Applications	Computer Project Authorization and Control
Type of Industry	Petroleum
Name of User	Sun Oil Co. Philadelphia, Pa.

Equipment Used	GE 635 Computer System Univac 1108 IBM System/360 Model 20

Synopsis

Sun Oil Co. uses a variety of computers, mostly small systems, which are located throughout the country to meet specific needs. In addition, a computer center at corporate headquarters in Philadelphia makes large scale equipment available to anyone within the company. Faced with tremendous expansion of its data processing operation in Philadelphia, Sun Oil decided to implement a system whereby management would exercise direct control over project authorization and be kept continually informed of the progress of each project. Within the computer center, prices were established for each service and a priority schedule was developed. At the same time, techniques were developed for ascertaining, in advance, not only what each project would cost but what its anticipated value to the company would be. The level of management which exercises approval for projects is determined by the expected cost of the project. Methods are also provided for quantifying--that is, establishing in dollar figures--the economic incentives for projects in which the cost and potential benefit are not readily ascertained. Data derived during project authorization is keypunched and fed into the computer for use in follow-up reports. This data is supplemented each time an individual project is evaluated during its lifetime.

Company history

Sun Oil Co. was founded in 1886, at first acquiring leases and drilling wells. The company's next major move came in 1894 with the purchase of a small refinery at Toledo. Then in 1901 the discovery of the Spindletop gusher near Beaumont, Texas, provided the company with a large source of domestic crude oil and Sun constructed a major new refinery at Marcus Hook, Pa. shortly thereafter.

The company's first service station was opened in 1920 and Blue Sunoco, Sun's first branded gasoline, was placed on the market in 1927. Sun played a leading role in the development of catalytic cracking and in the production of 100 octane-plus aviation gasoline during World War II. In recent years Sun has diversified into petrochemicals, developed the unique Custom Blending System for marketing motor fuels, and inaugurated a worldwide oil exploration program.

Sun Oil recently acquired Sunray DX Oil Co. through a merger. In the six-year period 1963-1968, on a combined basis, revenue increased from $1.3 billion to $1.8 billion. The company and its subsidiaries distribute branded motor products through some 17,100 service stations, and has seven refineries. It employs approximately 30,000 people worldwide.

EDP BACKGROUND

Prior to 1963, the bulk of the company's computer operations in the Philadelphia area were handled via an IBM 650 at the firm's refinery at Marcus Hook, Pa. Applications were predominantly engineering-oriented; demands for additional service had begun to build and expenditures for outside computer services were on the increase. A study group was formed and its recommendations included establishing a corporate Computation Center at company headquarters in Philadelphia with installation of an IBM 7040. There was, however, no attempt to centralize the control of application selection. Applications were handled on a request basis. In 1963, there were 12 people employed in the computer center. By August 1964, that number had grown to 50, and by 1967, 190 were employed in data processing at the center. The growth stemmed from increased demand for services from "user" organizations within the company. Up to this time, there had been no constraints in the Computation Center to refuse jobs.

Increases in personnel were recommended and approved on a semi-annual basis. The Computation Center based its requirements on information gathered from users and potential users about their anticipated needs.

The demand for more hardware grew along with the need for more personnel. To cope with the increasing load, a General Electric 635 computer was installed in 1965 to replace the IBM 7040. Later, in 1967 a Univac 1108 was added. The company also uses other equipment outside the Computation Center, including IBM System/360 Models 30, 40 and 50 and a Control Data 6400, to meet special needs at locations throughout the country.

In 1967, when the size of the computer center staff had reached 190, company President Robert Dunlop decided to "freeze" the staff and the expense level for equipment. For some months prior to this action, discussions had been going on relative to development of an authorization and control system for work done at the Computation Center. Dunlop's action was interpreted as a mandate to proceed with development and implementation of such a system. There have been some increases in staff during the succeeding years, but these have been relatively small and have been, for the most part, offset by attrition. The authorization and control system has effectively kept expenditures within levels acceptable to higher management while at the same time enabling the Computation Center to improve and increase its services. The system, developed and implemented by Walther F. Schneider, manager, Computation Center, and M. F. Brown Jr., assistant manager, has also placed the

responsibility for deciding whether projects are worth undertaking on management, and not on the Computation Center.

THE OPEN SHOP APPROACH

The Computation Center still functions as if it were an internal service bureau. Many jobs handled are originated by a Profit Improvement Project Dept., actually a group within accounting, which functions much like an internal management consulting organization. PIPD's responsibilities include projects that do not require EDP as well as those which do. Prior to installation of the authorization and control system, the center accounted for its expenses by prorating them among the various departments which used its services. Project approval was a somewhat informal procedure. The open shop approach has been retained, but with a notable exception; formal approval for project go-ahead must come from management. The control system involves development of figures reflecting benefit, or potential benefit, to the company as well as costs. The level of management approval required is based on the size of the dollar figures. Sun Oil had established a hierarchy for management approval of capital expenditures. The project authorization and control system is based on that hierarchy, and provides for delegation of authority to approve Computation Center projects up to fixed dollar amounts.

The Computation Center has developed a price list for its services which, generally, is based on the "going" rate of outside competitive services, minus 10 percent. The price varies with the priority of service required and with the computer used (either the Univac 1108, GE 635 or IBM System/360 Model 20). The price list is detailed, running 11 pages, and includes instructions on how to compute prices.

Under the open shop philosophy, no one is obligated to use Sun Oil's Computation Center for its computer work. Individual economic assessments of alternate approaches to handling dp tasks, including use of Center facilities. And, as Schneider explains, even if a manager wanted to install his own computer to handle the job, as a good manager he realizes he must take the most economic route--and that route is to the Computation Center, in most cases. If the economics indicate that a separate computer should be installed, the manager and the Center submit a joint proposal to corporate management for approval.

Project Assessment

To aid project originators in developing the economic analysis required to get management approval, the Computation Center has prepared a manual with details on how to make the computations required, and fill out the necessary forms.

Since a computer application usually involves expenses outside the Center as well as within, the manual uses several terms in a specialized manner: "venture" and "project". The definitions are as follows:

> Venture--an activity undertaken by the company in expectation of increasing corporate profitability, or in compliance with some extra-corporate requirement. A venture normally will include expenses both outside the Center and within it.
>
> Project--that portion of a venture which takes place exclusively within the Computation Center. Only Center expenses (or charges) are involved.
>
> Alternate--the best alternate to the use of Center-type facilities. The alternate is essentially a replacement for the Center project, in which the same needs of the venture are met without using large scale computing facilities. In some cases there may not be an available meaningful alternate to the use of Center-type facilities for the venture.

There are two major types of ventures, and hence, two corresponding types of expenses.

Development expense--funds which are spent to acquire a new capability for the company. The company does not realize any direct value from the development expense--all value is potential. No value can be realized until the "product" of the development (i.e., the new capability) is put to use.

Production expense--funds which are spent in the act of using acquired capability. Value derived from production is real as opposed to the potential value of development.

Two measures of attractiveness are used to evaluate a venture or a project: a Value Index and Interest Rate of Return. Managers are free to choose whichever measure they find most easy to work with or most meaningful to them.

Value Index

Value Index measures the number of times that a project's cost is recovered; thus a project with a VI=3.0 will recover value to the company worth three times the cost. A Value Assessment Summary form, containing explanatory notes, is used in calculating the VI of a project.

Two formulas are employed, depending on whether the project is development or production. For a development project, where benefits are potential rather than real, the formula is:

$$VI = \frac{PW\ (Value - Operating\ Cost)}{PW\ (Development + Startup\ Costs)}$$

PW denotes "present worth" at a defined point in time, compounded continuously at a nominal annual interest rate. (At Sun Oil, the rate used is 12 percent.)

Value denotes any income, savings or other measure of benefit which result from the project throughout its effective life.

Operating Cost denotes any costs for running or maintaining the program(s) after development is finished, throughout the effective life of the project.

Development Cost denotes all expenses necessary to create the program(s) and to bring them to an initial usable condition.

Startup Cost denotes all costs involved in setting up initial data files, in user training, or other one-time costs associated with initial use of the program(s).

FINDING VI FOR A HYPOTHETICAL DEVELOPMENT PROJECT

Before taking a look at the VI formula for a production project, an example of how the formula for a development project works may be helpful in understanding the system.

Assume the following estimates for a hypothetical project:

(1) Development, testing and documentation of new programs will take six months and cost $5,000.

(2) At startup, an existing historical file must be incorporated into the system. The combination of manual effort, keypunching and computer time to create the file is expected to cost $2,000.

VALUE ASSESSMENT SUMMARY

NOTE: BOXES (13) – (18) ARE FOR DEV. PROJECTS: (19) – (24) FOR OPERATING PROJECTS.

	ITEM	$ PW AT START UP	IF POSSIBLE, SHOW FACTORS FOR CALCULATING PW	DESCRIPTION
1	U	16,000	Assumed greater than $40,300	GROSS OPERATING VALUE (INCOME + SAVINGS)
2	P_N			OP. COSTS NOT ASSOCIATED WITH USE OF C.C.
3	P_C	24,100	(6,000 + 3,600) X 2.519	C.C. OPERATING CHARGES
4	P_O			NON – C.C. OP. COSTS ASSOCIATED WITH USE OF C.C.
5	P	24,100		$P = P_N + P_C + P_O$ = TOTAL OP. COSTS
6	D_N			DEV. & INSTALLATION COSTS NOT ASSOCIATED WITH C.C.
7	D_C	7,150	10,000 X .515 + 2,000	C.C. DEVELOPMENT CHARGES
8	D_O			NON – C.C. DEV. COSTS ASSOCIATED WITH USE OF C.C.
9	D	7,150		$D = D_N + D_C + D_O$ = TOTAL DEVELOPMENT COSTS
10	A			COSTS TO DEVELOP & INSTALL AN ALTERNATE TO C.C.
11	A	40,300	16,000 X 2,519	COSTS TO OPERATE AN ALTERNATE TO C.C.
12	A			TOTAL COSTS OF ALTERNATE

	(LINE NO. FOR PROJ. AUTH. FORM)	IF THERE IS NO PRACTICAL ALTERNATE TO C.C.	IF THERE IS A PRACTICAL ALTERNATE TO C.C.
DEVELOPMENT	VI_D (LINE 7)	(13) $\frac{U-P}{D}$ =	(16) $\frac{A-P}{D} = \frac{40,300-24,100}{7,150} = 2.27$
	$V_D = D_C * VI_D$ (LINE 6)	(14) =	(17) = 7,150 X 2.27 = 16,200
	$U_D = V_D + P_C$ (LINE 4)	(15) =	(18) = 16,200 + 24,100 = 40,300
OPERATION	VI_P (LINE 7)	(19) $\frac{U}{P}$ =	(22) $\frac{A}{P}$ =
	$U_P = P_C * VI_P$ (LINE 4)	(20) =	(23) =
	$V_P = U_P - P_C$ (LINE 6)	(21) =	(24) =

(3) Once the programs become operational, they will be run about 400 times a year. Each run is expected to cost $15 and will replace existing manual procedures costing $40. The programs will not be run on a scheduled basis, but will be used randomly throughout the year.

(4) Changes to the programs will be required during their effective life, at an average cost of about $300 per month.

(5) The programs, maintained as in (4), will be useful for about three years, after which they will become so obsolete that they probably will be replaced by new programs.

On an average annual basis, the cash flows are:

Value = (400) (40) =		$16,000
Operating Cost = (400) (15) =	$6,000	
Program Maintenance = (300) (12) =	3,600	
Total Operating Costs =	9,600	
		9,600
Net Operating Value =		$ 6,400

At this point, the formula looks like this:

$$VI = \frac{PW (\$16,000 - \$9,600)}{PW (\$5,000 + \$2,000)}$$

Before it can be solved, present worth factors for the dollar amounts must be computed. Sun Oil has developed a table to simplify this exercise. The factors "F" and "G" are tabulated for R=12 percent nominal annual interest, at "T" years from startup.

T	F	G
-2.0	2.260	1.271
-1.5	1.643	1.197
-1.0	1.062	1.128
-.75	0.785	1.094
-.50	0.515	1.062
-.25	0.254	1.031
0	0	1
0.5	0.485	0.942
1.0	0.942	0.887
1.5	1.373	0.835
2.0	1.778	0.787
2.5	2.160	0.741
3.0	2.519	0.698
3.5	2.860	0.657
4.0	3.177	0.619
4.5	3.477	0.583
5.0	3.760	0.549

The formula used to ascertain present worth, when the table is employed, is:

$$P = aF\ (T)$$

P represents present worth. "a" is the constant rush flow rate in dollars per year between startup and "T" years from startup. To find the present worth of the net operating value, then:

$$a = 6,400$$

"a" is the dollars per year between startup and "T" years from startup. To find "F", the user looks under the "T" column to 3.0 -- the three years for which the programs will run -- and finds next to it, under F, 2.519. "P" then equals 6,400 x 2.519, or $16,130.

Following the same procedure for the denominator (development = startup cost), then

$$VI = \frac{16,130}{5,150 + 2000} = 2.3$$

Over its full life, the project is expected to recover net operating value which is worth 2.3 times the total development cost.

VI FOR PRODUCTION PROJECT

In a production project, the present worth factors usually cancel out each other since the benefit usually occurs at the same time as the expense. The formula, then, is:

$$VI = \frac{\text{Gross Value}}{\text{Operating Costs}}$$

ALTERNATE PROJECTS

The calculation of VI for a Computation Center project depends on whether a practical alternate is available. If there is no practical alternate to the use of the Computation Center, then the project VI is exactly equal to the VI of the entire venture since the project is an inseparable part of the venture.

If there is a practical alternate which would be used if necessary, the VI of the project may be less than or greater than the VI of the entire venture, depending upon the costs of the alternate. In terms of the costs of the alternate for a development project:

$$VI = \frac{A-(Pc = Po)}{Dc + Do}$$

(Note that each letter represents an appropriate PW value).

A = the total cost of developing and operating the best alternate.

P_C = cost to be charged by the Computation Center

P_O = costs outside the Center which are in conjunction with the Center-run project.

D_C = costs to be charged by the Center in conjunction with the development of the project.

D_O = costs outside the center in conjunction with developing the project.

For a production project, the formula is:

$$VI = \frac{A}{P_C + P_O}$$

INTEREST RATE OF RETURN

The Interest Rate of Return is the nominal annual interest rate, compounded continuously, which would be required to match the cash flows involved in the project--that is, it is the interest rate necessary to satisfy the equation:

$$\Sigma_i PW\ (CF_i) = 0$$

Where CF: denotes cash flow in the i^{th} year of the project. PW denotes present worth, at an interest rate equal to IRR. Σ_i denotes the sum over all years of the project's effective life, year by year.

The formulas used to compute interest Rate of Return are the same as those used to derive the tables for the Value Index computation.

For a cash flow which remains constant at the rate of "A" dollars per year between startup and "T" years from startup, the formula is $P = a\frac{(1-e^{-RT})}{R}$

For an instantaneous cash flow of "A" dollars at "T" years from startup, the formula is $P = AE^{-RT}$. When the Value Index is used, R is unknown quantity--12 percent--hence the tables which simplify computation can be developed and a simpler formula used.

Thus:

For constant cash flow: $P = aF\ (T) = a\frac{(1-e^{-RT})}{R}$

For instantaneous cash flow: $P = AG\ (T) = Ae^{-RT}$

When IRR is used, R is not known but is found through an iterative calculation -- altering the value for R until the equation is satisfied.

The iterative calculation will not be demonstrated here, but the means to check its conclusion follow, with the figures developed in the hypothetical example used in determining the Value Index also used for IRR.

The cash flows for the hypothetical project already have been calculated:

(1) For the six months prior to startup, the cash flow is at the average of -$10,000 per year.

(2) At startup, there is a one-time cash flow of -$2,000.

(3) For the three years following startup, the cash flow is $6,400 per year.

An iterative calculation shows that this project has an IRR of 70 percent. The validity will now be checked, using the formula for cash flow at a constant rate:

$$P = \frac{a}{R}\,(1-e^{-RT})$$

Values for the term "e^{-RT}" can be found in any standard table of exponential functions.

(1) Before startup,

$$P_1 = \frac{-10,000}{.70}\left|1-e\,(.70)\,(.5)\right| = -10,000\ \frac{(.419)}{(.70)} = -\$5,980$$

(2) At startup,

$$P_2 = -\$2,000$$

(3) After startup,

$$P_3 = \frac{6,400}{.70}\left|1-e^{-(.70)\ (3)}\right| = 6,400\ \frac{(.878)}{(.70)} = \$8,020$$

If 70 percent is the correct IRR, the sum ($P_1 + P_2 + P_3$) should be zero

P_3 =		$8,020
P_2 =	-5,980	
P_1 =	-2,000	
	-7,980	-7,980
		$ 40

For present purposes, the $40 difference is satisfactorily close to zero.

Obtaining Value Estimates

Obtaining value estimates is sometimes a difficult procedure, because some projects defy measurement in terms of dollars. There are generally three types of projects:

(1) Where the value is knowable. These projects lend themselves to quantification. An example might be a means of preparing a report faster and with less manpower.

(2) Where there may be value, but whether there is or not, it is unknowable. An example might be a research project "to see if we can do anything useful with linear programing." Such a project is necessarily exploratory, and a logical prediction of value can seldom be made. With this type of project, the "backwards" approach is used. An attempt is made to ascertain what it is that makes the job originator want to spend the estimated amount to do the project. In a sense, management judgment is quantified. For example, if the project cost is $10,000 and the workload is such that it cannot be done in the allowable time span unless it gets a Value Index of 3.0, the originator is asked "Do you think the benefit is at least $30,000?" Also taken into account is the manager's "batting average." If he feels the project has a 10 percent chance of success and he has a history of 3 percent success, the estimate may be altered accordingly.

(3) A class of job for which there is no meaningful value to the company, but which must be done anyway. For example, a government requirement that certain data must be provided. If there is an alternate method of handling this type of project, the alternate becomes the measure of value. If no alternate is available, it becomes a demand project and the value is ascertained by the priority which must be given the job in order to get it finished.

There is a fourth type of project which comes up from time to time. These are projects which are simply "exempted" from value assessment by management. However, all other aspects of the system continue to function. Sun Oil has found that this approach is not as "free wheeling" as it appears, since the manager who exempts a project from value assessment still is accountable to his superior.

Project Authorization

Supporting data for the measures of attractiveness are entered on the value assessment summary form. Data from this form then is entered on the project authorization form which goes to the appropriate level of management for approval. The level of approval is determined by the dollar amount of the project. Sun Oil adapted the hierarchy established for capital appropriations to its project authorization system. For project authorization, authority to approve may be delegated. For example, if a vice president is authorized to approve $30,000 in expenditures, he may delegate to his managers authority to approve projects up to that amount.

#3389

CC PROJECT AUTHORIZATION

FOR CC USE ONLY	
Auth. No.	
Ref. Auth. No.	
W. O. No.	
Task No.	
Due Date	(d)
Approved By	
Approval Date	

SUN OIL COMPANY
COMPUTATION CENTER
PHILADELPHIA, PA.

	SIGNATURE	DATE
REQUESTED BY		
REVIEWED FOR CC BY		
APPROVED BY (See Note a)		

PROJECT TITLE

The schedule for this Project may have to be revised if Authorization is returned to CC after (Date)

PROJECT DESCRIPTION

This Authorization applies to Phase No. _____, _____, of this Project, due _____ (d).

PROJECT TYPE: Check one block

EACH BLOCK LISTS THE COLUMNS TO BE USED IN THE ECONOMIC SUMMARY

TYPE \ STATUS →	NEW	REVISION	CONTINUATION
DEVELOPMENT	B, D, E	ALL	ALL
MAINTENANCE	A,B,D,E	ALL	A, B, C, E
OPERATION	B, E	ALL	A, B, C, E

ECONOMIC SUMMARY (BACKUP DETAILS ARE ON ATTACHED SHEETS)		A PREVIOUS EVALUATION	B THIS EVALUATION	C CHANGE IN PROJECT	D ALREADY SPENT	E THIS REQUEST COVERS
1) Total Development cost within CC	(b)	$	$	$	$	$
2) Average annual operating cost within CC	(b)	$	$	$	$	$
3) Decision level (Line 1 + Line 2)	(b)	$	$	$	$	$
4) Gross Value, Total for life of project	(c)	$	$	$	$	$
Effective life of project	(c)	yrs.	yrs.	yrs.		
Total for life of project						

PROJECT AUTHORIZATION FORM

Project Initiation

After management approval is obtained, the project enters the Computation Center. Data on the project authorization form is keypunched and entered into the computer system to be used in follow-up reports for review of project status.

Status Reporting

Sun Oil's philosophy on project reports is that anyone involved in a project will get a copy of the exact information about this project that also goes to the man above him, as well as more detailed information which he alone gets.

Three reports are produced on a monthly basis:

(1) A project summary lists all projects in progress. It identifies: project authorization code, description of the project, expenditures for the current month, project date status, current limit of funds budgeted for the project, and percentage of those funds used to date.

(2) Daily Summary for the month of machine run charges. Each user organization gets a report only for its own projects.

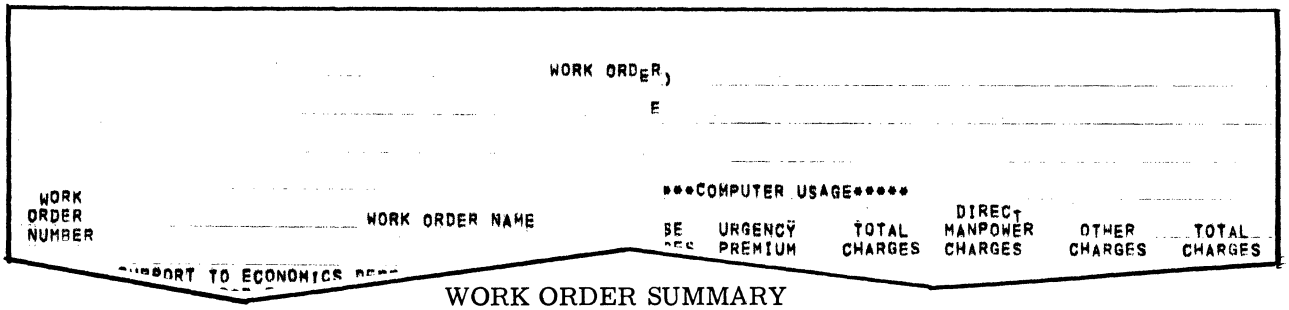
PAGE 1

DAILY SUMMARY FOR YEAR-DAY 152-181 ORGANIZATION *** PT ***

IDENT. NO.	PROGRAM NAME	S.NUMB	USER MESSAGE	DAY IN R+I	W.O. NUMBER	URGENCY CODE	CHARGEABLE TIME (MIN)	BASE CHARGES	URGENCY CHARGES	TOTAL CHARGES
SV=HJT	PMANT1	WE187	147-152	155	11902	D	3,054	34,33	-8,58	25,75
SV=HJT	PMANT1	MN054		167	11902	C	2,976	33,38	0,00	33,38
SV=HJT	PMANT1	TU062	B155156	168	11902	C	1,752	20,71	0,00	20,71
					SUBTOTAL FOR PROGRAM	PMANT1	7,782 $	88,42 $	-8,58	$ 79,84
					SUBTOTAL FOR W.O. #	11902	7,782 $	88,42 $	-8,58	$ 79,84
GA=SWZ		61003		0	11910	C	0,000	2,70	0,00	2,70
					SUBTOTAL FOR PROGRAM		0,000 $	2,70 $	0,00	$ 2,70
SV=HJT	DOCKET1	FR193		171	11910	Y	0,812	9,98	-3,26	6,72
SV=HJT	DOCKET1	FR090		171	11910	C	0,839	10,29	0,00	10,29
					SUBTOTAL FOR PROGRAM	DOCKET1	1,651 $	20,27 $	-3,26	$ 17,01
SV=HJT	MTTWX1	FR089		171	11910	C	0,056	2,70	0,00	2,70
SV=HJT	MTTWX1	FR194		171	11910	Y	1,117	13,46	-4,31	9,15
SV=HJT	MTTWX1	TU051	DATE	175	11910	C	1,091	13,16	0,00	13,16
					SUBTOTAL FOR PROGRAM	MTTWX1	2,264 $	29,32 $	-4,31	$ 25,01
							2,558	30,11	0,00	30,11

DAILY SUMMARY

(3) Work order summary in dollars for each department



WORK ORDER SUMMARY

Project Termination

Whenever a project is completed, or is terminated before completion, a project termination form is completed. It repeats estimates from the project authorization form, with figures added for the most recent evaluation made and for the termination evaluation.

#3557

C. C. PROJECT TERMINATION

THE SUN OIL COMPANY COMPUTATION CENTER PHILADELPHIA, PA.	REQUESTED BY		AUTH. NO.	
	REVIEWED FOR C. C. BY		REF. AUTH. NO.	
	APPROVED BY		W. O. NO.	
			TASK NO.	
			PROJECT TYPE CHECK ONE	
WITH CONCURRENCE FROM THE REQUESTOR, THE FOLLOWING PROJECT WAS COMPLETED/DISCONTINUED ON _____ (DATE). PLEASE CONTACT THE UNDERSIGNED AT EXT. _____ FOR FURTHER INFORMATION.			DEVELOPMENT	
			MAINTENANCE	
			OPERATION	

PROJECT TITLE

PROJECT DESCRIPTION

THIS PROJECT
☐ WAS
☐ WAS NOT
COMPLETED TO THE SATISFACTION OF THE REQUESTOR. (IF NOT, SEE COMMENTS BELOW)

ECONOMIC SUMMARY PW AT STARTUP, AT 12%	EARLIEST EVALUATION	MOST RECENT EVALUATION	TERMINATION EVALUATION
DATE OF EVALUATION			
PROJECT COMPLETION DATE			
1. TOTAL DEVELOPMENT COST WITHIN C.C.	$	$	$
2. AVERAGE ANNUAL OPERATING COST WITHIN C.C	$	$	$
3. DECISION LEVEL (LINE 1 + LINE 2)	$	$	$
4. GROSS VALUE, TOTAL FOR LIFE OF PROJECT	$	$	$

PROJECT TERMINATION FORM

One of the major objectives of Sun's Project Authorization System is to make sure that all data processing expenses are approved in advance by appropriate levels of management. The key-word here is "appropriate": a top executive cannot afford to spend a lot of time deciding on each of a long series of minor expenditures--nor can he afford to be unaware of a group of "minor" items which collectively represent a major expense. Sun's project system has special provisions for handling the two project-types which cause the most trouble in selecting appropriate decision levels.

Master Projects

One type occurs most frequently in service organizations. For example, one group of engineers use the computer to help solve problems in refinery operations. Past experience

indicates that they will spend about $40,000 on such work in the next year, but they cannot predict the specific problems which they will be working on. They know, however, that each problem will probably involve only a few thousand (or even hundred) dollars expense at the Center, and that it must be decided upon individually when it arises.

To handle this situation, they would set up a "master project" at the beginning of the year. The expected expense would be $40,000, and the expected value would be extrapolated from previous years' performances. By obtaining project approval for $40,000, they are sure that appropriate management supports the general level of expense involved. As each individual study arises under the master project, it is set up as a sub-project which only needs approval of its own relatively modest expense. There is no need to return to the $40,000 approval level unless the work being done strays significantly from the original description of type, profitability and expense.

Project Phasing

The second problem-area arises typically with major development efforts. Such efforts often involve several stages, and can seldom by evaluated reliably until after considerable sums have been spent to gather information. The originator of such a project is understandably reluctant to seek top-level approval before he has his economics and approach well-defined, and his management is similarly unwilling to give the entire project a premature go-ahead.

The problem is avoided by setting up a "phased project," in which the overall effort is broken down into successive stages. The work may then be started, based on approval of the first phase alone. At the end of each phase the entire project is reevaluated in the light of the most recently obtained information. Approval to proceed to the next phase must then be obtained at a level consistent with the expected cost of the next phase plus all earlier expenses on the project. The necessary decision level consequently climbs steadily upward while the reliability of the planning information is improving. The plans and evaluation should be firmed up for overall project approval before the final implementation phase is started.

For such problems, the Computation Center has developed guidelines for project planning:

Phase 1: Needs Analysis and Value Assessment. Establish broadly what the new system is to accomplish and the corporate value of the needs which are to be satisfied. This value then sets the incentive for continuing the study.

Phase 2: Feasibility Study. At minimum effort, estimate the cost of developing the system, and of using it operationally. The estimates are still relatively rough, but should give a better idea of whether to undertake the greater expense of detailed design.

Phase 3: Design and Economic Evaluation. Develop firm documents describing:

(a) detailed specification of what the system is to accomplish,

(b) detailed design of the computer system to meet the specifications,

(c) detailed analysis of system performance, of development and operating costs,

(d) detailed statements of resource requirements, schedules and monitoring procedures.

These items provide the firm basis for management review before the major expense of system implementation is undertaken.

Phase 4: Program Development and Testing. Write the actual computer code and debug it. User personnel test the debugged programs to assure that they perform as required.

Phase 5: File Conversion. Create the machine-oriented files necessary to start up the system. When appropriate, this may be concurrent with Phase 4.

Phase 6: User Training. This phase is needed only if the system is to be used directly by personnel who did not participate in the detailed specification. It may proceed in parallel with the latter stages of Phases 4 and 5.

Phase 7: Start-Up. All one-time activities associates with bringing the new system into operation, but which are not already covered in an earlier phase, are grouped into this phase. It may include, for example, a period of parallel operation with the system which it will replace.

Phase 8: Project Audit Report to Management. After the new system is operational, the effectiveness with which the project attained its economic and performance objectives should be reviewed.

A formal management review is suggested at the end of each of the first three phases to determine whether to continue with the project. No such detailed review is normally needed in later phases, except to monitor how well the project adheres to the schedules and economics established in Phase 3.

Prior to each of the first four phases, estimates should be prepared (or revised) showing expected expenses for all phases of the project. Only rough estimates would be possible before Phase 1, or course, but the estimates should become more reliable as the project proceeds. By the end of Phase 3, a firm economic analysis will be available for the entire project. The decision to proceed from one phase to the next can thus be based on the economics of the project as a whole, as presented at each management review.

RESULTS AND FUTURE PLANS

The project authorization and control system has placed the responsibility for project authorization and control where it should be, in the hands of management. The system gives management a direct accounting for each and every project in progress in terms of dollars, but more important it provides a meaningful way of evaluating and establishing priorities for projects before they get under way.

Better management control is undoubtedly the major benefit of the system, but it also has enabled the Computation Center to fulfill its function within the company at a price that is acceptable to management.

Various elements of the system have been refined since it was initiated and other improvements can be anticipated. The future plans hinge in large part on management decisions about how the information needs of the larger company, resulting from the recent merger of Sunray DX into Sun Oil Co., are going to be met.