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MAY 1973 DRAFT

Preliminary copies to:
G. Franklin
P. Carpenter
E. Pierce

DATE: May 16, 1973

TO : Clayton Rich, M.D.

FROM : J. Lederberg

SUBJECT: Agenda Item for the June Board of Trustees Meeting

REFERENCES: 1) Memorandum from Elliott Levinthal to Clayton Rich, M.D., Subject: SUMEX Grant, November 14, 1972 (attached).

2) Memorandum from William B. Rowland to Clayton Rich, M.D., Subject: Request for Advance of Capital, December 1, 1972 (attached).

3) Memorandum from Frank G. Riddle to Clayton Rich, M.D., Subject: Purchase of PDP-10 Computer for SUMEX Grant Proposal, December 1, 1972 (attached).

The Stanford University Medical Experimental Computer (SUMEX) proposal, now pending with the Biotechnology Resources Branch of the National Institutes of Health, is nearing the final stages of review. The National Advisory Research Resources Council will consider SUMEX on June 14-15. As discussed last fall (see referenced memoranda), there is a possibility that University assistance will be required to finance the SUMEX computer system. Such assistance was tentatively approved at that time, subject to Board of Trustees concurrence.

It is proposed that University financing of the computer be considered at the June 15 Board of Trustees meeting for approval contingent upon NIH awarding of the grant, and the unavailability of government funds to purchase the computer system in the first grant year. This financing would entail an external loan of approximately $870,531, the principal of which would be paid back in equal installments over the five year term of the grant. At the end of this term, cumulative interest charges amounting to $152,343 would remain unreimbursed to the University, assuming a 7% interest rate.

I recognize that the results of the NIH Advisory Council's review cannot be known in time for the June Board meeting. Also the timing of a grant award, if made, is uncertain. An award could be made as early as June or delayed depending upon priorities established at NIH. However, in the event of an early award, Board action in June would avoid a delay through the summer until the Board reconvenes in the fall. The disadvantages of such a delay are presented in subsequent paragraphs.

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BACKGROUND

The SUMEX proposal has been pending with NIH for approximately one year (submitted June 1, 1972). In that time the grant has undergone several rounds of elaboration with the Computer and Biomathematical Sciences Study Section. The most recent version of the application (March 18, 1973) is attached.

The SUMEX proposal seeks to establish a powerful national resource for the development of applications of computer and biochemical analysis techniques in biomedical research. The resource has two interacting themes: 1) applications of Artificial Intelligence techniques in Medicine (AIM) and 2) applications of analytic methodologies such as gas chromatography/mass spectrometry to problems of biomolecular characterization. Our on-going research effort (Heuristic DENDRAL), which applies artificial intelligence techniques to problems of mass spectrometry and body fluid analysis, serves as a core for this resource. The resource would consist of a PDP-10 computer facility together with a local group of professionals, experienced in utilizing AI techniques in a range of problem areas. This group of people is inter-disciplinary, representing medical science under me as Principal Investigator, computer science under Professor Feigenbaum, and chemistry under Professor Djerassi. The resource would be made available to a national community of NIH-funded users (including other approved projects at Stanford) via a national communications network, under the review of a National AIM Advisory Committee established by NIH.

Besides the exploration of advanced applications of computer science and biochemical analysis techniques in medicine, this proposal addresses the problems of developing the relatively new concept of nationally shared resources. Basic communication problems having been solved, facilities such as SUMEX potentially offer a far more economical means for supporting computer-related research and encouraging regular intellectual interactions between remote groups.

The SUMEX facility would not solicit users from other campus computing facilities. Thus, no competition for the funding base of campus facilities is entailed in SUMEX. In fact the National Advisory Committee for AIM will review all authorized users and control access to SUMEX.

GRANT STATUS

The SUMEX application was reviewed by the Computer and Biomathematical Sciences Study Section on April 25, 1973. It will be given final review by the National Advisory Research Resources Council on June 14-15. We do not know the details of the Study Section deliberations. However, if SUMEX had been deferred (as has happened previously) or completely disapproved, we would know that by now. Therefore available indications, while unspecific, are that an action for approval at some priority level was taken by the Study Section subject to review by the Advisory Council in June. The effects on the grant award of Council review and the interaction of the resulting SUMEX priority score with NIH program goals and appropriations are

difficult to predict. Our previous contacts with the Biotechnology Resources Branch indicate a strong interest in establishing nationally shared resources as the future direction for supporting research activities requiring large scale facilities. SUMEX appears to fit that model well. Such speculation, however, does not offset the fact that definitive action by NIH cannot occur before the last half of June and could be delayed longer.

FINANCIAL CONSIDERATIONS

As summarized in the introduction, ~~previous iterations~~ earlier negotiations with NIH ~~have~~ raised the possible need for University assistance in ~~purchasing~~ financing the proposed SUMEX PDP-10 computer. Purchase is favored over lease in order to meet the equipment configuration needs of the research program. NIH indicated that the finance charges contained in the initially proposed lease-purchase plan (standard with Digital Equipment Corporation (DEC)) could not be allowed and that a revised budget should cover only the purchase price of the equipment. At the same time the overall proposal budget was reduced in a way so as to specifically constrain the machine configuration to be minimal relative to program needs. An attempt to lease the equipment must increase costs to cover third party involvement and because of the NIH budget ceiling, these costs would have to be absorbed as a reduction in the equipment configuration. Our subsequent investigations of the experience of existing artificial intelligence-oriented PDP-10 facilities and discussions with the proposed national user community have supported the need for an undiminished facility. Hence, last fall we proposed University assistance to finance the SUMEX machine through an advance of capital with subsequent reimbursement from the grant. This proposal received tentative approval as indicated in the attached memoranda. Our most recent budget is higher than that submitted last fall specifically in the areas of personnel and supporting supplies. This increase is responsive to a Study Section criticism of too little support for the external facility users. The equipment budget remains constrained as above.

Since these discussions last fall, the fluctuations in federal budgets have raised a possible alternative approach. Because of NIH-BRB interest in pursuing nationally shared resource programs, and the long-term benefit to their grantee community (including Stanford) of establishing a facility such as SUMEX, NIH indicated it may be able to advance all of the money needed to purchase the SUMEX facility in the first year. This prospect is still under consideration. Recent indications are that a definitive statement on the availability of such funds could not be made until later as the FY '74 budget becomes clearer.

Thus two possibilities exist in financing the SUMEX machine: direct government purchase or Stanford financing. The former is clearly to be preferred but can be implemented only with NIH impetus and the availability of adequate federal funds. We will continue to ~~pursue~~ stress this alternative, and have some optimism, but no assurance, that all or a large part of the purchase may be financed from a first year grant (i.e. no interest charge to the university)

Should this approach not be feasible, we request Board of Trustee approval to advance the necessary capital through external borrowing. The following numbers refine those contained in Dr. Levinthal's memorandum of November 14, 1972 (reference 1). These numbers relate to only the SUMEX portion of the proposal (as did the November 14 numbers) and do not include the related DENDRAL research grant. Note that a renewal application for DENDRAL was submitted along with the SUMEX elaboration on March 18, 1973.

BUDGET YEAR	1	2	3	4	5
Estimated Total Direct Costs (Page P-89 of the SUMEX proposal)	$765,573	$785,286	$909,109	$877,486	$909,167
Estimated Equipment Costs Not Subject to Indirect Recovery	$137,633	$232,633	$292,633	$232,633	$232,633
Net Total Direct Costs	$627,940	$552,653	$616,476	$644,853	$676,534
Estimated Indirect Recovery @ 47% NTDC	$295,132	$259,747	$289,744	$303,081	$317,971

Estimated Total Indirect Recovery = $1,465,675

Assuming initial equipment costs of $1,088,164, including 6% tax, the grant budget provides for recovery of this principal over five years at $217,633 per year. Thus, assuming recovery starts at the beginning of year 1 and an interest rate of 7% for the required $870,531 (1,088,164-217,633) loan, the following interest charges would be paid by the University:

BUDGET YEAR	1	2	3	4	5
Outstanding Principal	$870,531	$652,898	$435,265	$217,632	$ 0
Interest @ 7%	$ 60,937	$ 45,703	$ 30,469	$ 15,234	$ 0

Total Loan Interest Charges = $152,343

It should be noted that these are estimated budget numbers and must be negotiated further with NIH if a grant is awarded. In that respect they represent upper bounds on the numbers.

We have negotiated a 15% discount with Digital Equipment Corporation for a portion of the equipment, conditional on a cash payment for the computer system upon satisfactory installation, on a firm order by July 31, 1973, and on a minimum order of $700,000. Violation of these conditions makes this discount subject to renegotiation with DEC. This discount applied to the DEC portion of the equipment would reduce the purchase price to $946,723, including tax. This in turn reduces the cumulative loan interest charges to $132,541. Our ability to realize these savings depends upon grant award timing and subsequent negotiations.

Because government funding cannot be guaranteed, even with a five year approved grant, the equipment acts as a guarantee of the loan. The resale value of computer systems is difficult to predict because they are technology dependent. The proposed system is the latest large scale machine offered by DEC (first shipped in the fall of 1972) and represents a significant investment in design upgrade over the earlier models. The PDP-10 machine is popular among universities, ARPA contractors, and increasingly in medium scale terminal-oriented business applications. A very incomplete list of PDP-10 facilities includes Stanford (AI Lab and IMSSS), SRI, Ames Research Center, Caltech, UCLA, MIT, Harvard University, Carnegie-Mellon Institute, TYMSHARE, Copley Press, etc. This list of PDP-10 users substantiates the potential resale market. At the end of each year, the resale value required for the University to break even on its investment (cumulative interest charges plus outstanding principal), expressed as a fraction of the initial purchase price, is summarized below. Note these numbers ignore the possible advantageous effects of a purchase price discount.

BUDGET YEAR	1	2	3	4	5
Ratio of Loan Costs plus Remaining Principal to Purchase Price	85.6%	69.8%	52.6%	34.0%	14.0%

At the end of the grant period, the machine ~~could be sold to recover the loan costs, or alternatively a philanthropic source could be found to recover these costs and to add the SUMEX facility permanently to available University research facilities.~~ title to would pass to the university in the worst case

~~In the best case~~ It would then be an asset for important research computations at the university; in the worst case it could be sold as collateral on the loan. We intend also to formulate a detailed "gift opportunity presentation" to solicit gifts directed to assuming the university's burdens in sharing the cost of this program with the government. The high leverage ($150,000 to $6,000,000), almost

40:1 on an aggregate of almost $6 million, should make this an attractive target for a private gift with ample assets for specific donors

REASONS FOR BOARD OF TRUSTEES ACTION

In summary, Board action is necessary to approve the ~~external borrowing of money for possible University assistance in~~ financing the SUMEX computer. ~~Board~~ approval is requested ~~contingent upon awarding of the grant and upon~~ unavailability of government ~~computer purchase funds~~. We, of course, will continue to pursue direct NIH purchase. If this is not possible, we feel it is in the University's interests to advance the necessary funds to be reimbursed over the five years of the grant.

It is important to obtain this contingent approval as early as possible so that the various time-critical elements involved in implementing SUMEX not be impacted. In addition such action confirms for NIH the University's commitment to support the grant, thereby encouraging its being awarded. The aspects of SUMEX implementation for which time is important include internal budget planning, procurement negotiations with DEC, and establishing a viable resource as soon as possible relative to the national user community. In some ways the internal problems are most important since delays in finalizing a SUMEX grant increase the risks we face in personnel and budget commitments that must be made for the next academic year.

We urge Board consideration and approval of the proposed financing arrangements at their June 15 meeting.

November 14, 1972

Clayton Rich

Elliott Levinthal

SUMEX Grant

The following is a summary of the current status of the SUMEX proposal to NIH for a new PDP-10 computer and a recommendation for arranging the financing of the machine under a revised grant application. As you know, the SUMEX proposal was submitted to the Biotechnology Research Resources Branch of NIH in June 1972 and was site visited on September 11-12. We have recently received a letter from NIH indicating that consideration of the proposal was deferred based on the inability of a portion of the collaborator community to justify the proposed scope of the facility. The letter further stated that a modification of the proposal reducing its scope and emphasizing applications of artificial intelligence, would be reconsidered by the study section if submitted by December 4, 1972. We separately received a suggested outline for an overall 45.5% budget reduction.

This budget reduction affects several aspects of the proposal:

1. A significant reduction in personnel support (46.5%)

2. A significant reduction in hardware facilities (28.8%)

3. A disallowance of finance charges included in the original procurement budget for the computer. We had proposed to purchase the machine under a lease-purchase plan based on its estimated long term value as a research tool in the Medical School.

Based on these guidelines we have been modifying the grant application for the December 4 deadline and find, after examining available alternatives, that in order to maintain a viable technical solution to the problems posed, we require University assistance in financing the computer acquisition. The dilemma is basically that the study section of NIH reduced the computer system on technical grounds to a truly minimal configuration and at the same time limited the funding level to cover only 20% of the purchase price per year over the five year grant. Any attempt to lease the equipment would increase yearly costs with a corresponding decrease in hardware complement to a point which would not allow conduct of the research. The only apparent alternative which preserves the viability of the grant is for Stanford to advance the capital to purchase the machine and to pay the necessary interest or the lost revenue on general funds thereby committed out of indirect funds generated by the grant. The resale value of the computer equipment adequately guarantees the investment. To this end, we are attempting to get the Digital Equipment Corporation to guarantee the repurchase of the machine at a schedule after 3, 4 or 5 years corresponding to Stanford's outstanding investment in the equipment (principal and accrued interest). These negotiations are under way via C.R.Blanton at this time.

The following are estimates of the income and costs involved:

Budget Year:					
Estimated Total Direct Cost	$565.6K	548.7	564.0	581.2	598.3
Estimated Capital Equip.Costs*	175.2K	175.2	175.2	175.2	175.2
Estimated Net Total Direct Costs	$390.4K	373.5	388.8	406.0	423.1
Estimated Indirect @ 46% NTDC	$179.6K	171.8	178.8	186.8	194.6

TOTAL INDIRECT = $911.6K

Estimated Interest or lost Income @ 7% on Initial $876K outlay	$ 49.1K	40.3	30.7	20.6	9.9

TOTAL INTEREST = $150.6K

± 17.2% of initial outlay

Equivalent Third Party Finance Charges @ 2.4% per Month Repayment	$ 77.1	77.1	77.1	77.1	77.1

TOTAL THIRD PARTY INTEREST = $385.5K

*This assumes a purchase price for computer equipment of $876K paid back with five installments of 20% each from the grant and that a $50K/year maintenance contract will qualify for indirect recovery.

Since the government has refused to pay finance charges for a third party arrangement, we propose that the University advance the $876 purchase price of the computer to be paid back on a yearly basis at $175.2K/year. Since the first year payment would be immediately forthcoming this would require an effective $700.8K advance. At any point in the grant the University's investment is covered by the resale value of the machine. We are attempting to have DEC guarantee the repurchase based on the outstanding principal and accrued interest. It is likely if,we can negotiate such an arrangement,that conditions will be imposed such as:

1. Minimum configuration size
2. DEC maintenance at least at time of resale
3. Adequate insurance coverage
4. No guarantee until years 3, 4, and 5 of the grant
5. Only PDP-10 portions of the system will be covered - approximately $50K of the original equipment consists of small PDP-11 machines under separate administrative control at DEC.

The necessary percentages of initial value to cover Stanford's investment, assuming 7% interest, are:

Budget Year	1	2	3	4	5
Outstanding Principal and Accrued Interest as % of Original Cost at the End of Each Year	85.6%	70.2	53.7	36.1	17.2

The impact of this arrangement after 5 years is that Stanford would own a computer of significant value as a research tool and could choose:

1. To sell the equipment to regain invested capital and accrued interest for a net zero cost.
2. To regain invested capital through fee for service use of the machine from subsequent grants or other sources.
3. To accept the investment of 17.2% of the original price as a valid addition to University research facilities.

We understand that this use of University funds must, of course, compete with other priorities but we feel that the investment is justified both in enabling the acquisition of a $500-600K per year research grant as well as in providing a valuable long-term computing asset to the school. We recommend approval of this method of financing the SUMEX facility.

cc: W. Rowland

DATE: 1 December 1972

TO : Clayton Rich, M.D.

FROM : William B. Rowland

SUBJECT: Request for Advance of Capital

Drs. Lederberg and Levinthal request clearance to commit between $800,000 and $900,000 of University general funds as a cash advance for the purchase of a new computer (PDP-10, SUMEX Grant Proposal). This program was approved by you earlier this year when the first grant application was submitted to NIH. At that time no capital advance was required, but there was a potential obligation of $75,000 in general funds for alteration expense. This earlier grant proposal was reviewed by the Computer and Biomathematical Sciences Study Section and returned with certain revisions recommended. The revised proposal (attached) is ready for submission.

I recommend that you approve this proposal for forwarding to NIH. The highlights are as follows:

Program - approved by you earlier when no medical school general funds were involved.

Financial Committment -
--$170,000 in medical school general funds for interest expense (Stanford would borrow the money and recover the principal by charging the grant over a five year period).
--Contingent liability to pay off the loan out of general funds in the event that the government should terminate funding before the five year grant period was ended.
--It will be necessary to obtain Board of Trustees approval to borrow the necessary funds on University credit.

Means of Recovery or Escape - The grant application does not commit the University to any particular means of financing (open to negotiation so that the study section is not involved in the financing mechanism). The University is not committed to proceed until the grant has been offered and the University has accepted.

The Department (Joshua Lederberg) will seek gifts to cover the general fund requirement for interest expense ($170,000).

The potential liability may be reduced by negotiating the recovery for the equipment to be budgeted in three years instead of five years.

The liability may be reduced by negotiating a fifteen percent discount over the present price arrangement.

The Reason for Approving

--The research program has been approved in principal by you last May.
--The University will acquire the research equipment at a relatively minor cost.
--This substantial research project will provide a broader base for spreading University and Medical School overhead.
--The computer may, under certain conditions, be available to other projects. That is, the application contains the phrase "projects (would) be entitled to cooperate with SUMEX by furnishing poolable resources in exchange for prorata shares of time on the augmented resource".

Additional space will not be required. General funds will not be required for additional personnel or alterations. The project has been cleared with Gene F. Franklin for University wide coordination of computer facilities. The Controller's office has reviewed and approved the financial proposal. *

*Financial report from Frank Riddle

WBR:mk

Attachments
Grant Proposal

cc: Richard L. Balch
Frank G. Riddle
Elwood C. Pierce

DATE: December 1, 1972

TO : Clayton Rich, M.D.

FROM : Frank G. Riddle

SUBJECT: Purchase of PDP-10 Computer for SUMEX Grant Proposal

After analyzing the request for capital to purchase a PDP-10 computer for the SUMEX grant proposal, I am recommending your seeking outside borrowing for the required $893,000 (based upon a $1,116 purchase price). External borrowing will require Board of Trustee approval which you will have to prepare. Interest on the $893,000 investment would be covered from internal resources of the Medical School. The recommendation is based upon the facts described in William Rowland's November 17, 1972 letter to you, Elliott Levinthal's letter of November 14, 1972, also to you, and supplemental information supplied by Elliott Levinthal on November 30. It is my understanding NIH is willing to fund only the original cost of the computer in a three to five year period, with the University committed to pay interest or finance charges. It is also my understanding that Digital Equipment Corporation has refused to guarantee repurchase of the computer.

The following rationale was developed in making the recommendation to borrow externally:

(1) The computer will be used solely for the SUMEX project and will not compete with other central computer facilities.

(2) The current priority needs on the University's plant fund reserves preclude funding the PDP-10 from these reserves.

(3) Third party financing at 2.4% per month is too costly.

(4) The use of Medical School Ford funds would also be a costly investment. The attached schedule shows a loss of $210.1K in growth potential and $112.9K loss in income for a total investment loss of $323.0K.

Borrowing externally at the following interest rates will cost $133.8 - $178.7K in interest payments for the five years which must be covered from Medical School resources.

(000's)

Year	Beginning Balance	Interest Rates 6%	7%	8%
1	$893	$53.4	$62.5	$71.4
2	670	40.2	46.9	53.6
3	447	26.8	31.3	35.8
4	224	13.4	15.6	17.9
5	0	-	-	-
Total Interest		$133.8	$156.3	$178.7

A partial offset to the interest payments will be the indirect cost recovered on the project and allocated to the Medical School which pertains to the use of equipment. This amount is approximately 3.8% of the indirect cost recovered. Using Elliott Levinthal's indirect cost calculation, the amount pertaining to equipment usage is $25,200 for the five year period.

Another added factor is the potential of tax exempt borrowing under the proposed "California Educational Facilities Authority." If approved by the California Legislature, the act will give the University the ability to borrow with tax exempt status and reduce interest rates by 2% to 2.5%.

You should discuss obtaining Board of Trustee approval and borrowing with Rod Adams as soon as possible. I have copied him in on this memo so that he will be informed on the subject.

Attachment

cc: R. Augsburger
K. Creighton
G. Franklin
R. Adams
W. Rowland

Attachment

Investment Loss When Financing PDP-10 From Medical School Ford Funds

A. Assumptions

1. Required Investment $893 repaid in four equal annual payments of $223.
2. Yield and Gain Pool Rate of Return.

   Yield - 4%

   Gain - 8%

B. Potential Yield and Gain if $893.0 Remains in Y and G Pool

	Period				
	1	2	3	4	5
Growth	$893.0	$964.4	$1041.6	$1124.9	$1214.9
Yield	35.7	38.6	41.7	45.0	48.6

Total Yield = $209.6

C. Potential Yield and Gain if $893 is removed from pool and repaid in 4 equal payments

	Period				
Payments	1	2	3	4	5
-	$0	$ 0	$ 0	$ 0	$ 0
1		223.0	240.8	260.1	280.9
2			223.0	240.8	260.1
3				223.0	240.8
4					223.0
Total Growth	0	223.0	463.8	723.9	1,004.8
Yield	0	8.9	18.6	29.0	40.2

Total Yield = $96.7

D. INVESTMENT LOSS

	Without Investment	With Investment	Investment Loss
Principal at Year 5	$1214.9	$1004.8	$210.1
Yield for five Years	209.6	96.7	112.9
		Investment Loss	$323.0