DOCUMENT RESUME

ED 032 782 24 EM 007 458

By-Chapin, June R.
The Financial Support and Usage of Computer Centers in Higher Education. Final Report.
Notre Dame Coll., Belmont, Calif.
Spons Agency-Office of Education (DHEW), Washington, D.C. Bureau of Research.
Bureau No-BR-8-I-066
Pub Date Jun 69
Grant-OEG-9-8-081066-0128-010
Note-38p.
EDRS Price MF-$0.25 HC-$2.00
Descriptors-Capital Outlay (for Fixed Assets), Computer Oriented Programs, *Computers, Costs, Digital Computers, Educational Facilities, *Educational Finance, Electronic Equipment, Equipment Utilization, *Facility Case Studies, Facility Inventory, *Federal Aid, *Financial Support, Higher Education, Operating Expenses, Program Costs, Statistical Data, Universities

With data obtained from a National Science Foundation Survey on Computers in higher education, the differences in the pattern of costs and usage of computer centers at higher learning institutions on the West Coast and comparative institutions in the rest of the nation were analyzed. Doctoral granting institutions of the West Coast are strikingly different from those of the rest of the nation. In comparison with other institutions, the public doctoral granting institutions of the West Coast are highly dependent on federal funds for their computer centers, think in big terms for expansion, depend on and use federal funds in many computer activities, and have a different usage pattern in some subject areas. Private doctoral institutions also have a greater reliance on federal funds for their computer centers. In many respects, the public West Coast doctoral institutions are closer to the pattern of a private West Coast institution than to equivalent Eastern doctoral granting public institutions. There is great value in analyzing sub-sets since some of the differences between regions, and between public and private institutions are causing distortions in the national pattern. (Author/JY)

THE FINANCIAL SUPPORT AND USAGE OF COMPUTER CENTERS IN HIGHER EDUCATION

June R. Chapin

A Final Report on Project No. 8-I-066
Grant No. OEG 9-8-081066-0128(010)

For The
U.S. Department of
Health, Education, and Welfare
Office of Education
Bureau of Research

College of Notre Dame
Belmont, California 94002

Final Report

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The research reported herein was performed pursuant to a grant with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

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SUMMARY

The cost problem of computer centers has been incompletely investigated. Yet, due to the expensive nature of computer centers, it appears imperative that decision-makers better understand some of the regional differences that are found in computer centers in higher education in the USA. The purpose of this study using data on costs and usage of computer centers was to indicate the differences in the pattern of costs and usage of computer centers of institutions of higher learning on the West Coast, and comparative institutions of higher education in the rest of the nation.

Data obtained from a NSF survey of Computers in Higher Education was analyzed. The public and private doctoral granting institutions of the West Coast (California, Oregon, Washington, Arizona, Nevada, Hawaii, and Alaska) are strikingly different from the rest of the nation. In particular, the public doctoral institutions of the West Coast in comparison with the rest of the public doctoral granting institutions are highly dependent on federal funds for their computer centers, think in big terms for expansion, depend on and use federal funds in many different computer activities, and have a different usage pattern in some subject areas. Private doctoral institutions also have a greater reliance on federal funds for their computer centers and in many respects the public West Coast doctoral institutions are closer to the pattern of a private West Coast institution than to equivalent Eastern doctoral granting public institutions.

There is extreme value in analyzing sub-sets since some of of the differences between regions and public and private are causing distortions in the national pattern.

DIFFERENCES BETWEEN COSTS AND USAGE PATTERNS OF WEST COAST HIGHER EDUCATION COMPUTER CENTERS AND OTHER HIGHER EDUCATION COMPUTER CENTERS

Problem

Predictions on the future of higher education in the USA usually emphasize the expanding role of computers. One problem facing higher education is the impact that computer centers will have on instructional goals, methods, and costs to the institution. In light of the predicted expansion, it appears imperative that the government, administrators, faculty, and staff better understand some of the regional differences among higher education computer centers in the United States.

The cost problem of computers in industry and government has been a thorny one. Industry, which has had extensive experience with computer centers, has found the estimation of computer costs to be a complex problem. In addition, inconsistent government and university accounting practices, the great variety of sources of computing support, and the relatively new use of computers have made studies of costs and usage of computer centers of higher education incomplete and scant. The existence of multi-computer centers on large universities controlled by different departments or projects has also made it difficult to see the overall pattern of computer costs and usage on a given campus.

The purpose of this report, using data on costs and usage of computer centers of higher education, is to indicate the differences in the pattern of costs and usage in institutions of higher learning of the West Coast and comparative institutions of higher education in the rest of the nation.

Method

Permission and access to data of the National Science Foundation's survey "Computers in Higher Education: Expenditures, Sources of Funds, and Utilization for Research and Instruction 1964-65 with Projections for 1968-69" were obtained. A report summarizing this national survey entitled Computers in Higher Education was published in August, 1967.[1] Dr. John W. Hamblen, director of this first large-scale national survey on computers in higher education, obtained data by use of a questionnaire which was sent to a stratified

random sample of approximately 700 of the 2200 institutions of higher education. The overall response rate to his questionnaire was 92 per cent. Readers interested in his discussion of the survey and a copy of the complete questionnaire developed by the National Science Foundation (NSF) are referred to Hamblen's excellent report.[2]

Hamblen found in FY 1965 that 80 per cent of all computer activity in higher education was concentrated at doctoral granting institutions. Fortunately, Hamblen solicited response from 100 per cent of the doctoral granting institutions. Generalizations about computer centers at these doctoral granting institutions can be made with more confidence than other categories where 10 to 50 per cent of the institutions of higher education were sampled.

However, even for doctoral granting institutions, the accuracy and reliability of different items of the questionnaire vary. Hamblen indicated that data on costs like machine rental are relatively accurate since the university accounting system normally receives monthly bills. However, other titles such as computer financial support in the future are tentative guesses on the part of computer center directors. Yet how computers center directors see the future cost picture (ignoring whether or not it is reasonable) are data that also are used in this study.

From the national sample, the West Coast institutions of higher education were placed into one category hereafter referred to as the West Coast or USOE Region 9. This category included the states of California, Oregon, Washington, Arizona, Nevada, Hawaii, Alaska, and the territories of Guam and Samoa. The territories, however, did not have computers in their institutions of higher education. Further subdivisions were made in type of institution on the basis of public or private, type of institution, and highest level of degree offered. Data were coded to protect the confidential financial data that institutions had provided originally to the National Science Foundation.

By pulling out the data on the West Coast's institutions, comparisons could be made between the West Coast institutions and the institutions of higher learning in the rest of the nation designated the East. The East (using the term broadly) includes all institutions of higher learning from the Atlantic Coast to and including the Rocky

Mountains. The comparison proved to be quite fruitful since, in many respects, the Western institutions, in many ways, have a different pattern in costs and usage in their computer centers than do equivalent institutions in the rest of the nation. The West Coast institutions in these instances when included in the total national sample cause some distortion because the differences influence the national findings.

Findings and Analysis

West Coast Public Doctoral Granting Degree Institutions

1. Source and Amount of Funds

While costs may be considered relative, it is obvious that computing centers are not cheap and that millions of dollars are spent on this activity (Table 1 and 2). Note tables normally appear in pairs. Both sample and estimated population figures are given except when complete population was sampled. The distinction between sample and the estimated population is not critical in doctoral granting institutions where an attempt was made to sample 100 per cent. But it is extremely important in interpreting data for other types of institutions. The funds spent for the school's administration computer activities are not included in the tables.

The 18 public institutions of higher learning on the West Coast which grant a doctoral degree are about 18 per cent of the total population of public doctoral granting institutions in the whole nation. The eight institutions that are part of the large University of California doctoral granting system may raise a little the number of this type of institution found in the West compared to the rest of the nation.

Besides number, the West's public doctoral granting institutions are different from the equivalent institutions in the East in the following important manner. The Federal government's support of the West Coast public doctoral granting institutions is significantly higher using a bionomial test at the 5 per cent level of significance (Table 2 compared to Table 4). In addition, in future projections of support, the West's public doctoral granting institutions expect a higher percentage of federal support for their computer centers; this difference is significant at the 1 per cent level of significance using a bionomial test (Table 2 compared to Table 4).

Table 1. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965 West Coast Public Doctoral Granting Institutions. Data in Thousands of Dollars. Sample Size of 17.

Source	Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Primarily Comp. Act.	1578	339	1917	9041
2. Other Contracts/ Grants	1785	742	2527	6714
Total Fed. Govt.	3363	1081	4444	15755
B. Institution	2787	392	3179	7186
C. Other	802	86	888	2572
D. Total	6952	1559	8511	25513

Table 2. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965 West Coast Public Doctoral Granting Institutions. Data in Thousands of Dollars. Estimated Population of 18.

Source	Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Primarily Comp. Act.	1720	369	2089	9854
2. Other Contracts/ Grants	1945	808	2754	7318
Total Fed. Govt.	3665	1178	4843	17172
B. Institutions	3037	427	3465	7832
C. Other	874	93	967	2803
D. Total	7577	1699	9276	27809

Table 3. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965 Eastern Public Doctoral Granting Institutions. Data in Thousands of Dollars. Sample Size of 77.

Source	Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Primarily Comp. Act.	2824	2584	5408	16554
2. Other Contracts/ Grants	4024	1297	5231	10098
Total Fed. Govt.	6848	3791	10639	26652
B. Institution	12323	4502	16825	44136
C. Other	1813	737	2550	6764
D. Total	20984	9030	30014	77552

Table 4. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965 Eastern Public Doctoral Granting Institutions. Data in Thousands of Dollars. Estimated Population Size 83.

Sources	Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Primarily Comp. Act.	3078	2816	5894	18043
2. Other Contracts/ Grants	4386	1315	5701	11006
Total Fed. Govt.	7464	4132	11596	29050
B. Institution	13432	4907	18339	48108
C. Other	1976	803	2779	7372
D. Total	22872	9842	32715	84531

The West Coast public doctoral granting institutions received more federal support in FY 1965 for their computer centers than Eastern public doctoral granting institutions. Furthermore, they expect in the future more federal funds than comparable institutions in the East. Although supported primarily by state public funds, they expect the federal government to play an important and increasing role in support of their computer centers.

More concretely, using Tables 2 and 4, the public doctoral granting institutions of higher education on the West Coast received 51 per cent of their total computer funds (almost five million dollars) from the federal government in FY 1965. In their projected figure for FY 1969, they expect federal support to be 62 per cent or around 17 million. In contrast, the public doctoral granting institutions in the East in FY 1965 received only 35 per cent of their total computing support from the federal government and expect about 34 per cent in FY 1969 (around 29 million).

These figures illustrate the value of using the West Coast as a separate category. Hamblen reported that 50 per cent of the federal funds for FY 1965 for computer services to research and instruction came from Federal sources in doctoral granting institutions (national). Considering both private and public doctoral granting institutions, they expected 47 per cent of their funds in the future to come from federal support. It would appear that the national picture is influenced by the optimistic, more federally supported West Coast public doctoral institutions while in fact the East's public doctoral institutions on the basis of their own experience in funding of around one-third in FY 1965, are expecting only about one-third of their future costs to be supported by the federal government.

2. Further Differences in Type of Federal Funds

What might account for the difference between the West Coast's public doctoral granting institutions' computer centers and other public doctoral computer centers throughout the nation? A close examination of the two main sources of federal funds for computer support will partly explain this difference. Presently, there are two main types of federal funds for computer centers: 1; funds for primarily computer activity; and 2; funds for other research contracts and grants. In FY 1965, the Eastern public doctoral granting institutions received in total a little more federal computing funds from the first category, primarily computing activity ($5,400,000 to $5,900,000) vs. the other research category ($5,200,000 to $5,700,000) as indicated in Tables 3 and 4 although the two sources were about equal to 50 per cent. In contrast, the West Coast's public doctoral granting institutions received a total higher percentage of

federal computer money, 58 per cent, in FY 1965 from the other research contracts and grants ($2,500,000 to $2,800,000) than primarily computer activity ($1,900,000 to $2,100,000) as indicated in Tables 1 and 2.

In the future projection of FY 1969, the West Coast public doctoral granting institutions expect to follow the national pattern of a higher percentage of federal funds from primarily computing activity. But, in contrast to Eastern public doctoral granting institutions, they still expect a little higher percentage of other research computing funds in FY 1969 than do the Eastern public doctoral institutions.

3. Significant Differences in Use of Federal Funds

As indicated previously, one of the two main sources for federal computing funds was the category designated "primarily for the support of computer equipment, buildings, and activities." These federal funds for primarily computer activities were also supported in various ways by the institutions themselves.

Looking at Tables 5 through 8, one is immediately struck by the differences in how these federal funds and the institutional funds were utilized. In fact, the West Coast public doctoral granting institutions, which represent only 18 per cent of the total population of public doctoral granting institutions, receive more funds for computer science activities from the federal government than the rest of the 83 other public doctoral granting institutions. This is also true in the category computer time for undergraduate but the amounts are so small in this particular category that it is not statistically significant. The amazing point is how federal funds for primarily computer activities are spread out by the West Coast doctoral granting institutions to a far greater extent over all the categories while the East Coast's doctoral institutions have focused 64 per cent of their funds received into rental and purchase of computer equipment.

Table 5. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities West Coast Public Doctoral Granting Institutions. Data in Thousands of Dollars. Sample Size of 17.

Source	Digital Computer Equipment or Building		Computer Time for		Computer Science Activities
	Rental or Purchase Cost	Operating Cost	R&D Grad. Instruc.	Undergrad. Instruc.	
Federal	814	645	452	8	353
Non-Fed	6	48	157	22	40
Total	820	693	609	30	393

Table 6. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities West Coast Public Doctoral Granting Institutions. Data in Thousands of Dollars. Sample Size of 18

Source	Digital Computer Equipment or Building		Computer time for		Computer Science Activities
	Rental or Purchase Cost	Operating Cost	R&D Grad. Instruc.	Undergrad. Instruc.	
Federal	887	703	492	8	384
Non-Fed	6	52	171	23	43
Total	893	755	663	32	428

Table 7. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities. Eastern Public Doctoral Granting Institutions. Data in Thousands of Dollars. Sample Size of 77.

	Digital Computer Equipment or Building				
	Rental or Purchase		Computer Time for		Computer
Source	Cost	Operating Cost	R&D Grad. Instruct.	Undergrad. Instruct.	Science Activities
Federal	3438	1014	1041	4	310
Non-Fed	1052	318	240	180	56
Total	4490	1332	1281	184	366

Table 8. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities. Eastern Public Doctoral Granting Institutions. Data in Thousands of Dollars. Population Size of 83.

	Digital Computer Equipment or Building				
	Rental or Purchase		Computer Time for		Computer
Source	Cost	Operating Cost	R&D Grad. Instruct.	Undergrad. Instruct.	Science Activities
Federal	3747	1105	1134	4	337
Non-Fed.	1146	346	262	196	61
Total	4894	1451	1396	200	398

Table 9, summarizing data from the previous tables, illustrates significant differences between the West Coast public doctoral granting institutions and the equivalent institutions in the rest of the nation.

In this table, and subsequent tables of this same form, the data may not add to 100% due apparently to inconsistency in the data.

Table 9. Comparison of Use of Federal Funds Primarily for Support of Computer Activities, In Thousands of Dollars. Fiscal Year 1965, Public Doctoral Institutions

	West Coast		East		Significant at
Amount Received	2089	100%	5894	100%	--
Rental/Purchase	887	42%	3747	64%	1% Level
Operation Costs	703	34%	1105	19%	1% Level
R&D, Grad. Instruct.	492	24%	1134	19%	1% Level
Undergrad. Instruct.	8	*	4	*	
Computer Sci. Act.	383	18%	337	6%	1% Level

* less than 1%

Remarkably, there are significant differences using a bionomial test at the 1% level of significance for all categories except undergraduate instruction which is less than 1% in both Western and Eastern public doctoral granting institutions. What does this mean? The West Coast's public doctoral granting institutions are dependent upon the federal government for support in all computer areas. Not only part of the equipment rental and purchase are being picked up by the federal government, but in comparison with the Eastern public doctoral granting institutions, the federal funds are helping support all the computer activities. This tends to confirm the previous data on the dependence of West Coast public doctoral granting institutions for federal funds. Indeed, the public granting doctoral degree institutions of the West Coast's computer centers appear different than equivalent institutions in the rest of the nation.

4. The Western Computer Centers' Wishful Thinking on Capital Expenditures?

Again, compare the projections for capital expenditures made between the East and the West Coast public doctoral granting institutions (Tables 10 through 13). Variations occurred from year to year and in different categories making it hard to generalize about the data. It should also be remembered that these data are projections with the exception of the first year.

But of interest is the West's optimistic projections which are in some cases of 9-10 fold increases. This is especially true in the category of buildings where in one year around ten million dollars are expected. In fact, in some categories the projections of the 18 West coast public doctoral institutions are equal in a given year to the total sum projected from 83 other public doctoral institutions located in the East. It appears that "Westerners" think big and have much higher hopes of expansion compared to their colleagues operating computer centers at equivalent institutions in the East.

Table 10. Capital Expenditures for Digital Computer Activities. West Coast Public Doctoral Granting Institutions. Data in Thousands of Dollars. Sample Size 17.

Year	Capital Expenditures: Computer & Periph.	Buildings	Furniture Etc.	Total
1964-65	815	0	37	852
1965-66 Projection	2523	260	41	2824
1966-67 Projection	3283	3210	176	6669
1967-68 Projection	3094	9698	183	12975
1968-69 Projection	5904	810	932	7646

Table 11. Capital Expenditures for Digital Computer Activities. West Coast Public Doctoral Granting Institutions. Data in Thousands of Dollars. Estimated Population Size 18.

Year	Capital Expenditures: Computer & Periph.	Buildings	Furniture Etc.	Total
1964-65	888	0	40	928
1965-66 Projection	2750	283	44	3078
1966-67 Projection	3578	3498	191	7269
1967-68 Projection	3372	10570	199	14142
1968-69 Projection	6435	882	1015	8334

Table 12. Capital Expenditures for Digital Computer Activities. Eastern Public Doctoral Granting Institutions. Data in Thousands of Dollars. Sample Size 77.

Year	Capital Expenditures: Computer & Periph.	Buildings	Furniture Etc.	Total
1964-65	6954	1344	325	8623
1965-66 Projection	4598	4787	291	9676
1966-67 Projection	8608	3607	458	12673
1967-68 Projection	5909	8423	1046	15378
1968-69 Projection	10957	7570	976	19503

Table 13. Capital Expenditures for Digital Computer Activities. Eastern Public Doctoral Granting Institutions. Data in Thousands of Dollara. Estimated Population Size 83.

Year	Capital Expenditures Computer & Periph.	Buildings	Furniture Etc.	Total
1964-65	7579	1464	354	9399
1965-66 Projections	5011	5217	317	10546
1966-67 Projections	9382	3931	499	13813
1967-68 Projections	6440	9181	1140	16762
1968-69 Projections	11943	8251	1063	21258

5. Usage of the Computer

Caution must be used in interpreting what departments use and pay for computing services at institutions of higher education. In the past, it has been difficult to give meaningful answers to this question. The 17 public doctoral granting institutions on the West Coast (Sample) and the 77 public doctoral granting institutions (Sample) in the rest of the nation appeared significantly different at the 5% level using a bionomial test at the following three usage areas:

1. Research and Development and Graduate Instruction using computers in Engineering on the West Coast is lower than compared to Eastern institutions

2. Undergraduate instruction using computers in Engineering on the West Coast is lower than compared to Eastern institutions.

3. Undergraduates on the West Coast in public doctoral granting institutions use the computer less in the physical sciences than equivalent Eastern institutions.

The interpretation (if any) to be made about these statements (see Tables 14 and 15) is uncertain. The differences may reflect merely less concentration in engineering at public doctoral granting institutions on the West Coast.

Table 14. Utilization of Digital Computers for Research, Development, and Education, West Public Doctoral Granting Institutions. Sample Size 17. (F is the estimated theoretical frequency)* FY 1965.

	Class Limits	Eng. F	Phys. Sci. F	Life Sci. F	Soc. Sci. F	Comp. Sci. F	Other F
R & D Grad							
	76-100		1				
	51- 75		2				
	26- 50	1	3	3	1		2
	01- 25	7	7	10	10	4	7
	No-Resp-00	9	4	4	6	13	8
	Total F	17	17	17	17	17	17
Under-Grad	76-100						
	51- 75						
	26- 50	1					
	01- 25	7	7	7	7	6	2
	No-Resp-00	9	10	10	10	11	15
	Total F	17	17	17	17	17	17

Table 15. Utilization of Digital Computers for Research, Development, and Education, Eastern Public Doctoral Granting Institutions. Sample Size 77. FY 1965.

	Class Limits	Eng. F	Phys. Sci. F	Life Sci. F	Soc. Sci. F	Comp. Sci. F	Other F
R & D Grad							
	76-100			2			
	51- 75		5				
	26- 50	18	12	3	1		2
	01- 25	43	49	56	62	30	52
	No-Resp-00	16	11	16	14	47	23
	Total F	77	77	77	77	77	77
Under-Grad.	76-100	1				1	
	51- 75					1	
	26- 50	8			1	1	1
	01- 25	47	47	28	30	33	31
	No-Resp-00	21	30	49	46	41	45
	Total F	77	77	77	77	77	77

*It is believed that the estimates are likely to be less than values given; i.e., numbers are biased on the low side. See Hamblen for explanation, Page VII-1.

West Coast Private Doctoral Granting Degree Institutions

1. Source and Amount of Funds

The six private doctoral granting institutions on the West Coast were completely sampled. This means that it is not necessary to make estimates from the sample to the population since there was 100 per cent coverage.

The private doctoral granting institutions on the West Coast received 68 per cent of their computer funds from the federal government (See Table 16) or about $2½ million dollars. They expect in the future that the federal share will be 72 per cent. In a somewhat similar manner, the private Eastern doctoral granting institutions receive 60 per cent of their funds for their computer centers from federal sources (around $19 million) and expect in the future that this proportion will be approximately the same, 60 per cent or $42 million. (See Tables 17 and 18)

Table 16. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965, West Coast Private Doctoral Granting Institutions, Data in Thousands of Dollars, Sample & Population Size of 6.

Source	Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Primarily Comp. Act.	1327	126	1453	2917
2. Other Contr. Grants	942	260	1202	3637
Total Fed. Govt.	2269	386	2655	6554
B. Institutions	496	9	505	1212
C. Other	577	116	693	1200
D. Total	3342	511	3853	8966

Table 17. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965, Eastern Private Doctoral Granting Institutions, Data in Thousands of Dollars, Sample Size of 50.

Source	Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Primarily Comp. Act.	8833	2003	10836	19753
2. Other Contr. Grants	6443	577	7020	19474
Total Fed. Govt.	19276	2580	17856	39227
B. Institutions	5721	1744	7465	19541
C. Other	1718	2519	4237	5891
D. Total	22715	6843	29558	64659

Table 18. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965, Eastern Private Doctoral Granting Institutions. Data in Thousands of Dollars. Estimated Size of 54.

Source	Current	Capitol	Total	Projected 1968-69
A. Fed Govt.				
1. Primarily Comp. Act.	9539	2163	11702	21333
2. Other Contr. Grants	6958	623	7581	21031
Total Fed. Govt.	16498	2786	19284	42365
B. Institutions	6178	1883	8062	21104
C. Other	1855	2720	4575	6362
D. Total	24532	7390	31922	69831

Let us contrast these figures with public doctoral granting degree institutions:

Public Doctoral Granting Institutions

	West Coast	Eastern
% of Fed. Funds	51%	35%
Future-Fed. Funds	62%	34%

Private Doctoral Granting Institutions

	West Coast	Eastern
% of Fed. Funds	68%	60%
Future-Fed. Funds	72%	60%

Using unit of $10,000, the difference between the private West Coast and private Eastern is significant at the 1% level using a biomial test. In addition, the East public doctoral granting institutions are clearly different at the 1% level of significance from all the other three types of doctoral granting institutions. Its pattern of source of funds is clearly unique. In a certain sense, the West Coast public doctoral granting institutions come closer to the pattern of securing computer funds of private doctoral granting than they conform to the Eastern public doctoral granting institutions.

2. Significant Differences in the Use of Federal Funds

Again, the West Coast was different from the East in the use of federal computing funds designated "primarily for the support of computer equipment, buildings, and activities." These federal funds were also supported in various ways by the institutions themselves.

Like public Western doctoral granting institutions, Western private doctoral granting institutions use more of their federal funds for operating costs (see Tables 19 compared to Tables 20 and 21).

Table 19. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities, West Coast Private Doctoral Granting Institutions, Data in Thousands of Dollars, Sample and Population Size of 6

Source	Rental/ Purch. Cost	Operating Cost	Computer R&D and Grad.	Time on Under-Grad.	Computer Science Activit.
Federal	143	1137	168	0	5
Non-Fed	89	97	78	0	0
Total	232	1234	246	0	5

Table 20. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities, Eastern Private Doctoral Granting Institutions, Data in Thousands of Dollars, Sample Size of 50

Source	Rental/ Purch. Cost	Operating Cost	Computer R&D and Grad.	Time on Under-Grad.	Computer Science Activit.
Federal	5985	3314	1035	174	419
Non-Fed	1073	362	384	3	493
Total	7058	3676	1419	177	912

Table 21. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities, Eastern Private Doctoral Granting Institutions, Data in Thousands of Dollars, Population Size of 54

Source	Rental/ Purch. Cost	Operating Cost	Computer R&D and Grad.	Time on Under-Grad.	Computer Science Activit.
Federal	6463	3579	1117	187	452
Non-Fed	1158	390	415	3	532
Total	7622	3970	1532	191	984

Table 22, summarizing data from the previous tables, illustrates the significant differences between the West Coast private doctoral granting institutions and the equivalent institutions in the rest of the nation.

Table 22. Comparison of Doctoral Granting Institutions Use of Federal Funds, Primarily for the Support of Computer Activity, In Thousands of Dollars, FY 1965

Item	West Coast Private		Eastern Area Private		Signif @
Amount Received	1453	100%	11702	100%	
Rental/Purchase	143	10%	6463	55%	1% Level
Operation Cost	1137	78%	3579	30%	1% Level
R&D, Grad. Inst.	168	12%	1117	10%	1% Level
Undergrad. Inst.	0	0%	187	2%	
Computer S. Act.	5	*	452	4%	
	West Coast Public		Eastern Area Public		
Amount Received	2089	100%	5894	100%	
Rental/Purchase	887	42%	3747	64%	1% Level
Operation Cost	703	34%	1105	19%	1% Level
R&D, Grad. Inst.	492	24%	1134	19%	1% Level
Undergrad. Inst.	8	*	4	*	
Computer S. Act.	383	18%	337	6%	1% Level

* Less than 1%

Further comparisons with public doctoral granting institutions shows the four rather unique patterns of use of the federal funds in the category, Primarily Support of Computer Activities (Table 22). Of extreme interest is the fact that the West Coast private and public institutions granting a doctoral degree are more closely alike than comparing them with the equivalent Eastern institutions. On the whole, western institutions of higher learning granting a doctoral degree depend upon federal support in more areas. In contrast, the Eastern institutions, both private and public, tend to concentrate their funds in rental and purchase of computing equipment.

3. Usage of the Computer

Again, caution must be used in interpreting what departments use and pay for computing services. It should also be noted that the samples are too small to report statistically significant differences. However, since entire populations are reported, real differences appear as follows:

1. undergraduate engineering using computers on the West Coast declines compared to the East;

2. more graduate and undergraduate students in Physical Sciences in the East use computers compared to the West;

3. graduate computer science usage is higher in the East

Further details on usage of private Western and Eastern area doctoral granting institutions are found in Tables 23 and 24.

Table 23. Utilization of Digital Computers for Research, Development, and Education, West Private Doctoral Granting Institutions, Sample and Population of 6

Item	Class Limits	Engr. F	Phys. Sci. F	Life Sci. F	Soc. Sci. F	Comp. Sci. F
R&D-Grad	76-100	1				
	51-75					
	26-50		1		1	
	01-25	3	2	3	2	3
	No-Resp-00	2	3	3	3	3
	Total F	6	6	6	6	6
Undergrad	76-100					
	51-75					
	26-50					
	01-25	2	2	1	2	1
	No-Resp-00	4	4	5	4	5
	Total F	6	6	6	6	6

Table 24. Utilization of Digital Computers for Research, Development, and Education, East Private Doctoral Granting Institutions, Estimated Population of 50

Item	Class Limits	Engr. F	Phys. Sci. F	Life Sci. F	Soc. Sci. F	Comp. Sci. F
R&D-Grad	76-100		1	2		1
	51-75	1	5	1		1
	26-50	7	12	2	4	1
	01-25	17	22	23	30	9
	No-Resp-00	25	10	22	16	38
	Total F	50	50	50	50	50
Undergrad	76-100					1
	51-75					
	26-50	2	3		1	
	01-25	24	26	10	17	12
	No-Resp-00	24	21	40	32	37
	Total	50	50	50	50	50

Public Junior Colleges

1. Source and Amount of Funds

The West Coast contains a higher proportion of public junior colleges than any part of the nation. The California system of public junior colleges is the most extensive in the United States. This is reflected by the fact in FY 1965 there were 113 public junior colleges in the West Coast and a total of 193 in the rest of the nation.

The West Coast's public junior colleges received over $200,000 federal computer funds which accounted for 25 per cent of the financial support of the computer centers (Tables 25 and 26). In contrast, the rest of the public junior colleges in the nation received almost $700,000 in federal funds or about six per cent of their total costs for their computer centers (Tables 27 and 28). These public Eastern junior colleges support through their own funds their computer centers more than West Coast public junior colleges. In the future, Western public junior colleges expect the ratio of federal funds to remain the same proportion of around 25 per cent while public junior colleges in the East expect federal funds to be around ten per cent.

Table 25. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965, West Coast Public Junior Colleges, Data in Thousands of Dollars, Sample Size of 10

Source	Reported Amounts Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Prim. Comp. Act.	54	34	88	153
2. Other contracts	0	0	0	0
Total Fed. Govt.	54	34	88	153
B. Institution	197	32	229	430
C. Other	33	0	33	33
Total	284	66	350	616

Table 26. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965, West Coast Public Junior Colleges, Data in Thousands of Dollars, Est. Population Size of 113

Source	Reported Amounts Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Prim. Comp. Act.	613	386	999	1738
2. Other contracts	0	0	0	0
Total Fed. Govt.	613	386	999	1738
B. Institution	2237	363	2601	4884
C. Other	374	0	374	374
Total	3226	749	3976	6997

Table 27. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965, Eastern Public Junior Colleges, Data in Thousands of Dollars, Sample Size of 17

Source	Reported Amounts Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Prim. Comp. ,Act.	28	32	60	127
2. Other contracts	0	0	0	45
Total Fed. Govt.	28	32	60	172
B. Institution	299	276	575	1399
C. Other	36	200	236	267
Total	363	508	871	1838

Table 28. Current and Capital Expenditures for Digital Computer Activities by Source of Funds, FY 1965, Eastern Public Junior Colleges, Data in Thousands of Dollars, Estimation Population of 193

Source	Reported Amounts Current	Capital	Total	Projected 1968-69
A. Fed. Govt.				
1. Prim. Comp. Act.	318	363	681	1442
2. Other	0	0	0	511
Total Fed. Govt.	318	363	681	1953
B. Institution	3396	3135	6532	15892
C. Other	408	2272	2680	3033
Total	4123	5770	9894	20879

2. Use of Federal Funds

The junior colleges only received federal funds for the category, Primarily for the support of Computer Equipment, Buildings, and Activities. These federal funds were supported in various ways by the institutions themselves.

As indicated by Tables 29 through 32, the West Coast junior colleges and the Eastern area junior colleges used their federal funds in different ways and the institutions' contribution came in different areas. The highest proportion of federal funds in the public junior colleges in the West are concentrated in rental and purchase of equipment. In contrast, almost equal proportions of funds of the Eastern junior colleges are used in the following three areas: equipment rental or purchase, operating cost, and undergraduate instruction (Table 33).

Table 29. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities, West Coast Public Junior Colleges, Data in Thousands of Dollars, Sample Size of 10

Source	Rental/ Purch. Cost	Operat- ing Cost	Computer R&D and Grad.	Time on Under- Grad.	Computer Science Activit.
Federal	49	7	0	1	0
Non-Fed	32	33	0	0	0
Total	81	40	0	1	0

Table 30. Expenditures of Federal Funds Used Primarily for the Support of Computer Equipment, Buildings, and Activities, West Coast Public Junior Colleges, Data in Thousands of Dollars, Estimated Population Size of 113

Source	Rental/ Purch. Cost	Operating Cost	Computer R&D and Grad.	Time on Under-Grad.	Computer Science Activit.
Federal	556	79	0	11	0
Non-Fed	363	374	0	0	0
Total	920	454	0	11	0

Table 31. Expenditures of Federal Funds Used Primarily for Support of Computer Equipment, Buildings, and Activities, Eastern Public Junior Colleges, Data in Thousands of Dollars, Sample Size of 17

Source	Rental/ Purch. Cost	Operating Cost	Computer R&D and Grad.	Time on Under-Grad.	Computer Science Activit.
Federal	19	21	0	20	0
Non-Fed	107	0	0	50	5
Total	126	21	0	70	5

Table 32. Expenditures of Federal Funds Used Primarily for Support of Computer Equipment, Buildings, and Activities, Eastern Public Junior Colleges, Data in Thousands of Dollars Estimated Population Size of 193

Source	Rental/ Purch. Cost	Operating Cost	Computer Time on R&D and Grad.	Time on Under-Grad.	Computer Science Activit.
Federal	215	238	0	227	0
Non-Fed	1215	0	0	568	56
Total	1431	238	0	795	56

The public junior colleges of the West Coast are significantly different at the 1% level using bionomial tests of significance compared to Eastern area junior colleges in all three categories: rental/ purchase, operating cost, and undergraduate instruction. In contrast, the Eastern area junior colleges are spreading out their federal funds into the three main categories.

3. Usage of the Computer

Again, tentative judgement must be used in interpreting the data on what departments are using computer facilities. However, in contrast with other institutions of higher education, in junior colleges, both in the East and on the West Coast, the highest usage is concentrated in computer sciences; around 50 per cent of both samples reported this pattern of usage. A small proportion of the total time is also used by engineering and physical science students (see Tables 33 and 34).

Table 33. Utilization of Digital Computers for Research, Development, and Education, West Coast Public Junior Colleges, FY 65 Sample Size 10

Item	Class Limits	Engr. F	Phys. Sci. F	Life Sci. F	Soc. Sci. F	Comp. Sci. F
Undergrad	76-100	1				3
	51-75					
	26-50					
	01-25	2	1			2
	No-Respon-00	7	9	10	10	5
	Total F	10	10	10	10	10

Table 34. Utilization of Digital Computers for Research, Development, and Education, Eastern Area Junior Colleges, FY 65, Sample Size 17

Item	Class Limits	Engr F	Phys. Sci. F	Life Sci. F	Soc. Sci. F	Comp. Sci. F
Undergrad	76-100	1				6
	51-75					
	26-50					3
	01-25	2	2			
	No-Respon-0	14	15	17	17	8
	Total F	17	17	17	17	17

Conclusions

This study has shown that there are significant differences in patterns of computer financial support and usage between the West Coast higher education institutions and Eastern area higher education institutions. The West Coast public doctoral granting institutions, private doctoral granting institutions, and public junior colleges all depend more heavily upon federal support for their computer centers than do equivalent institutions in the East or the rest of the nation. In addition, the public doctoral granting institutions of the West are peculiarly different from the Eastern doctoral granting institutions in receiving more research computer contracts and grants, expect in the future far more federal funds, have higher hopes for future expansion of computer centers, depend more heavily on federal funds in all computer activities, and have less usage by the engineering department of computer facilities than public doctoral granting institutions in the West.

Private doctoral granting institutions, both on the West Coast and in the East, received a higher percentage of their computer funds from the federal government than public doctoral granting institutions and expect in the future the federal share will remain at least at the present level. In this respect, the public doctoral institutions of the West were closer to the pattern of the private doctoral granting institutions, East and West, than to public Eastern doctoral granting institutions. In how doctoral institutions used their federal funds, Primarily Computer Activities, an unique pattern was observed for all four types of doctoral granting institutions: public and private, Eastern area and West Coast. The East tended to concentrate these funds in the rental and purchase of computing equipment. The West Coast tended to use the federal financial support in more areas. Although usage figures should be interpreted with caution, surprising differences were observed between the East to the West Coast doctoral granting institutions, both public and private.

The public junior Western colleges, like West Coast doctoral granting institutions, received significantly higher percentages of federal funds for their computer centers. The West Coast junior colleges, in contrast with Eastern area public junior colleges, expected in the future to continue to receive about one-fourth of their funds from the federal government. The expenditures of federal funds were significantly different for public junior Western colleges and the East. Usage patterns, again tentative, appeared similar between the East and West public junior colleges. The highest usage occurred in computer sciences with a little use in engineering and the physical sciences, and almost nothing in the other subject areas.

Further investigation of patterns of financial costs and usage using the most recent data would be valuable both to funding agencies and the institutions themselves. In general, it would appear that a lot of misconceptions are common about costs of computer centers.

Bibliography

1. John W. Hamblen. Computers in Higher Education. Expenditures, Sources of Funds, and Utilization for Research and Instruction 1964-65, with Projections for 1968-69. Southern Regional Education Board, Atlanta, Georgia, 30313, August, 1967.

2. Ibid., Appendix E, Questionnaire, pp. 71-81.