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ABC of Cash Flow Projections

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Cash flow is the life line of a business. Many start-up companies fail because of insufficient cash flow. From the perspectives of both owner and contractor, managing cash flow is vital to a successful project. Cash flow is where the project cost meets the schedule. Cash flow projections developed from credible project execution plans become the basis of project controls. Combining the cash flow and earned value technique, a project can track the real status of progress and detect any early cost deviation. A poor cash flow projection could lead to an inability to fund the project or impose undue stress to the project execution team.

A project typically goes through multiple phases prior to the final approval. Cost estimates, schedule and an execution plan are developed at each phase. Cash flow projection is also prepared to support funding decision at each phase. The sophistication of cash flow projection increases as it moves toward the final project approval. Each project is unique in its execution and hence in its cash flow projection. However, there are basic concepts that are applicable to development of any cash flow projection. This paper describes simplified tools that will facilitate the cash flow projection.

CASH FLOW VS. EXPENDITURE

The terms cash flow and expenditure are used interchangeably by many project teams and organizations. In a strict sense, expenditure is the cost incurred after receiving goods or services. Accrual liability includes invoices received on hand, but not yet processed and represents a portion of payment obligation. From an owner's perspective, the project cash flow is the actual payments made to meet expenditure obligations. A corporation funds the project through the internal operation cash flow or finances the project from outside sources.

Contractors perform the work and have to meet the weekly payroll obligation. In addition, materials are procured to support the construction as the project progresses. Depending on the construction contract style, contractors usually receive payments from the owner based on milestone progress or other negotiated measurements. Contractors have to prepare invoices with supporting documents prior to payment submittal requests. Owners also take time to review invoices and process payments. It is not unusual for contractors to receive discrete payments 30 to 60 days after the cost was actually incurred. The difference between the actual expenditure and payment received is the cash flow that a contractor needs to finance on a short-term basis. Contractors generally recover such finance charges through overhead, fees or large upfront mobilization charges. Refer to figure 1 for an example of a typical contractor cash flow chart presented in the November 2006 **Cost Engineering** journal by Tarek Hegazy [4].

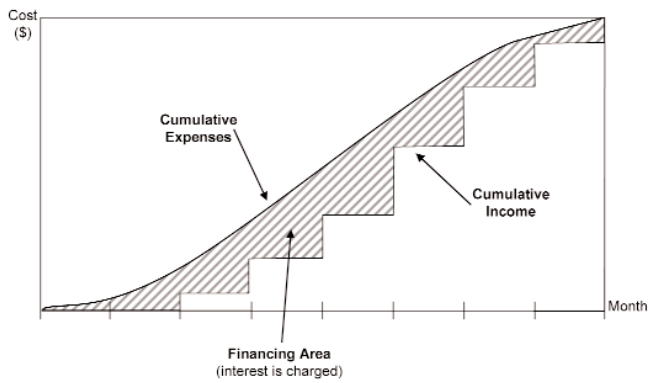

Figure 1— Contractor's Project Cash Flow

Accurate cash flow projections are important to both an owner and a contractor. A corporation's business plan generally includes multi-year cash flow and expenditure forecasts. Inaccurate cash flow projection of a large project could steer business leaders to make decisions that are not in the best interest of the company. In order to recover finance charges, contractors depend on the cash flow projection. A poorly developed projection could lead to either over or under bidding a contract, resulting in lost business opportunity or incurred financial loss. For a contractor to maintain competitiveness, construction cash flow projections must be realistic and accurate. A preferred method is for an owner to negotiate payment schedule with a contractor using a cash neutral approach to minimize the contractor's finance charges. Using a cash neutral method, discrete payments received from an owner are essentially sufficient to cover the projected contractors' cash flow requirement.

The project cash flow projection is derived from an execution plan and estimated expenditure. Many projects treat estimated expenditures as cash flow projections. In fact, cash flow generally lags actual expenditure by one accounting period; i.e., one month. A planned project cash flow is the baseline for comparison with the actual project expenditure. Deviation from the planned cash flow is analyzed by the project controls specialist

and/or project manager to determine any corrective actions required for the remaining work. For example, is the project truly ahead of schedule or heads toward the inevitable final cost overrun if the actual spending is too fast? Conversely, when the actual spending is too slow, is the project behind the schedule or expects to achieve a budget underrun? By incorporating an earned value system, an objective evaluation will reveal the true project status.

FACTORS LEADING TO CASH FLOW VARIANCE

Final project costs of many successful projects are typically well within a reasonable range of the approved budget. However, the actual expenditure per period might vary from the planned cash flow by a large margin. Key factors leading to cash flow variance include the following.

- Project managers are typically optimistic and develop execution plan and progress curves based on an early start schedule. [3]
- Aggressive large contract negotiations generally result in releasing payments from owners later than the initial plan.
- A contractor incurs the cost first, but needs time to assemble all invoice supporting documents. The time delay ranges from two weeks to two months depending on the contract style and contractor's management capability.
- Inherent time delay associated with the invoice approval cycle. Owner's approval and actual payment check release could take 30 days or more after receiving an invoice.
- Delay in receiving equipment or construction materials that impacts the engineering or construction progress.

To minimize cash flow variance, it is essential to develop a credible project execution plan with inputs from the owner, key equipment suppliers, engineers and contractors at project front end planning. When key parties are not available, analyzing past similar projects can be used as a second method. When using this method, material differences in schedule, labor availability, and/or geographic locations should all be taken into consideration.

Capitalized interest is calculated from the actual cash flow on a monthly basis. It is a component of the true cost to implement a project. A corporation's annual financial report also includes capitalized interests from all projects. It is the project manager's responsibility to provide accurate cash flow data to meet the corporation's business strategy and ever increasing accounting requirements.

PRE-REQUISITE OF A CASH FLOW PROJECTION

A cash flow reflects goods and services received. Process equipment payment schedules are typically tied to critical engineering documents and manufacturing progress. Engineering and construction cash flows follow closely with the resources (i.e., work hours) applied. Engineering resource is needed at the project's front end. It builds up to a peak level quickly then tapers off over a long period to support construction. On the other hand, the construction resource tends to reach a peak level over a long period, and then quickly runs down toward the construction completion. Both engineering and construction resource profiles resemble trapezoids with different peak resource levels as shown in figure 2. Trapezoidal approximation can be applied to most projects except shutdown turnaround projects. [1, 2].

The accuracy requirement of cash flow projection varies with project phase. A quick and simple projection is needed at the opportunity study. As a project moves through the feasibility study and final approval, the expected degree of accuracy

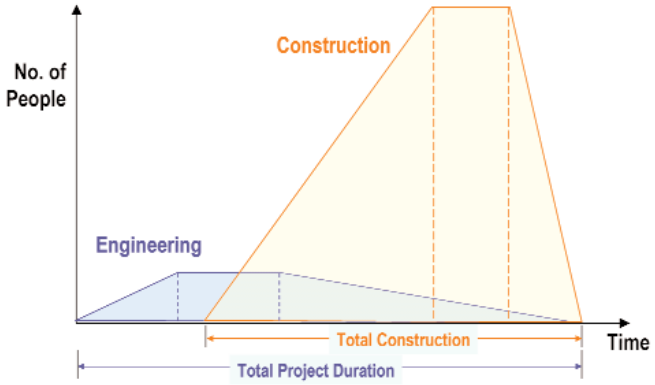

Figure 2—Engineering and Construction Resource Profile Approximation

increases. This paper will limit the discussion to the project's early phase cash flow projection.

A projection can be easily prepared with a relatively few supporting documents. The resulting accuracy will depend on the detail levels available. The minimum required documents are:

- Project major cost breakdown.
- Project summary schedule, including engineering, procurement and construction. And,
- Available payment schedules of major contracts.

BASIC STEPS OF DEVELOPING A CASH FLOW PROJECTION

A typical construction project will include at least five work/cost breakdowns: procurement, engineering, construction, commissioning and project management. We will use these five breakdowns to outline the basic steps in developing a cash flow projection.

- Step 1 Confirm key cost breakdown.
- Step 2 Identify the time line (duration) of each breakdown.
- Step 3 Secure available payment schedules of major contracts.
- Step 4 Assign percentage of cash flow within each breakdown using data from Steps 2 and 3.
- Step 5 Convert cash flow from % to $ using data from Steps 1 and 4.
- Step 6 Calculate periodic and cumulative cash flow.
- Step 7 Plot cash flow curve.

	$K	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	Subtotal
Major Process Eq 1	$2,500		10%	10%	15%	15%			10%	30%			10%	100%
All Other Process Equipment	$1,500			10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	100%
Engineering	$800	5%	15%	20%	30%	10%	10%	5%	2%	2%	1%			100%
Construction	$4,200				5%	15%	20%	20%	30%	5%	5%			100%
Commissioning	$300									30%	50%	10%	10%	100%
Project Management	$700	5%	10%	10%	10%	10%	10%	10%	10%	10%	5%	5%	5%	100%
Total Estimate	$10,000													
Major Process Eq 1		$0	$250	$250	$375	$375	$0	$0	$250	$750	$0	$0	$250	$2,500
All Other Process Equipment		$0	$0	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$1,500
Engineering		$40	$120	$160	$240	$80	$80	$40	$16	$16	$8	$0	$0	$800
Construction		$0	$0	$0	$210	$630	$840	$840	$1,260	$210	$210	$0	$0	$4,200
Commissioning		$0	$0	$0	$0	$0	$0	$0	$0	$90	$150	$30	$30	$300
Project Management		$35	$70	$70	$70	$70	$70	$70	$70	$70	$35	$35	$35	$700
Subtotal		$75	$440	$630	$1,045	$1,305	$1,140	$1,100	$1,746	$1,286	$553	$215	$465	$10,000
Subtotal in %		0.8%	4.4%	6.3%	10.5%	13.1%	11.4%	11.0%	17.5%	12.9%	5.5%	2.2%	4.7%	
Cumulative Total in %		0.8%	5.2%	11.5%	21.9%	35.0%	46.4%	57.4%	74.8%	87.7%	93.2%	95.4%	100.0%	

Table 1—Twelve-Month Cash Flow Calculation

- Step 8 Perform reality check of the cash flow projection against execution plan and past similar projects.

TWELVE-MONTH PROJECT CASH FLOW EXAMPLE

A 12-month fast track project will be used to demonstrate the basic concept of developing a cash flow projection.

Assumptions

1. One major process equipment commitment was made prior to the final project approval. Payment schedule including 10 percent retention was agreed upon. The remaining equipment is procured as engineering progresses.
2. Construction starts after three months of engineering progress.
3. Construction materials are procured regularly as the installation progresses.
4. Use trapezoidal approximation to forecast both engineering and construction resources.
5. Project management has a straight line staffing level, except at front and back ends.

Procedure

Step 1 Enter key cost breakdown in table 1.
Step 2 Confirm engineering and construction durations of 10 and 7 months, respectively.
Step 3 Secure major process equipment payment schedule.
Step 4 Enter major equipment payment schedule and apply trapezoidal approximations to engineering and construction in percent. Spread remaining equipment payments evenly over 10 months.
Step 5 Convert cash flow of each cost breakdown from percent to dollars.
Step 6 Calculate periodic and cumulative cash flow.
Step 7 Plot cumulative cash flow curve in percent as shown in figure 3.
Step 8 Perform cash flow reality check.

TWO-YEAR PROJECT CASH FLOW EXAMPLE

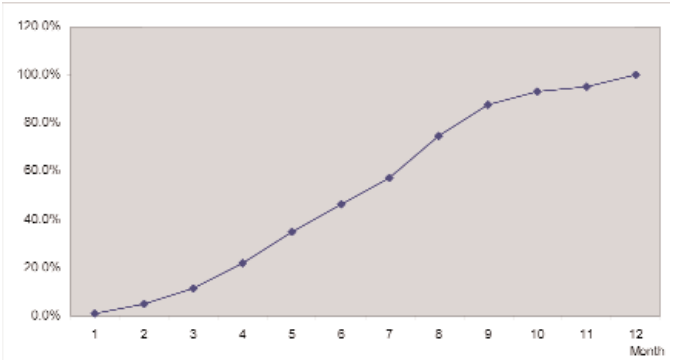

Figure 3—Twelve-Month Cash Flow Curve

The same basic steps used on the 12-month project can also be applied to a larger project with longer duration. We will use a $100 million project having a two-year project duration to develop a quarterly cash flow projection for senior management's feasibility review.

Assumptions

- One major process equipment was ordered with a cancellation clause prior to the final project approval. The remaining equipment is procured in concert with engineering progress.
- Site preparation begins one quarter after the start of engineering.
- Seventy percent of construction bulk materials are purchased early, with the remaining quantity procured after engineering information becomes available.
- Use trapezoidal approximation to forecast both engineering and construction resource cash flow.
- Project management team builds up to a steady staffing level and then quickly runs down at the end.

Procedure

- Step 1 Enter key cost breakdown in table 2.
- Step 2 Confirm engineering and construction durations will stretch over six quarters.
- Step 3 Secure major process equipment payment schedule.

	$K	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Subtotal
Major Process Eq 1	**$22,000**	15%	15%	20%	35%	10%	5%			100%
All Other Process Equipment	**$18,000**		10%	15%	25%	20%	15%	10%	5%	100%
Engineering	**$8,000**	10%	15%	25%	30%	10%	10%			100%
Construction	**$42,000**		10%	12%	18%	25%	30%	5%		100%
Commissioning	**$3,000**						30%	60%	10%	100%
Project Management	**$7,000**	10%	10%	15%	15%	15%	15%	15%	5%	100%
Project Total Estimate	**$100,000**									
Major Process Eq 1		$3,300	$3,300	$4,400	$7,700	$2,200	$1,100	$0	$0	$22,000
All Other Process Equipment		$0	$1,800	$2,700	$4,500	$3,600	$2,700	$1,800	$900	$18,000
Engineering		$800	$1,200	$2,000	$2,400	$800	$800	$0	$0	$8,000
Construction		$0	$4,200	$5,040	$7,560	$10,500	$12,600	$2,100	$0	$42,000
Commissioning		$0	$0	$0	$0	$0	$900	$1,800	$300	$3,000
Project Management		$700	$700	$1,050	$1,050	$1,050	$1,050	$1,050	$350	$7,000
Subtotal		$4,800	$11,200	$15,190	$23,210	$18,150	$19,150	$6,750	$1,550	$100,000
Subtotal in %		4.8%	11.2%	15.2%	23.2%	18.2%	19.2%	6.8%	1.6%	
Cumulative Total in %		4.8%	16.0%	31.2%	54.4%	72.6%	91.7%	98.5%	100.0%	

Table 2—Two-Year Quarterly Cash Flow Calculation

- Step 4 Enter major equipment payment schedule and apply trapezoidal approximations to engineering and construction in percentages.
- Step 5 Convert cash flow of each cost breakdown from percent to dollars.
- Step 6 Calculate periodic and cumulative cash flow.
- Step 7 Plot cumulative cash flow curve in percent as shown in figure 4.
- Step 8 Perform cash flow reality check.

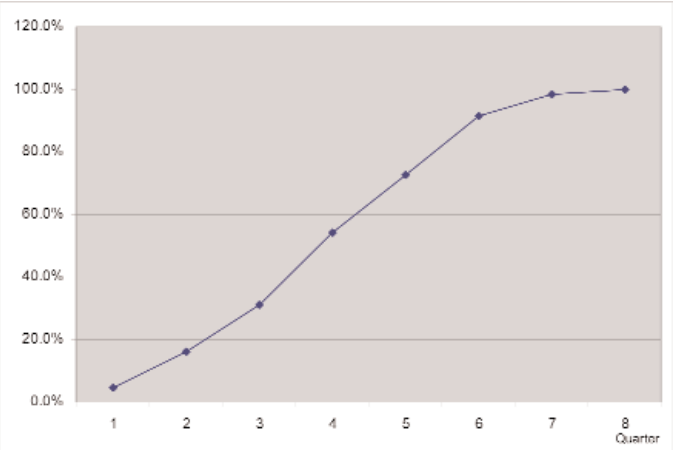

Figure 4—Two-Year Quarterly Cash Flow Curve

CASH FLOW PROJECTION REFINEMENT

The above two examples use only five key cost/work breakdowns for simple cash flow projections. Additional cost/work breakdowns will provide further refinement and improve the accuracy of projections. Having a realistic project execution plan with buy-in from key shareholders including suppliers, engineers and contractors is the real key to enhancing the accuracy of cash flow projections. For practical purpose, it is best to limit the high level cost/work breakdowns to less than twenty critical elements.

Cash flow projections establish the project tracking baseline. As a project progresses, efforts will be focused on capturing the actual expenditure, analyzing deviation from the plan, and forecasting the remaining work. Timely corrective actions might be required to accomplish the project goals and objectives. Most projects develop cash flow projections based solely on the anticipated expenditures. Recognizing an inherent time lag between the actual cash payment release and actual expenditure, a realistic cash flow financial obligation would typically be offset by one to two project periods. The year-end payment could be further influenced by the corporation's cash flow constraints or desire to improve the balance sheet.

Cash flow projections are developed to support business decisions at each project phase. Only a simple and high-level cash flow projection is needed at the opportunity study phase. More detailed and accurate cash flow projections are expected as the project moves through feasibility and final approval phases. The approved cash flow projection becomes the project tracking baseline. Corporations use such projections to reserve funds to meet project obligations and enable total project portfolio management.

Contractors incur costs as the construction progresses. Contractors have to meet the ongoing weekly payroll and monthly material payment obligations while waiting for owners' discrete payments. The gap between cumulative expenses and actual payments received will be financed. Contractors usually recover such financing interest charges through overhead, fees or large up-front mobilization charges. For the best interest of the overall project, it would be prudent for an owner to negotiate a contractor payment schedule using a "cash neutral" basis to achieve the lowest total project cost.

This paper demonstrates simple and fast methods to develop cash flow projections for both short and long project durations. Additional refinements are required to fine tune the projections to align with the revised execution plan and accuracy expected by the organization.

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