1900004 | 1691082 | 335810 |
| Equipment | 107184 | 365295 | 1006055 | 105121 |
| TOTAL | 2021315 | 2265299 | 2697137 | 460931 |
| ASF | 44660 | 86975 | 98053 | 9821 |
| TOTAL $/ASF | 45.3 | 26.0 | 27.5 | 46.9 |

T = Trailer Space in square feet

TC = Town Center Rental Cost in $

a = Support Capital and Equipment located in Instructional and Research Buildings

capital stock is discussed at the end of this section. Specific classroom laboratories are included under instruction in either lower division (LD), upper division (UD) or graduate (G). These categories are *not* hard and fast because by definition in the "University of California Types of Rooms," a classroom laboratory room is counted in the highest category of use. Laboratories exist in only a few departments and proportionately increase the requirement for capital stock in those departments. In addition, Figure 12 includes administrative and other support capital such as classrooms, libraries, physical education, and the computer center that co-exist in structures which contain academic departments. While these amounts are significantly large, they will be handled as indirect capital support except for classroom capital stock. The town center and trailer figures are marked respectively TC and T and are not included in the totals because the same costing and updating procedures are inappropriate. This will bias the capital stock value of a few of the smaller departments.

Another problem which reflects on the accuracy of the space survey is room type 220, which are research lab and service facilities including: "All rooms supporting or providing service to research laboratories, such as dark rooms, controlled-environment storage rooms, sterilizer rooms, supply and equipment issue rooms, separate mechanical rooms serving special labs only, etc. Note: Includes dressing rooms, locker rooms, washrooms, and showers related to research labs, also IBM rooms. Stations to be reported: none."[27] One interpretation of this definition is that these are not work spaces in the usual sense. However, the space survey indicates that in practice a number of academic personnel and even more graduate and support personnel are assigned to work in these areas. This type of situation introduces an unknown bias in

[27]"U.C. Types of Rooms, Standard Abbreviations and Definitions of Specific Types of Instruction Codes (Interim Listing)," op. cit.

the departmental capital share figures presented here.

While the preceding paragraphs have discussed some of the problems involved in reducing the data, it also seems appropriate to point out a few of the notable characteristics of the departmental level shares of capital stock in Figure 12. The most notable attribute is the heavy emphasis placed on the physical sciences. The social sciences, languages and arts are either not yet developed or not emphasized to the same degree as the physical sciences. Research as a percentage of total capital share shows that the larger hard science departments exhibit a proportionately larger share of their capital devoted to research. On the other hand, the arts have very little of their capital devoted to research consistent with the esoteric nature of that discipline.

Each department has its own subtle characteristics resulting both from inherent discipline differences and from the personality of the present departmental decision makers. The biological sciences capital share per ASF is lowest of the hard sciences because of the large amount of relatively cheap greenhouse space. There are numerous other locations on campus devoted to campus administration and the other University support activities and the administrative capital figure is only part of the campus administration occupying these buildings. Note that the assignable space devoted to graduate work is relatively small, possibly because graduate students are supported by other research facilities. However, the space studies indicate that only the limited space reported is dedicated to graduate use. This again illustrates the importance of accurate space inventories. Another possible explanation is that graduate students in the languages and social sciences, except psychology, inherently require less direct capital support than in the hard sciences. Often library work space may be all they need. If the amount of capital stock devoted to departmental administration seems

surprisingly large, it should be remembered that this category is also the repository for all miscellaneous space.

We now continue with the problems of distributing the classroom capital, library capital, and indirect support capital to the departmental level. One distributional methodology for classrooms is to allocate capital in relation to departmental utilization. This would involve knowing the capital value of each classroom and its use by departments. While the capital value of each classroom is not available, the total capital value of all classrooms is expressed in column 1 of Figure 12. Departmental use records at the University Administrative level do exist but are either very aggregated or very detailed. In the detailed case the necessary data reduction would require an extensive computer program. In addition, it seems unrepresentative to allocate capital share on the basis of one quarter's scheduling. Consequently, classroom allocation is assigned to the departmental level on the basis of that department's fraction of total weekly classroom hours (WCH) in the non-laboratory categories.[28] This technique prejudices the department that is normally scheduled in the less expensive or more psychologically obsolete structure or normally teaches only small classes in small rooms The WCH fraction as calculated from total weekly classroom hours for fall 1968 and the implied fraction of the general academic total is included in Figure 12.[29] The results of Figure 12 seem reasonable because the hard sciences' share is small and they utilize laboratories which are controlled by the department. In contrast, the English and foreign language departments require a large share of total weekly classroom hours and these disciplines logically involve

[28] The University of California Office of the Vice President - Planning & Analysis, "Total Weekly Room Hours," (Berkeley: Fall 1968). (Computer Run.)

[29] Mr. Donovan Smith, Physical Planning Specialist, Office of the Vice President - Planning & Analysis, indicated that these WCH fractions are relatively stable over a year.

the most actual time in classrooms.

The problem of allocating library capital to the departments is a similar situation as the allocation of classroom capital stock, only in this case the available information is aggregated on a University-wide basis. There is a split of research and instruction, but it is developed from head count figures modified by a University-wide weighting factor.[30] This weighting factor is applied equally to all departments; as a consequence, the data currently does not distinguish different departmental use whereas allocating capital stock and institutional costs is a prime consideration in this study. Therefore, library capital is not allocated to departments because an adequate data base does not exist.

The final distributional question to be considered is the allocation of support capital. A special problem at Irvine with the land and some of the administrative support services is the physical existence of the Health Sciences School on the same campus. Logically, the allocation of support capital stock should consider the entire campus community. Another problem is that many support activities such as physical education, recreational facilities, and residential housing are utilized only by a particular segment of the student body, staff, or research personnel. In keeping with the spirit of this study we should attempt to allocate the capital stock and institutional costs directly to the user segments of the campus communities. However, the user segments for these facilities do not correspond to the various academic departments.

The most meaningful way to allocate capital stock and institutional

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[30] The University of California Office of the Vice President - Business and Finance, "Explanation of the Computation of Libraries Expense, Component of the 1967-68 Indirect Cost Rate Calculations," (University of California Rate Proposal Presented to the United States Government: 1969), pp. 1 - 4.

costs is to charge the users directly. This philosophy has been partially carried out in some capital support areas such as parking and residential housing. Conceptually, if all support capital were charged to the users, the remainder would be land and miscellaneous administrative services which could be allocated to the entire student body, staff and research personnel on the basis of head count. Of course this concept could be carried out to absurdity if the users were charged for parks, grass or the student union where turnstiles could be installed. The delineation of the point of absurdity and the separation of the services that should be individually charged is largely a matter of philosophy and convenience and is beyond the scope of this report. For these reasons, no attempt is made to distribute the support capital stock to departmental level. User charges would work to allocate University support services if decisions were made concerning whom to charge and how much.

The concluding and summarizing remarks to this section are concerned with the ideal data base necessary to fully allocate capital costs to the department level. When buildings are constructed, costs should be associated with the individual subunits in the structure. Space survey definitions should be strengthened to assist dividing departments into instructional, administrative and research use categories. Also faculty output studies should be expanded to determine differences by discipline in the temporal division of academic staff offices. If the room costs and the "ownership" are known, it is relatively easy to allocate capital costs to the departments in the manner described in this report. Equipment capital would also be easy to distribute provided the "ownership" and location were known. Classrooms, libraries and support capital all are variations on the same general problem: what to charge to the departments as direct support of

their activities and what to charge the university population. In these areas there is a dearth of information as to the actual users of capital and the amount of capital they use. This is because traditionally all of these have been considered free services to any person within the campus community. If these services are to continue to be considered this way, the only fair allocation would be uniformly to the entire campus community. In other words, divide the total support capital by the sum of the people involved.

4. Allocation of the Departmental Shares to the Measures of Departmental Output, the FTEP and FTER

The basic objectives of this last section are to develop the full time equivalent student instruction load (FTESIL) and the full time equivalent researcher (FTER) in the academic departments. To begin with, the results of Figure 12 are consolidated into a program budget format.[31] Figure 13 is a listing of the relevant program budget categories for the Irvine campus along with the Irvine departments assigned to each category. Figure 14 is the same data of Figure 12 presented in a program budget format. Several arbitrary decisions had to be made in this consolidation which prevent the detailed analysis of each department. The information-communication department has been combined with the computer center because of its small size. The trailer space has arbitrarily been assigned a capital value of $10 per square foot. The town center rental figure has been arbitrarily multiplied by a factor of ten to indicate a complete capital payoff to the town at the end of ten years. The psychology department has been combined with the social

[31] The University of California Office of the Vice President - Planning & Analysis, "Program Budget Structure of the University of California," (Berkeley: 1969). (Mimeographed.)

FIGURE 13: LISTING OF PROGRAM BUDGET CATEGORIES RELEVANT TO THE IRVINE CAMPUS

| PROGRAM BUDGET | IRVINE DEPARTMENTS INCLUDED |
|---|---|
| (1) Biological Sciences | Biological Sciences |
| (2) Mathematical Sciences | Math |
| (3) Physical Sciences | Chemistry |
| | Physics |
| | Physical Sciences |
| (4) Engineering Sciences | Engineering Sciences |
| (5) Psychology | Psychology |
| (6) Social Sciences | Social Science |
| | Anthropology |
| | Geography |
| | Comparative Literature |
| | History |
| (7) Arts | Art |
| | Dance |
| | Drama |
| | Music |
| | Fine Arts |
| (8) Letters | Classics |
| | English |
| | French & Italian |
| | Spanish and Portuguese |
| | German and Russian |
| | Philosophy |
| | Humanities |

FIGURE 14: CONSOLIDATED DEPARTMENTAL SHARES OF CAPITAL STOCK ALONG PROGRAM BUDGET LINES



| | (1) Biological Sciences | (2) Math. Sciences | (3) Physical Sciences | (4) Eng. Sciences | (5) Psychology & Soc. Sci. | (6) Arts | (7) Letters |
|---|---|---|---|---|---|---|---|
| Total ASF | 80949 | 14655 | 80906 | 8332 | 20337 | 17558 | 15525 |
| Total Support Capital (Administrative)($) | $1020625 | 325601 | 1638572 | 78268 | 307328 | 609017 | 405447 |
| Instruction $ | 450073 | 179450 | 708179 | 45520 | 333528 | 124485 | 273454 |
| LD $ | 106866 | 159618 | 403670 | | 44756* | 32981 | |
| UD $ | 378189 | 97680 | 420986 | | 81280* | 286712 | 35840 |
| G $ | 157821 | | | | 13200 | | 24000 |
| Equipment $ | 270370 | 56187 | 312313 | 13924 | 84367 | 50145 | 28452 |
| Total Instruction $ | 1363319 | 492935 | 1845148 | 59444 | 567931 | 494323 | 367146 |
| Research $ | 1920702 | 110384 | 3885685 | 102194 | 217748 | 50448 | 175008 |
| G $ | 119989 | 189292 | 292596 | 165090 | 56411 | | 1200 |
| '220' $ | 38931 | | 528878 | 14400 | 83013 | | |
| Equipment $ | 866478 | 38513 | 873274 | 86521 | 58600 | 5634 | 15658 |
| Total Research $ | 2955800 | 338189 | 5580613 | 368205 | 415722 | 56082 | 191866 |
| TOTAL $ | 5339743 | 1156725 | 9064333 | 505917 | 1280231 | 1159422 | 959059 |
| Total $/ASF | 66.0 | 78.9 | 112.0 | 60.7 | 63.0 | 66.0 | 61.8 |
| % of Total (Col 1 →7) | 27.4% | 5.9% | 26.5% | 2.5% | 6.5% | 5.9% | 4.9% |
| WCH | 20 | 96 | 27 | 55 | 175 | 101 | 548 |
| Gen. Academic Fraction $ | 31435 | 150890 | 42441 | 86448 | 275057 | 158747 | 861332 |
| % of Total | | | | 67.9 | | | |

FIGURE 14 (Continued)

| | (8) Physical Education | (9) Library | (10) Administration | (11) Computer Center | (12) General Academic (Classrooms) |
|---|---|---|---|---|---|
| Total ASF | 44660 | 86975 | 98053 | 9821 | |
| Total Support Capital (Administrative) | 2021315 | 2265299 | 2697137 | 460931 | 1723005 |
| Total/ASF | 45.3 | 26.0 | 27.5 | 46.9 | |
| % of Total | 7.0% | 7.9% | 9.4% | 1.6% | 6.0% |

sciences department because the payroll data necessary to develop the FTER are aggregated in this manner. It should be remembered that the capital stock in Figure 14 does *not* include the land value, support capital stock or the library collection as shown on Figure 1. Expressed here is the capital share directly utilized by each department.

The full-time equivalent student instructional load (FTESIL) is an indicator of the output of an instructional program as contained in the program budget. The FTESIL is developed in terms of a full-time workload in a single program category. Each student is assumed to receive equivalent and equal instruction.

Figure 15 lists the fall 1969 Irvine enrollment[32] and the fall 1968 induced course matrix[33] for the Irvine campus. The induced course matrix as shown here presents the percent of his total credit hours that a student of a particular major and level takes in all instructional programs. For example, students majoring in lower division biological sciences earned 2.5% of their total credit hours in the biological sciences, 16.5% in the mathematical sciences, 32.4% in the physical sciences, and so forth horizontally across the matrix. Unfortunately the fall 1969 induced course matrix was unavailable; this necessitates the assumption that over the one year period the induced course matrix was stable, which may not be valid for a rapidly evolving campus like Irvine. A second and less critical assumption is that student credit hours across the program categories are equivalent; that is, a credit hour of English is worth the same as a credit hour of chemistry. The effect of this assumption is that the addition-

[32]The University of California, Statistical Summary: Students and Faculty, Fall 1969, (Officeof the Vice President - Planning & Analysis: Berkeley, 1970).

[33]The University of California Office of the Vice President - Planning & Analysis, "Induced Course Load Matrix Program, Fall 1968,". (Computer Run.)

FIGURE 15: INDUCED COURSE LOAD MATRIX - FALL 1968

| Instr. Programs→ | Fall 1969 Enroll. | Total SCH* | Bio. Sci. | Math Sci. | Phys. Sci. | Eng. Sci. | Psyc. & Soc. Sci. | Arts | Letters | General (Univ. Stud.) | Phys. Ed. | Comp. Sci. | Educ. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Students by level and discipline↓ | | | | | | | | | | | | | |
| 1)Bio. Sci. | | | | | | | | | | | | | |
| LD→ | 453 | 5370 | 2.5 | 16.5 | 32.4 | | 17.1 | 7.6 | 15.1 | 5.6 | 1.9 | 1.3 | |
| UD→ | 241 | 2718 | 76.7 | 1.6 | 1.8 | 2.9 | 7.3 | 3.8 | 4.8 | | | | 1.0 |
| G→ | 176 | 1075 | 98.9 | | 1.1 | | | | | | | | |
| 2)Math Sci. | | | | | | | | | | | | | |
| LD→ | 156 | 2163 | 5.2 | 22.6 | 1.6 | | 17.2 | 8.6 | 24.0 | 2.4 | 2.4 | 11.1 | |
| UD→ | 97 | 1110 | 1.0 | 71.0 | 1.1 | 1.4 | 13.7 | 4.3 | 1.1 | | | 2.2 | 4.3 |
| G→ | 73 | 368 | 1.1 | 95.6 | 3.3 | | | | | | | | |
| 3)Comp. Sci. | | | | | | | | | | | | | |
| LD→ | 22 | 80 | 5.0 | 35.0 | | | 35.0 | | 5.0 | 5.0 | | 15.0 | |
| UD→ | 35 | 84 | | 28.6 | | | 9.5 | | | | | 62.0 | |
| 4)Phys. Sci. | | | | | | | | | | | | | |
| LD→ | 193 | 2036 | 6.3 | 21.4 | 21.2 | | 14.3 | 2.8 | 15.7 | 4.7 | 1.9 | 11.6 | |
| UD→ | 85 | 610 | 14.4 | 24.3 | 48.5 | 3.3 | 5.9 | 1.0 | 1.3 | | | 1.3 | |
| G→ | 49 | 844 | .9 | | 98.8 | .2 | | | | | | | |
| 5)Eng. Sci. | | | | | | | | | | | | | |
| LD→ | 1 | 1198 | 6.3 | 24.4 | 19.7 | | 17.4 | 1.7 | 8.7 | 3.1 | 2.7 | 16.0 | |
| UD→ | 52 | 914 | .9 | 21.4 | .9 | 72.2 | 1.3 | 1.1 | 1.8 | | | .4 | |
| G→ | 66 | 322 | | 3.7 | 2.5 | 93.8 | | | | | | | |

*Student Credit Hours

FIGURE 15 (Continued)

| | Fall 1969 Enroll. | Tot. SCH* | Bio. Sci. | Math Sci. | Phys. Sci. | Eng. Sci. | Psyc. &Soc. Sci. | Arts | Letters | General (Univ. Stud.) | Phys. Ed. | Comp. Sci. | Educ. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6)Psyc. | | | | | | | | | | | | | |
| LD→ | 86 | 1327 | 4.8 | 24.7 | 2.4 | | 31.6 | 12.8 | 17.2 | 1.8 | 2.5 | 2.1 | |
| UD→ | 81 | 998 | 2.2 | 7.2 | .4 | 1.6 | 79.8 | 3.2 | 1.0 | | | .4 | 1.2 |
| G→ | 26 | 140 | 2.9 | | | | 91.4 | | | | | 5.7 | |
| 7)Soc. Sci. | | | | | | | | | | | | | |
| LD→ | 246 | 5472 | 5.9 | 16.4 | 1.2 | | 32.4 | 11.7 | 24.9 | 2.7 | 2.4 | 2.3 | |
| UD→ | 217 | 3552 | .6 | 3.9 | | 1.2 | 80.1 | 4.3 | 5.5 | | | .5 | 3.9 |
| G→ | 48 | 420 | | | | | 97.2 | | | | | | |
| 8)Fine Arts | | | | | | | | | | | | | |
| LD→ | 173 | 2619 | 4.6 | 3.1 | .8 | | 11.8 | 61.7 | 14.8 | 2.6 | .6 | .2 | |
| UD→ | 270 | 2078 | .9 | | | .2 | 7.9 | 87.2 | 2.9 | | | | 1.0 |
| 9)Letters | | | | | | | | | | | | | |
| LD→ | 408 | 6004 | 5.9 | 2.9 | .5 | | 20.1 | 13.8 | 51.9 | 3.2 | 1.3 | .5 | |
| UD→ | 443 | 3122 | 2.0 | | | .8 | 16.4 | 10.0 | 66.1 | | | | 4.7 |
| G→ | 207 | 1282 | | | | | .3 | | 98.8 | | | | .9 |
| 10)Unclass. | | | | | | | | | | | | | |
| LD→ | 383 | 1622 | 8.6 | 13.3 | 6.7 | | 23.2 | 14.3 | 24.9 | 5.4 | 1.8 | 1.7 | |
| UD→ | 47 | 1224 | 8.9 | 8.9 | 1.8 | 3.6 | 50.0 | 10.7 | 14.3 | | | | 1.8 |
| FTFS | | | | | | | | | | | | | |
| LD→ | | | 116.4 | 288.8 | 232.4 | | 438.1 | 310.8 | 545.7 | 85.7 | 37.3 | 65.4 | |
| UD→ | | | 216.8 | 133.1 | 48.2 | 58.7 | 395.5 | 311.5 | 337.1 | | | 26.5 | 40.4 |
| G→ | | | 176.1 | 72.3 | 55.2 | 62.5 | 77.1 | | 204.8 | | | 12.0 | 19.1 |

*Student Credit Hours

al instructional time in the laboratory sciences is considered to be inherent in the capital necessary for that program to function.[34]

In Figure 15 the percentages of total earned student credit hours are multiplied by the enrollment head count to give the number of FTESIL students in each category. These partial FTESIL students are then summed for each level (LD, UD, G) and the result is shown at the bottom of Figure 15. Thus, the number of FTESIL students is accumulated in each column. Head count could be used instead of FTE enrollment on the Irvine campus because 96.7% of the undergraduates and 95.7% of the graduate students are full time students.[35] In general, the development of the induced course load matrix makes the task of developing measures of instructional output relatively easy under suitable assumptions.

The full time equivalent researcher (FTER) is an indicator of research output in terms of the equivalent number of people working full time at research. As with the FTES, we assume that all research output is essentially equal in quality. With this assumption the FTER can be defined as the equivalent number of full time positions devoted to professional research in each program category. This does not include technicians and administrative support personnel. We assume that the amount of capital stock for research is directly proportional to the number of FTER that the capital stock supports. Furthermore, technical and administrative support will be considered inherent to research in the various disciplines. An example of

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[34] It is noteworthy, considering the outcry concerning the narrowness of the physical sciences curriculum that the matrix implies that physical sciences students earn a higher percentage of credit hours **outside** the physical sciences than do students in social sciences, arts, or letters earn outside their respective fields.

[35] The University of California, Statistical Summary: Students and Faculty, Fall 1969, op. cit.

this is the comparison of the very limited resources and capital stock necessary for research in the letters with research in the biological sciences which is a major resource consumer. Research on the professional level is defined to include research personnel on the University payroll, second stage doctoral students, and a proration of the instructional professor's time, which is approximately 32%.[36] These data are displayed in Figure 16.

There are a number of pertinent observations deducible from Figure 16. The number of research personnel on the University payroll (column 1), seems intuitively low in relation to the amount of capital invested in research facilities, for which there are several possible explanations. One is that the 2nd stage doctoral students are performing most of the research under academic direction. Another explanation is that the faculty output study understates the amount of effort faculty actually invest in research. Finally, there is the possibility that research personnel are carried on the payroll in other title categories. The data base in this area is largely guesswork because the research process and especially the measurement of research output is not a widely explored field.

The consolidated department capital share, as shown in Figure 14, can be associated with the FTESIL and FTER developed in the preceeding sections as shown in Figure 17. However, there are a number of conceptual problems in associating departmental capital stock with the output indicators developed. The first of these is the division of the administrative support capital between the instruction and research outputs; research intuitively seems to demand more departmental administrative support than instruction. However, no easy measure of the additional capital support required is available because of the inability to determine adequately the function

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[36] "Faculty Effort and Output Study," op. cit.

FIGURE 16: DEVELOPMENT OF FTER

| Program Category | (1) Research Personnel[37] | | (2) 2nd Stage Doctorals[37] | | (3) Professors[38] | | (4) FTFR |
|---|---|---|---|---|---|---|---|
| Biological Sci. | 8.4 | + | 126 | + | (28.73 X .32) (9.2) | = | 143.6 |
| Mathematical Sci. | 3.0 | + | 23 | + | (28.0 X .32) (9.0) | = | 35.0 |
| Physical Science | 39.50 | + | 43 | + | (38.37 X .32) (12.3) | = | 94.8 |
| Engineering Sci. | .52 | | 28 | | (11.0 X .32) (3.5) | = | 32.02 |
| Psychology & Social Science | 6.05 | + | 41 | + | (63.26 X .32) (20.4) | = | 67.45 |
| Arts | 0 | + | 0 | + | (26.2 X .32) (8.4) | = | 8.4 |
| Letters | 1.71 | + | 75 | + | (61.8 X .32) (19.8) | = | 96.51 |
| Computer Sciences | 0 | + | 4 | + | (3.05 X .32) (1.0) | = | 5.0 |

[37] The University of California Office of the Vice President - Planning and Analysis, "Induced Course Load Matrix Program, Fall 1968." (Computer Run.)

[38] The University of California Office of the Vice President - Planning and Analysis, "Personnel Statistics, November 1969, PA 604 and PA 614," (Berkeley: 1969). (Computer Run.)

FIGURE 17: ALLOCATION OF PROGRAM BUDGET CAPITAL SHARES AMONG THE OUTPUT INDICATORS

| | (1) Bio. Sciences | (2) Math. Sciences | (3) Phys. Sciences | (4) Eng. Sciences | (5) Psyc. & Soc. Sci. | (6) Arts | (7) Letters | (8) Univ. Studies | (9) Phys. Ed. | (10) Computer Sciences |
|---|---|---|---|---|---|---|---|---|---|---|
| LD FTES (Fig. 15) | 116.4 | 288.8 | 232.4 | | 438.1 | 310.8 | 545.7 | 85.7 | 37.3 | 65.4 |
| UD FTES " | 216.8 | 133.1 | 48.2 | 58.7 | 395.5 | 311.5 | 337.1 | | | 26.5 |
| G FTES " | 176.1 | 72.3 | 55.2 | 62.5 | 77.1 | | 204.8 | | | 12.0 |
| FTER (Fig. 16) | 143.6 | 35.0 | 94.8 | 32.0 | 51.5 | 8.4 | 96.5 | | | 5.0 |
| Adm. Capital per FTES ($/FTES) | 631.6 | 390.7 | 1210.1 | 89.8 | 194.7 | 783.6 | 443.4 | | | |
| Adm. Capital per FTER ($/FTER) | 4868.6 | 3786.3 | 12997.9 | 439.9 | 2524.3 | 395.2 | 1457.9 | | | |
| Instruction | | | | | | | | | | |
| $/LD | 2397.5 | 1334.[illegible] | 4903.4 | | 862.8 | 583.6 | 1069.2 | | | |
| $/UD | 3219.1 | 1516.5 | 11934.0 | 1172.7 | 965.9 | 1396.5 | 1175.5 | | | |
| $/G | 2373.0 | 782.1 | 3163.5 | 1172.7 | 932.1 | | 1186.2 | | | |
| Research | | | | | | | | | | |
| $/FTER | 20526.4 | 9662.5 | 58743.3 | 11506.4 | 7995.6 | 7010.3 | 1978.0 | | | |
| G & '220" | 1282.0 | 2967.1 | 17769.0 | 3785.3 | 2108.3 | | 6.2 | | | |
| $/FTER w/o G & '220" | 18959.5 | 3558.8 | 48487.5 | 4172.3 | 4969.3 | 7010.3 | 1985.4 | | | |

of the majority of departmental space. Thus the only reasonable methods of allocation are to divide administrative support capital in proportion to either the personnel output indicators developed here or to the relative amount of capital stock devoted to instruction or research. While neither method is entirely satisfactory, the latter method is more desirable because it reflects the assumption that administrative capital actually supports other capital. Therefore, administrative capital is divided proportional to the ratio of instruction capital to the total of instruction and research capital. Within instruction or research, administrative support capital is then prorated to each FTESIL or FTER equally. The results of this allocation are shown in Figure 17.

Instructional capital is divided amongst the various levels of students within a discipline, to the extent that separate capital stock can be identified. However, Figure 14 shows that a large portion of instructional capital cannot be segregated and can only be divided equally among the various levels of students. General academic classroom capital is also disaggregated proportional to the three student enrollment levels. The results of this proration are shown in Figure 17. Conceptually, these are not the best methods of assigning capital stock to output, but with inadequate knowledge these overly simplistic methods are all that are available.

The research support capital was simply divided by the FTER, and the results are shown in Figure 17. The results of this calculation are counter intuitive because it is generally believed that more capital stock is devoted to graduate students than to undergraduate students. However, examination of Figure 14 indicates that part of the reason for these low figures may be the significant amounts of graduate and "220" capital stock, which is classified as graduate research and/or research assistant capital stock.

The utilization of this space is generally considered to have a joint product both of funded research performed by graduate students for a professor and the results of which become part of the graduate work of the student. Thus, this capital stock could be assigned to both research and instruction.

This section completes the analysis of the University records and has derived in Figure 17 the shares of capital stock per FTESIL and FTER. These results apply to fall 1969 and include only that capital stock directly assignable to the departments for instruction, research, and administration. The figures shown do not include land, general University support facilities, athletic facilities, libraries, or the computer center for reasons previously discussed. Conceptually, the same methodology presented here could have been applied to the entire University of California capital stock.

Summary Observations

(1) Of the four existing valuation methods used by the University of California - insurance, maintenance, accounting and project cost - accounting is the most complete.

(2) Accounting records must be updated with appropriate indexes and must be sufficiently identified to be allocatable.

(3) The capital stock of the Irvine campus can be allocated with regard to direct instructional usage and support of the usage.

(4) Capital stock such as the university owns loses value through:

a. functional obsolescence;

b. psychological obsolescence;

c. technical obsolescence.

(5) If a university attempts to counter the above loss in value, the effort should be visible in the campus maintenance records. However, maintenance records are not normally kept in a disaggregation pattern that would allow allocation of loss in capital value to a department.

(6) Capital structures are traditionally not broken down as to the value of particular rooms or sections of a building.

(7) Present space surveys are barely adequate as to definitions of space and are suspect as to their degree of completeness.

(8) Academic Offices must be broken down in a somewhat gross fashion due to lack of information to 50% instruction, 32% research and 18% administration. (This was done on the basis of faculty time inputs, not

faculty characterizations of outputs for this study; but the underlying problems of jointness present serious difficulties in any allocation procedures.)

(9) Results show an emphasis on the hard sciences on the Irvine campus and a relatively small portion of space devoted to graduate work.

(10) Indirect support capital could not be allocated to departments because usage patterns are not known and because it is suspected that user patterns do not necessarily follow departmental lines. This is a variation on the general problem: what to charge to departments and what to charge directly to users?

(11) The development of output measures, FTESIL and FTER, was barely adequate and leaves much room for development.

(12) The same techniques and methodology demonstrated in this chapter could have been applied to the entire University of California capital stock.

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