Spreadsheet Aids for Financial Planning for Construction Projects

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Financial planning and cash flow management are difficult yet important management tasks to ensure cost-effective construction. The unavailability of adequate funding or poor financing strategies can restrict construction options, substantially increase costs, and delay project completion. Adopting innovative financing strategies for cash flow management can avoid or reduce such problems, especially when coordination of multiple funding sources is required. This paper describes a spreadsheet template useful for cash flow management including the evaluation of supplemental financing strategies such as overdrafts and revenue bonds to cover construction expenses. With the capability for simple user interaction, extensive numerical calculations, easy simulation of different options, and numerous report formats (including graphics), spreadsheets provide an excellent environment for financial planning. A spreadsheet template described in this paper provides a structure to easily and quickly employ these general capabilities; in many cases, only specific numerical information on cash flows and financing options needs to be entered for a particular application.

Cost controls and financing strategies during the construction phase may have a profound effect on the ultimate cost and effectiveness of capital projects. Short-term finance of construction can be a major cost category to contractors and suppliers, and these costs will be reflected in bid prices. Sudden work stoppage during construction due to inadequate funds can greatly increase costs. In essence, the timing of payments to the various parties in construction can mean the difference between profitability and loss for contractors and can greatly affect the financial planning of public agencies initiating the construction. Thus, improved management of financing during construction will be beneficial to all parties.

In this paper, a spreadsheet template useful to cash flow management in a transit agency is described. The electronic spreadsheets designed for microcomputers provide the capability for rapid user interaction in handling the extensive numerical calculations related to financial planning. The template described in this paper allows consideration of multiple revenue sources and financing strategies, including overdraft financing and revenue bonds. Simulated experiments requiring what-if conditions can also be accommodated.

Because various participants in the facility construction process have widely varying financial circumstances and incentives, the spreadsheet template must be flexible. Private participants such as suppliers, engineers, and contractors are

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subject to taxes and borrowing limits. Financial interest charges and equipment depreciation result in tax deductions for these private participants. Because of differences in risk and financial circumstances, borrowing costs will vary among the different private and public participants. Understanding these different influences is of great importance in assessing the desirability of alternative financing mechanisms. Financing from the contractor point of view has been developed in another paper (*1*). This paper will focus on financing options from the public agency point of view. More detail on calculations and appropriate strategies appears in a report on finance during construction (*2*).

CASH FLOW CALCULATIONS

Recently, more attention has been given in the literature to the effects of financing costs on the economic feasibility of constructed facilities (*3*). The financing costs for construction projects greatly depend on the financing strategy employed (*1*). Thus, there is a need for a systematic procedure for evaluating the effects of various financing strategies on the project cash flows. Spreadsheet templates are powerful tools for evaluating the alternative financing strategies that exist for both the construction contractor and contracting agency.

For an owner agency, cumulative expenditures for a project represent payments to contractors or suppliers, while cumulative receipts represent grant, tax, or other revenues. Suppose that the payments made to the contractors by the agency during a period can be approximated by a piecewise continuous curve as shown in Figure 1, while the grant funds are received at the end of a period as represented by the step function in the same figure. To the extent that grant revenues do not exactly match expenditures, problems in financing can arise. Shortfalls in revenues must be bridged, whereas excess revenues present an opportunity for investment income. Moreover, there may be opportunities for reducing the total cost by altering the shape of the expenditure curve or that of the payment curve.

As an example, consider a public project that is funded by federal and local grants. The anticipated duration of the project is 6 years with receipts from grant funds allocated at the end of each year to cover 90 percent of payments to contractors for that year while the remaining 10 percent of the total payments to contractors will be allocated at the end of the sixth year. The end-of-year payments are given in Table 1 in which $t = 0$ refers to the beginning of the first year. The net
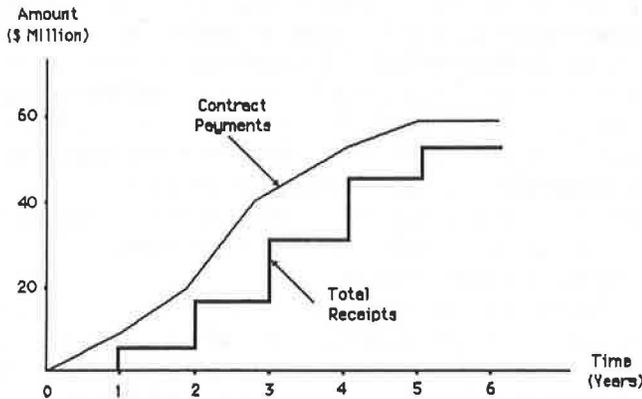
FIGURE 1   Contract payments and revenue receipts over time.

cash flow in Table 1 indicates that receipts are behind contract payments. To fund this shortfall, the public agency might borrow funds through bank overdrafts or some other mechanism to cover the expenses during the year and the cumulative overdraft due to a shortfall from grant funds at the end of each year. In this example, the cash flow calculations are shown for two financing mechanisms: (1) overdraft financing and (2) revenue bonds.

In order to make an appropriate comparison of the effects of various financing strategies, the net present value (NPV) of a cash flow A_t for $t = 0,1,2,...,n$, discounted at the minimum attractive rate of return ($MARR$) for the public agency is used to account for the time value of money. For $MARR = r$,

$$NPV = \sum_{t=0}^{n} A_t (1 + r)^{-t} \tag{1}$$

In overdraft financing, the interest on the cumulative overdraft due to a shortfall from grant funds at the end of each period t is given by

$$I_t = N_{t-1} i \tag{2}$$

where N_{t-1} is the cumulative net cash in period $t - 1$ (positive for a balance and negative for a shortfall), and i is the interest rate for that period. For $t > 0$, the interest on the average expenses during the period t can be approximated by

TABLE 1   CONTRACT PAYMENTS AND REVENUE RECEIPTS OVER TIME

End of Year t	Payments by Agency E_t	Total Receipts P_t	Net Cash Flow A_t	Cumulative Cash Flow N_t
0	0.000	0.000	0.000	0.000
1	-6.473	5.826	-0.647	-0.647
2	-9.334	8.401	-0.933	-1.580
3	3.348	12.013	-1.335	-2.915
4	-16.832	15.149	-1.683	-4.598
5	-15.538	13.984	-1.554	-6.152
6	0.000	6.152	6.152	-0.000
Total	-61.525	61.525	-0.000	

NOTE: Amounts of money are expressed in millions of dollars.

$$\bar{I}_t = iE_t/2 \tag{3}$$

where E_t is the payment by the agency for period t, recorded with a negative sign because it is a cost. Then the total annual financial or interest expenses incurred by the public agency will be the sum of the interest charges:

$$\hat{I}_t = (N_{t-1} i) + (iE_t/2) \tag{4}$$

Using additional overdrafts to cover cumulative shortfalls resulting from $\hat{I}_t$ until the end of year n, the total interest at $t = n$ is given by

$$D = [NFV]_i = \sum_{t=1}^{n} \hat{I}_t (1 + i)^{n-t} \tag{5}$$

where NFV is the net future value at the end of year n. Thus, no interest payment is made at ends of periods 1 to $n-1$. A numerical example of overdraft financing using an annual interest rate $i = 10$ percent for borrowing is shown in Table 2. Note that at $n = 6$, there is an overdraft of $D = -6.451$, which the agency must repay the bank.

TABLE 2   INTEREST RESULTING FROM OVERDRAFT FINANCING

End of Year t	Interest of Cumulative Overdraft I_t	Interest on Payments in Year t $\bar{I}_t$	Total Annual Interest $\hat{I}_t$	Accumulation Until Year $n = 6$ $\hat{I}_t (1+i)^{n-t}$
0	0.000	0.000	0.000	0.000
1	0.000	-0.356	-0.356	-0.600
2	-0.071	-0.513	-0.585	-0.887
3	-0.074	-0.734	-0.908	-1.242
4	-0.321	-0.926	-1.246	-1.536
5	-0.506	-0.855	-1.360	-1.510
6	-0.677	0.000	-0.677	-0.677
Total				-6.451

NOTE: Interest is expressed in millions of dollars.

Of course, the agency may choose to pay the annual interest for the overdraft at the end of each year without accumulating them to the end of the last period n. Then, the net present value for such interest payments for limited overdraft financing discounted at a $MARR$ of r is given by

$$[NPV] = \sum_{t=1}^{n} \hat{I}_t (1 + r)^{-t} \tag{6}$$

For the values of $\hat{I}_t$ in Table 2, discounted at $r = 10$ percent, $[NPV]_r = -3.567$ for limited overdraft financing. By contrast, the net present value of $D = -6.451$ discounted at $r = 10$ percent is $[NPV]_r = -3.642$. Because the borrowing rate $i = 11$ percent is higher than the $MARR$ of $r = 10$ percent, it is more costly to accumulate the annual interests as additional overdrafts until the end.

A second possible financing strategy is to issue revenue bonds during construction. The purpose of revenue bonds is for a public agency to borrow funds, secured by a grant or other revenue commitment, to cover delays in receipts. The agency borrows an amount Q (including issuing cost), in period $t = 0$, at a specified interest rate i, where Q is defined as negative for borrowing. The issuing cost of the bond is kQ, where k is a percentage of the amount borrowed. The net amount $(1 - k)Q$ received from borrowing is deposited in a separate revenue bond account in period $t = 0$. In each subsequent period t, the agency draws from the revenue bond account an amount equal to the shortfall in grant receipts N_t plus the bond interest on the borrowed amount Q during period t. Net cumulative cash flow in period t is given by

$$A_t = P_t + E_t \tag{7}$$

For $t > 0$, the interest $\bar{I}_t$ on the average payments during the period t as determined by Equation 3 will also be paid out from the project account. Let C_t be the drawdown of the project account in period t. For $t = 0, C_0 = A_0$; and for $t > 0$,

$$C_t = A_t + \bar{I}^t + Qi \tag{8}$$

Let R_t be the project account balance in period t, defined as positive for deposit in the account. Then, for $t = 0$,

$$R_0 = -(1 - k)Q + C_0 \tag{9}$$

The running balance in the project account can earn interest at a rate h; thus, the balance of the project balance in period t (for $t > 0$) is

$$R_t = (1 + h) R_{t-1} + C_t \tag{10}$$

Because the bond rate i for borrowing will generally exceed the investment rate h in the bond account and because issuing costs increase with the amount borrowed, the agency financial manager should minimize the amount of money borrowed under the revenue bond strategy. Thus, there is an optimal value for Q such that all estimated grant shortfalls are covered and interest payments and expenses are minimized. At the optimal level of Q, all values of R_t should be positive or zero because the repayment of Q in the terminal period n is not included in R_n. To minimize Q, a value of Q is selected such that at least one of these R_t values is zero. The cash flow

profile for the 6-year transit project under revenue bond financing (using 1 year for the period) for the same numerical example is shown in Table 3. Using a bond rate $i = 8$ percent, project account interest rate $h = 7$ percent, and the issuing cost at $k = 5$ percent of the bond value, the optimal value for Q is found to be -11.032. This is the amount just sufficient to cover the shortfalls in grant receipts as shown by an account balance of zero in Year 5. In practice, it may be desirable to select a Q slightly higher to account for uncertainty in the expense and revenue streams.

For revenue bond financing, the shortfall for the repayment of Q at $t = n$ is $Q + R_n$, because Q is defined as negative for borrowing. Hence the present value of the shortfall for revenue bond financing discounted at a *MARR* of r is

$$[NPV]_r = (Q + R_n)(1 + r)^{-t} \tag{11}$$

For the numerical example in Table 3, $Q = -11.032$ and $R_6 = +5.269$; hence, the shortfall at $n = 6$ is given by $Q + R_6 = -5.763$. Note that the value of Q is affected by the bond rate i and the interest rate h for the project account as well as the percentage k for the issuing cost.

In comparing the value of $Q + R_6 = -5.763$ at $n = 6$ resulting from revenue bond financing with the value of $D = -6.451$ at the same period resulting from overdraft financing, it is obvious that revenue bond financing is preferred because the value $Q + R_6$ is higher (less negative) than that of D. Similarly, the present value of $Q + R_6$ is -3.253 against the present value of D, which is -3.642 and more negative. On the other hand, if the agency pays the annual interest without accumulating them to the last period, then $[NPV]_r = -3.567$ from limited overdraft financing as opposed to $[NPV]_r = -3.253$ for revenue bond financing. Consequently, revenue bond financing is still more desirable than limited overdraft financing in this case because of the much lower borrowing rate.

VARIATIONS IN FINANCING CASH FLOWS

The cash flows representing payments to contractors and revenue receipts may vary from the basic cash flow presented earlier. Certainly, many variations of cash flows may be considered to evaluate their consequences. For example, the timing of payments to contractors may coincide with that of revenue receipts. Then, the relationship between the two will

TABLE 3   PROJECT FINANCING USING REVENUE BOND

End of Year t	Net Cash Flow A_t	Interest on Payment in Year t $\bar{I}_t$	Withdrawal from Account C_t	Project Account Balance R_t	Revenue Bond Cash Flow A_t
0	0	0.000	0.000	10.480	10.480
1	-0.647	-0.259	-1.788	9.426	-0.882
2	-0.933	-0.373	-2.189	7.896	-0.882
3	-1.335	-0.534	-2.751	5.698	-0.882
4	-1.683	-0.673	-3.239	2.858	-0.882
5	-1.554	-0.622	-3.058	0.000	-0.882
6	6.152	0.000	5.269	5.269	11.914

NOTE: Amounts of money are expressed in millions of dollars.

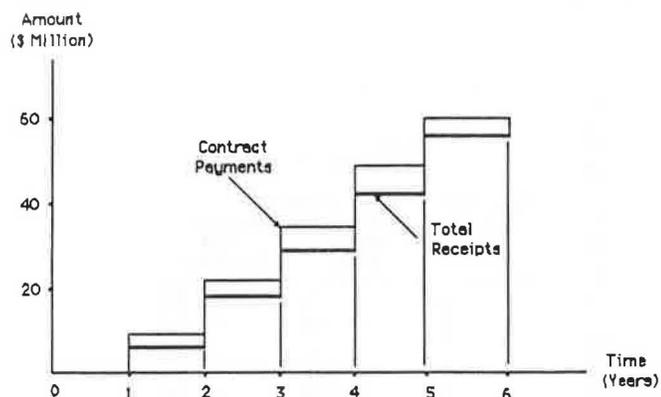be as shown in Figure 2, and the term $\bar{I}_t$ in Equation 3 will be zero.

FIGURE 2 **Projects with identical payment and receipt periods.**

If the timing of payments to contractors always coincides with that of revenue receipts, then there will be no interim interest for any period t, that is, $\bar{I}_t = 0$. The effects of interim interest on project financing for both overdraft and revenue bond cases for the data in Table 1 are recorded in Table 4. It can be seen that the matching of the timing of payments and receipts reduces the expenses in both cases.

On the other hand, if the contractor is paid without retainage at the end of each period but the agency receives the same amount one period later, the result can be quite detrimental to the agency. Even without interim interest because payments and receipts are transacted at the ends of periods only, the shortfalls are large. Consider the same project in Table 1 for which the grant receipts P_t lag behind the contract payments E_t by one period, that is, $P_{t+1} = -E_t$ for $t = 1, 2, 3, 4,$ and 5 instead of the values P_t given in Table 1. Then the resulting shortfalls for both overdraft and revenue bond financing corresponding to $\bar{I}_t = 0$ are summarized in Table 5.

In the computational procedures discussed thus far, it has been implicitly assumed that the amounts of the particular cash flow increments, the timing of these increments, and the rate of discount are known with certainty. In reality, forecasts of these quantities are highly uncertain. Many potential cash flow uncertainties exist for both the construction contractor and the transit agency. Unforeseen circumstances such as cost overruns or changes in grant provisions can dramatically alter the cash flows, and consideration should be given to the uncertainty of such quantities. An analytical approach to accommodating for uncertainty in cash flow items is discussed by Bussey and Stevens (4).

The effects of uncertainty may be observed by developing what-if scenarios of circumstances affecting the cash flow profiles. For example, if the project is not to begin for a sufficiently long period of time, there is significant uncertainty associated with borrowing rates. In such an instance, the calculations presented here may be repeated for different borrowing rates, thus generating the range of possible values for project worth under a given financing strategy.

In the construction of public projects, the cash flow period is often taken to be 1 month, thus the calculations of net cash flow, cumulative net cash, interest, and net present value are made for every month of the project. In general the interest rate per period and whether the period is 1 month or 1 year must be specified, and other related values are computed accordingly. It may also be the case that receipts are based on

TABLE 4   EFFECTS OF INTERIM INTEREST IN FINANCING

Items	Overdraft Financing ($i = 11\%, r = 10\%$)		Revenue Bond Financing ($i = 8\%, h = 7\%, k = 5\%, r = 10\%$)	
	$\bar{I}_t = iE_t, 2$	$\bar{I}_t = 0$	$\bar{I}_t = iE_t/2$	$\bar{I}_t = 0$
D	-6.451	-1.979	—	—
Q	—	—	-11.032	-7.880
$[NPV]_{r=10\%}$	-3.642	-1.117	-3.253	-1.332

NOTE: Amounts of money are expressed in millions of dollars.

TABLE 5   EFFECTS OF DELAY OF REVENUE RECEIPTS BY AGENCY

Items	Overdraft Financing ($i = 11\%, r = 10\%$)		Revenue Bond Financing ($i = 8\%, h = 7\%, k = 5\%, r = 10\%$)
	Accumulated to $n = 6$	Limited to Current Year	
D	-12.531	—	—
Q	—	—	-24.954
$[NPV]_{r=10\%}$	-7.073	-6.940	-6.442

NOTE: Amounts of money are expressed in millions of dollars.

projections from past expenses, so that calculations of expected receipts are required. Editing and updating data are often necessary to perform sensitivity analysis. With all of these calculations, it becomes clear that the numerical calculations in construction cash flow analysis can be extensive. In the sections that follow, electronic spreadsheets are shown to be valuable aids in performing the calculations necessary for construction cash flow and financial evaluation.

SPREADSHEETS AND NONPROCEDURAL PROGRAMMING

Electronic spreadsheets, first introduced in 1978, have become highly popular in the business world (5). Some of the most popular business applications of spreadsheets include budget planning, depreciation calculations, and capital investment analysis. Spreadsheet programs are conceptually easy to learn and offer some significant advantages over conventional procedural programming.

Spreadsheets are simply a programming environment for organizing and manipulating data. The data are organized into a matrix of rows and columns forming cells. Cells can store data in many forms such as letters, numerical values, and formulas. Formulas usually contain references to other cells. Thus, cells may be linked together by formulas. The power of the spreadsheet is seen upon changing the data of a given cell. When a change is made in the data of one cell, the data of all cells linked to it are updated accordingly.

More generally, spreadsheets are a form of nonprocedural programming. Unlike procedural programs, which lead the user through a controlled and fixed flow of procedures or statements, spreadsheet environments allow the user to interact with any portion of the spreadsheet at any time. Also, in nonprocedural programming environments, the programmer may add or remove programming statements at any place and at any time. Procedural languages or environments do not provide such flexibility.

Spreadsheets can be developed and saved for multiple uses as templates for specific applications. In templates, user input, formulas, and output can be organized in a modular fashion and extensive user aids can be provided. Templates for hundreds of applications including personal finance and construction management have become commercially available.

As a simple example of a spreadsheet programming environment, consider the computation of discounted cash flows using a 10 percent discount rate in Figure 3. The table represents a portion of a spreadsheet where the columns are referenced by letters and the rows by numbers. The net cash flow for each period and the discount rate are simple numerical data entries. The time periods are listed in Column *A*, Rows *11* through 17, the constituent cash flow stream to present is listed in Column *B*, Rows *11* through *17*, and the interest rate appears in Cell *C4*. The discounted cash flow stream is listed in Column *C*, Rows *11* through *17*; each of these cells contains a formula discounting the cash flow value in Column *B* to period 0; the calculated value from the formula is displayed on the computer screen as shown in

Figure 3. For example, the Cell *C13* contains the following formula:

$$C13 = B13*(1+C4)^{-2}$$

	A	B	C	D
1				
2				
3		MARR		
4		r (in %) =	10	
5				
6	===			
7	End of	Net	Discounted	
8	Year	Cash	Net	
9	t	Flow	Cash Flow	
10	===			
11	0	0	0.000	
12	1	-0.647	-0.588	
13	2	-0.933	-0.771	
14	3	-1.335	-1.003	
15	4	-1.683	-1.150	
16	5	-1.554	-0.965	
17	6	6.152	3.473	
18				

FIGURE 3   Example of spreadsheet cash flow calculation.

or, in the notation of the spreadsheet program LOTUS 1-2-3™.

$$B13*(1.+\$C\$)\hat{4}-2.$$

The cell *C19* containing the *NPV* of the cash flows has the following formula:

$$C19 = SUM(C11...C17)$$

Note that these formulas are linked to the cash flow data and the discount rate. Thus, to reevaluate the *NPV* for a discount rate of 20 percent, the entry in Cell *C4* need only be changed from 10 to 20. Additional periods can be easily added to the cash flow stream using the copying and transfer utilities found in all spreadsheet packages. Also, the data in this example can be linked to other cells in order to compute other quantities such as net future value (*NFV*) and cumulative interest payments (6).

Because spreadsheets are nonprocedural, there are no restrictions as to what operations the user can perform. In this simple example, the user is free to change the cash flow values, append periods to the cash flow stream, change the interest rate, program an additional formula, or work on a different portion of the spreadsheet.

The data-manipulating and calculating properties of spreadsheets allow one to study the results of what-if scenarios and to quickly simulate a financial or physical system (7). Given a system of inputs (numerical data stored in cells), formulas linking these cells, and outputs, new scenarios are created by changing the numerical values of the input data. Most spreadsheets contain features and functions that can be readily applied to templates for financial evaluation (8):

1. Mathematical operators such as summation and exponentiation are useful in computing such quantities as *NPV*, cumulative cash flows, and interest payments.

2. Conditional operators such as if-then-else statements allow a logical modeling of financial strategies. For example, consider an overdraft strategy where the proportion of construction expenditure borrowed is conditional on the period of the project. This rule can be easily represented in an if-then-else format.

3. Graphics are a powerful advantage of spreadsheet environments. In evaluating financing strategies, graphics such as XY plots are useful in viewing drawdown forecasts or cumulative project expenditures versus cumulative project receipts.

4. User interfaces such as menus, text editors, and help facilities make spreadsheets easy to learn and use. Also the conceptual representation of data into rows and columns facilitates the use of spreadsheets. Templates using these facilities allow financial managers to duplicate the effects of financing strategies under numerous scenarios.

A TEMPLATE FOR AGENCY FINANCIAL EVALUATION

The template described in this paper is divided into five separate sections for introduction, data entry, financial strategy development, preevaluation, and evaluation. The introduction section is for guiding the user in working with the template. Project-specific information such as interest rates, estimated expenditures, and revenues are entered in the data entry section. Note that information entered in the data entry section is project information that is independent of any financing strategy. A section is provided for financial strategy development, in which financing streams for particular strategies can be computed. The cells in the preevaluation section contain intermediate formulas that link the input data with the output data. Finally, the evaluation section provides an evaluation of the scenario entered including graphics.

The general flow of a financial evaluation session is shown in Figure 4; however, the user may interact with any of the template sections at any time. Issues in spreadsheet design and organization are discussed by Bromley (9). To illustrate the organization and use of the template, consider the 6-year example project described earlier. Because revenue receipts do not exactly match expenditures, problems in financing can arise. Two possible financing strategies are (a) to borrow for the initial expenditures and use overdrafts to cover expenses during the year, and (b) to issue revenue bonds for shortfalls in grant receipts.

Evaluating the two strategies begins with entering the template. The introduction section is menu formatted to indicate locations on the spreadsheet prepared for specific
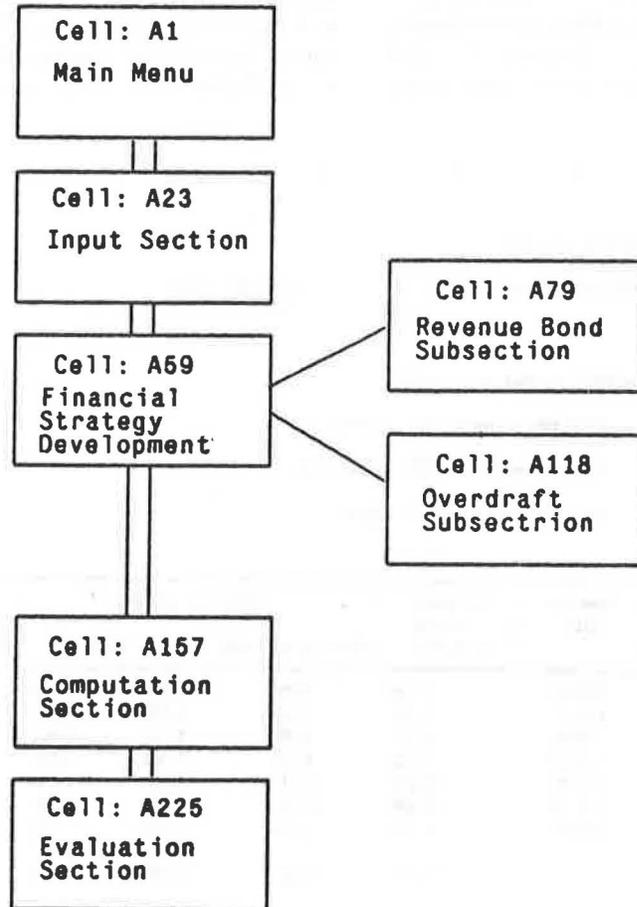

FIGURE 4   Sectional overview of the financial evaluation template.

purposes. Simple commands are available to go to any particular template section. The purpose of this section of the template is to assist the user; thus, this section is never altered. Figure 5 shows the layout of data entry sections for this example. For each of the six periods, the analyst must enter estimates for payments by the agency and revenues from various sources, in this case matching federal and state grants. The payments by the agency and grant revenues for this example are identical for both alternative financing schemes. Also the opportunity cost of capital or *MARR* for the agency must be entered, and a value of 10 percent will be used for this example. The only computation performed in this section is a totaling of the revenues. In cases in which receipts are a function of expenses, formulas to calculate revenues could be added in Columns *D, E,* and *F.*

The financial strategy development section is divided into subsections, one subsection for each possible financing scheme. A portion of the subsection for overdraft financing is shown in Figure 6. For overdraft financing, the annual interest rate for borrowing and the portion of expenses for which interest will be paid must be entered; two possible values are 11 and 50 percent, respectively. The former refers to the borrowing rate i = 11 percent, while the latter refers to the factor of $1/2$ (50 percent), representing approximately the average interest of payments in the period t. Upon entering these values, the financing costs associated with expenses and cumulative overdraft are calculated as shown.

The revenue bond financing subsection is shown in Figure 7. Values for the bond interest rate, account investment rate, and the issuing cost must be entered. In this example, we let the bond rate equal 8 percent, the project account interest rate

equal 7 percent, and the issuing cost equal 5 percent of the bond value. This subsection displays the shortfalls of grant receipts, the revenue bond cash flow, and the cumulative balance of the bond account; these quantities are recalculated upon entering an estimate for the borrowing value. The template informs the user whether a given estimate is above or below the optimal value.

The evaluation section of the template contains intermediate calculations necessary to obtain the net present worth of the project cash flow under each of the financing alternatives, that is, revenue bond financing versus limited overdraft financing. Here it is clear that the revenue bond financing is preferred, because the shortfalls are algebraically greater than that of overdraft financing. However, the evaluation could be otherwise if some conditions are changed. Consider the limited overdraft financing strategy for which annual interests are paid in each of the t periods of the project. Therefore, unlike overdraft financing, the net present value of interest payments is dependent on the *MARR* of the agency. The user may wish to view this section, which provides such intermediate quantities as the net cash flow stream, cumulative net cash flow, present value of financing costs, and others. Figure 8 is a view of a portion of the computation section for this example.

The evaluation section displays the resulting net present value of the after-financing project cash flow under a financing alternative and provides a menu of graphical utilities for evaluation and report generation. The graphical plots include cumulative expenditures and cumulative receipts versus time, receipts less expenditures versus time, and net present value versus interest rate.

	A	B	C	D	E	F	G
25							
26	Hit Home to return to main menu						
27							
28		Periodical discount rate or MARR			Number of periods:		
29			10 %		6		
30							
31							
32	Please enter estimated payments and receipts:						
33							
34		enter revenue source "A":		federal grant			
35							
36		enter revenue source "B":		local grant			
37							
38		enter revenue source "C":		other			
39							
40							
41							
42	Project	Expected	Estimated	Estimated Revenues			Total
43	Period	date	Payments				Estimated
44	t		by Agency	federal grant	local grant	other	Revenues
45							
46	0	1/23/80	0.000	0.000	0.000	0.000	0.000
47	1	1/16/81	6.473	4.661	1.165	0.000	5.826
48	2	1/30/82	9.334	6.721	1.680	0.000	8.401
49	3	1/24/83	13.348	9.610	2.403	0.000	12.013
50	4	1/10/84	16.832	12.119	3.030	0.000	15.149
51	5	1/23/85	15.538	11.187	2.797	0.000	13.984
52	6	1/14/86	0.000	4.922	1.230	0.000	6.152
53							
54	Total		61.525	49.220	12.305	0.000	61.525
55							

FIGURE 5 Data entry section of the financial evaluation template.

An evaluation between the two financing alternatives considered in this example can be made directly by comparing the shortfalls in period $t = 6$ due to revenue bond financing $Q - R_6 = -5.763$ and the annual interests due to limited overdraft financing, which are shown in the preevaluation subsection (Figure 8). The evaluation section allows one to view the project cash flows and present values under both financing strategies.

Finally, an example of graphic display of a plot of the *NPV* versus the *MARR* for the two alternative financing strategies for the 6-year project example is shown in Figure 9. As indicated in Figure 8, in which *MARR* = 10 percent is used,

	A	B	C	D	E	F	G
126							
127							
128	Hit Home to return to main menu						
129							
130		Overdraft Financing:					
131							
132		Borrowing rate per period:					
133				11 %			
134							
135		Interest of payment in periods (percent approximation)					
136				50 %			
137							
138							
139							
140							
141	Project	Expected	Pre-Financing	Cumulative	Interest of	Interest	Total
142	Period	date	Net Cash	Net Cash	Payments	Cumulative	Annual
143	t		Flow	Flow	in Year t	Overdraft	Interest
144							
145	0	1/23/80	0.000	0.000	0.000	0.000	0.000
146	1	1/16/81	-0.647	-0.647	-0.356	0.000	-0.356
147	2	1/30/82	-0.933	-1.580	-0.513	-0.071	-0.585
148	3	1/24/83	-1.335	-2.915	-0.734	-0.174	-0.908
149	4	1/10/84	-1.683	-4.598	-0.926	-0.321	-1.246
150	5	1/23/85	-1.554	-6.152	-0.855	-0.506	-1.360
151	6	1/14/86	6.152	-0.000	0.000	-0.677	-0.677

FIGURE 6   Overdraft financing subsection of the financial evaluation template.

	A	B	C	D	E	F
84						
85	Hit Home to return to main menu					
86						
87		Revenue Bond Financing:				
88						
89		Periodical interest on bonds:		Issuing cost:		
90				8 %	5 %	
91						
92		Periodical interest on bond account:				
93				7 %		
94						
95		Interest of payment in periods (in %):				
96				50 %		
97		Total value of revenue bonds issued:				
98				11.032		
99						
100	Minimum project account value through					
101	period t=n-1:			0.000		
102						
103						
104	Project	Expected	Pre-financing	Interest of	Withdrawal	Project
105	Period	date	Net Cash	Payments	from	Account
106	t		Flow	in Year t	Account	Balance
107						
108	0	1/23/80	0.000	0.000	0.000	10.480
109	1	1/16/81	-0.647	-0.259	-1.788	9.426
110	2	1/30/82	-0.933	-0.373	-2.189	7.896
111	3	1/24/83	-1.335	-0.534	-2.751	5.698
112	4	1/10/84	-1.683	-0.673	-3.239	2.858
113	5	1/23/85	-1.554	-0.622	-3.058	0.000
114	6	1/14/86	6.152	0.000	5.269	5.269
115						

FIGURE 7   Revenue bond financing subsection of the financial evaluation template.

the revenue bond financing is preferred over both cumulative overdraft and limited overdraft financing. The breakeven point between limited overdraft financing and revenue bond financing for this case appears at $MARR = 5.6$ percent in Figure 9, below which the limited overdraft strategy becomes more desirable.

CONCLUSIONS

This paper has presented the concept of using a spreadsheet template for cash flow management. With widespread use of microcomputers, the spreadsheet template provides a useful aid for user interaction in an environment for financial planning. Numerical examples have been given to illustrate the capability and flexibility of the spreadsheet template in analyzing various financing strategies during construction.

ACKNOWLEDGMENT

	A	B	C	D	E	F
164						
165						
166	Hit Home to return to main menu					
167						
168						
169	MARR =					
170	10 %					
171						
172	======	======	======	======	======	======
173	Project	Expected	Pre-financing	Deficit from	Interest	Limited
174	Period	date	Net Cash	Revenue Bond	Overdraft	Overdraft
175	t		Flow	Financing	Financing	Financing
176	======	======	======	======	======	======
177	0	1/23/80	0.000	0.000	0.000	0.000
178	1	1/16/81	-0.647	0.000	0.000	-0.356
179	2	1/30/82	-0.933	0.000	0.000	-0.585
180	3	1/24/83	-1.335	0.000	0.000	-0.908
181	4	1/10/84	-1.683	0.000	0.000	-1.246
182	5	1/23/85	-1.554	0.000	0.000	-1.360
183	6	1/14/86	6.152	-5.763	-6.451	-0.677
184						
185		Present Value:	-1.004	-3.253	-3.642	-3.567
186						

FIGURE 8 Preevaluation section of the financial evaluation template.
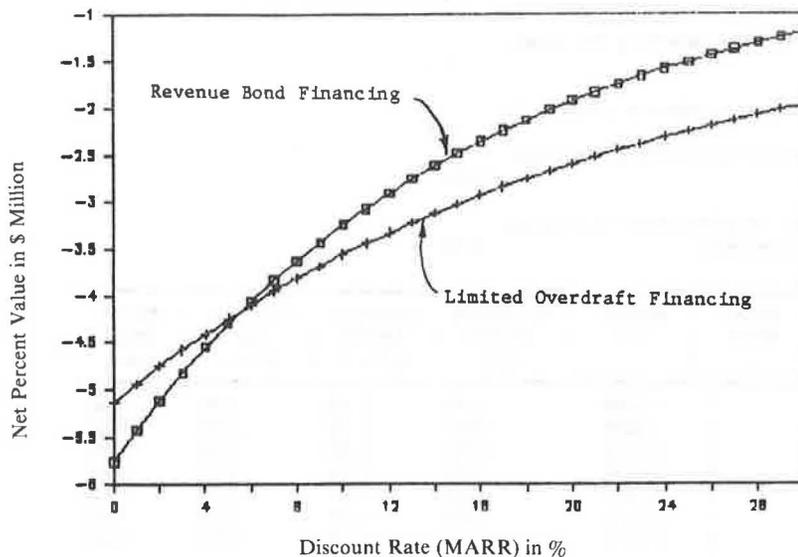

FIGURE 9 Graphical representation of *NPV* versus *MARR* for two financing strategies.

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