Project Cash Flow

By
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Scenario Testing

• The Need
  – Cash flows can be estimated by attempting to assess flows from
    1. Project in progress.
    2. Projects under contract but not yet begun.
    3. Potential projects which will start during the coming financial accounting period.
Scenario Testing

• The Need (cont’d)
  – These sources of income can be viewed as:
    1. Birds in the hand.
    2. Birds in the bush, and
    3. Birds flying the sky.
  – In other words, cash flows can be projected from projects in progress and projects which may, with some probability, start in the coming period for which forecasts are being made.

• The Need (cont’d0
  – The advent of spreadsheet analysis and high speed computers has led to “scenario testing” of future cash flow expectations.
The Technology

• Spreadsheet (can do probabilistic cash flow projections)
• More advanced analysis can also factor in historical evidence of payment trends and potential impact of macroeconomic factors.
• These techniques can go beyond the typical best-, expected-, and worst-case scenario modeling.

• These techniques may also rely on monte Carlo simulation, Markov modeling, or the use of “fuzzy” data sets to build up statistically valid outcomes.
• This level of analysis used to be in the economist’s realm, but is now commonplace in the future in the finance and business development groups of corporations.
Cash Flow Projections

• Life of a project can be used to develop the projection of income and expense during this project life.
• Complexity of the project obviously has an affect on the method used.
• In many contracts (e.g., public contracts such as those used by state agencies), the owner requires the contractor to provide an S-curve of estimated progress and costs across the life of the project.

Cash Flow Projections

• The contractor develops this by constructing a simple bar chart of the project, assigning costs to the bars, and smoothly connecting the projected amounts of expenditures over time.
• Consider the highly simplified project of the next slide in which four major activities are scheduled across a four-month time span.
Cash Flow Projections

- Bars representing the activities are positioned along a time scale indicating start and finish times.
- The direct costs associated with each activity are shown above each bar in the figure.
- It's assumed that the monthly cost of indirect charges (i.e., site office costs, telephone, heat, light, which cannot be charged directly to an activity) is $5,000.
Cash Flow Projections

- Assuming that the direct costs are evenly distributed across the duration of the activity, the monthly direct costs can be readily calculated and shown below the time line in the figure.
- The direct charges in the second month, for example, derive from activities A, B, and C, all of which have a portion in the period.

Cash Flow Projections

- The direct charge is simply calculated based on portion of the activity scheduled in the second month as:

  \[
  \text{Activity A: } \frac{1}{2} \times 50,000 = \$25,000 \\
  \text{Activity B: } \frac{1}{2} \times 40,000 = \$20,000 \\
  \text{Activity C: } \frac{1}{3} \times 60,000 = \$20,000 \\
  \text{Total: } \$65,000
  \]
Cash Flow Projections

• The figure shows the total monthly and cumulative monthly expenditures across the life of the project.
• The S-curve is nothing more than a graphical presentation of the cumulative expenditures over time.
• A curve is plotted below the time-scaled bars through the points of cumulative expenditures.

Cash Flow Projections

• As activities come on-line, the level of expenditures increases and the curve has a steeper middle section.
• Toward the end of a project, activities are winding down and expenditures flatten again.
Cash Flow to the Contractor

• The flow of money from the owner to the contractor is in the form of progress payments.
• As already noted, estimates of work completed are made by the contractor periodically (usually monthly) and verified by the owner’s representative.
• Depending on the type of contract (e.g., lump sum, unit price, etc.), the estimates are based on evaluations of the percentage of total contract completion or actual field measurements of quantities placed.

Cash Flow to the Contractor

• This process is best demonstrated by further consideration of the four-activity example just described.
• Assume that the contractor originally included a profit or markup in his bid of $50,000 (i.e., 25%) so that the total bid price was $250,000.
• The owner retains 10% of all validated progress payment claims until one-half of the contract value (i.e., $125,000) has been built and approved as an incentive for the contractor to complete the contract.
Cash Flow to the Contractor

• The retainage will be deducted from the progress payments on the first $125,000 and eventually paid to the contractor on satisfactory completion of the contract.
• The progress payment will be billed at the end of the month, and the owner will transfer the billed amount minus any retainage to the contractor’s account 30 days later.

Cash Flow to the Contractor

• The amount of each progress payment can be calculated as:

\[
\text{Pay} = 1.25 \left( \text{indirect expense} + \text{direct expense} \right) \\
= -0.10 \left[ 1.25(\text{indirect expense} + \text{direct expense}) \right]
\]
Cash Flow to the Contractor

- The minus term for retainage drops out of the equation when 50% of the contract has been completed.
- Because of the delay in payment of billings by the owner and retainage withheld, the revenue profile lags behind the expense S-curve as shown in the following figure of the next slide.

Figure 9.2 (p. 149)
Expenses and income profiles.
Cash Flow to the Contractor

- The revenue profile has a stair-step appearance since the progress payments are transferred in discrete amounts based on the preceding equation.
- The shaded area of the previous figure between the revenue and expense profiles indicates the need on the part of the contractor to finance part of the construction until such time as he is reimbursed by the owner.

Figure 9.3 (p. 150)
Influence of front, or mobilization, payment on expense or income profiles.
Table 9.1  (p. 151)
Overdraft calculations.

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct cost</td>
<td>$25,000</td>
<td>$65,000</td>
<td>$73,000</td>
<td>$50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect cost</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>30,000</td>
<td>70,000</td>
<td>78,000</td>
<td>55,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writhe (2%)</td>
<td>750</td>
<td>750</td>
<td>750</td>
<td>750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End bal</td>
<td>37,750</td>
<td>77,750</td>
<td>100,000</td>
<td>72,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reversal withhold</td>
<td>3,750</td>
<td>8,750</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Payment received</td>
<td>$33,750</td>
<td>$75,750</td>
<td>$100,000</td>
<td>$72,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cost to date</td>
<td>300,000</td>
<td>100,000</td>
<td>108,000</td>
<td>200,000</td>
<td>200,000</td>
<td></td>
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<tr>
<td>Total commitments</td>
<td>377,500</td>
<td>125,000</td>
<td>223,000</td>
<td>280,000</td>
<td>280,000</td>
<td></td>
</tr>
<tr>
<td>To date</td>
<td>$33,750</td>
<td>$39,750</td>
<td>$51,753</td>
<td>$91,250</td>
<td>$219,000</td>
<td>$219,000</td>
</tr>
<tr>
<td>Overdraft end of month</td>
<td>200</td>
<td>1,003</td>
<td>1,476</td>
<td>905</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Balance</td>
<td>30,300</td>
<td>101,303</td>
<td>$49,029</td>
<td>91,182</td>
<td>(8,182)</td>
<td></td>
</tr>
</tbody>
</table>

* A simple illustration only. Most lenders would calculate interest charges more precisely on the outstanding amount owing daily interest factors.

* Parentheses indicate a negative balance in this case.

Figure 9.4  (p. 152)
Plot of maximum overdraft.
Figure 9.5 (p. 153)
Composite overdraft profiles.

Figure 9.6 (p. 153)
ROR for small bar chart problem.
### Table 9.2 (p. 154)
ROR Calculations for Small Project.

<table>
<thead>
<tr>
<th>N</th>
<th>NET(^a)</th>
<th>PWF(^b) @ 20%</th>
<th>Total @ 20%</th>
<th>PWF @ 25%</th>
<th>Total @ 25%</th>
<th>PWF @ 22%</th>
<th>Total @ 22%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-30300</td>
<td>8133</td>
<td>-25249</td>
<td>8100</td>
<td>-24240</td>
<td>8196</td>
<td>-24834</td>
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<tr>
<td>2</td>
<td>-37253</td>
<td>6944</td>
<td>-25688</td>
<td>6300</td>
<td>-23442</td>
<td>6719</td>
<td>-23830</td>
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<tr>
<td>3</td>
<td>-2726</td>
<td>5787</td>
<td>-1537</td>
<td>5120</td>
<td>-1196</td>
<td>5507</td>
<td>-1501</td>
</tr>
<tr>
<td>4</td>
<td>79987</td>
<td>14822</td>
<td>58110</td>
<td>4085</td>
<td>52988</td>
<td>4514</td>
<td>35704</td>
</tr>
<tr>
<td>5</td>
<td>38608</td>
<td>4619</td>
<td>15911</td>
<td>3217</td>
<td>12289</td>
<td>3080</td>
<td>13862</td>
</tr>
</tbody>
</table>

\(^a\) A negative net value indicates expenses exceed revenue for this period.
\(^b\) PWF = Present Worth Factor.

### Figure 9.7 (p. 154)
ROR for small bar chart problem with mobilization payment.
### Table 9.3 (p. 155)
Overdraft Calculation with Mobilization Payment

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct cost</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>Indirect cost</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Subtotal</td>
<td>30,000</td>
<td>30,000</td>
<td>30,000</td>
<td>30,000</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Markup (20%)</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Total billed</td>
<td>36,000</td>
<td>36,000</td>
<td>36,000</td>
<td>36,000</td>
<td>36,000</td>
<td>36,000</td>
</tr>
<tr>
<td>Retaining w/thd (40%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payment received</td>
<td>$20,000</td>
<td>$33,750</td>
<td>$57,750</td>
<td>$199,000</td>
<td>$17,750</td>
<td>$17,750</td>
</tr>
<tr>
<td>Total paid to date</td>
<td>38,000</td>
<td>100,000</td>
<td>140,000</td>
<td>200,000</td>
<td>200,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Total amount billed to date</td>
<td>37,750</td>
<td>125,000</td>
<td>225,000</td>
<td>250,000</td>
<td>250,000</td>
<td>250,000</td>
</tr>
<tr>
<td>Total paid to date (out)</td>
<td>$20,000</td>
<td>$33,750</td>
<td>$57,750</td>
<td>$199,000</td>
<td>$212,000</td>
<td>$250,000</td>
</tr>
<tr>
<td>Overdraft end of period</td>
<td>38,000</td>
<td>100,000</td>
<td>140,000</td>
<td>180,000</td>
<td>180,000</td>
<td>180,000</td>
</tr>
<tr>
<td>Interest on overdraft</td>
<td>800</td>
<td>885</td>
<td>1,274</td>
<td>699</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total amount financed</td>
<td>$30,000</td>
<td>$61,800</td>
<td>$124,627</td>
<td>$180,570</td>
<td>$180,570</td>
<td>$180,570</td>
</tr>
</tbody>
</table>

*Parentheses indicate a negative balance.

### Table 9.4 (p. 156)
ROR Calculations to Include Mobilization Payment

\[
\begin{align*}
N & \quad \text{Net}\% & \quad \text{PWF}\% 30\% & \quad \text{Total@ 30}\% & \quad \text{PWF} 32\% & \quad \text{Total@ 32}\% & \quad \text{PWF} 34\% & \quad \text{Total@ 34}\% \\
1 & -10300 & .7925 & -7925 & .7575 & -7802 & .7463 & -7687 \\
2 & -37053 & .5917 & -21925 & .5739 & -21650 & .5590 & -20635 \\
3 & -2524 & .4552 & -11449 & .4358 & -11097 & .4159 & -10493 \\
4 & 79301 & .3501 & 27765 & .3294 & 26122 & .3101 & 24591 \\
5 & 17500 & .2693 & 4713 & .2495 & 4366 & .2345 & 4051 \\
\sum & 16462 & \frac{324}{2%} & \sum = 324 & \frac{324}{2%} & \sum = 324 & \frac{324}{2%} & \sum = 324 \\
\end{align*}
\]

\[X = \frac{324}{2\%} \quad \text{ROR} = [32 + 62\%] \]

* A negative net value indicates expenses exceed income for this period.

**PWF** = Present Worth Factor

### Table 9.4 (p. 156)
ROR Calculations to Include Mobilization Payment

\[
\begin{align*}
N & \quad \text{Net}\% & \quad \text{PWF}\% 30\% & \quad \text{Total@ 30}\% & \quad \text{PWF} 32\% & \quad \text{Total@ 32}\% & \quad \text{PWF} 34\% & \quad \text{Total@ 34}\% \\
1 & -10300 & .7925 & -7925 & .7575 & -7802 & .7463 & -7687 \\
2 & -37053 & .5917 & -21925 & .5739 & -21650 & .5590 & -20635 \\
3 & -2524 & .4552 & -11449 & .4358 & -11097 & .4159 & -10493 \\
4 & 79301 & .3501 & 27765 & .3294 & 26122 & .3101 & 24591 \\
5 & 17500 & .2693 & 4713 & .2495 & 4366 & .2345 & 4051 \\
\sum & 16462 & \frac{324}{2%} & \sum = 324 & \frac{324}{2%} & \sum = 324 & \frac{324}{2%} & \sum = 324 \\
\end{align*}
\]

* A negative net value indicates expenses exceed income for this period.

**PWF** = Present Worth Factor
### Problem 9.1 (p. 156)

<table>
<thead>
<tr>
<th>Month</th>
<th>Indirect + Direct Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$69,000</td>
</tr>
<tr>
<td>2</td>
<td>$21,800</td>
</tr>
<tr>
<td>3</td>
<td>$17,800</td>
</tr>
<tr>
<td>4</td>
<td>$40,900</td>
</tr>
</tbody>
</table>

#### Problem Solution

- Overdraft: $-50,000, $-130,500, $-82,395, $-13,727, $+10,336
- Interest: $-500, $-1,205, $-822, $-137, $-
- Cumulative: $-50,500, $-121,705, $-83,027, $-13,864, $+10,336

### Problem 9.2 (p. 157)

<table>
<thead>
<tr>
<th>Month</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

- Direct cost: $10,000, $10,000, $5,000
- Indirect cost: $10,000, $10,000, $5,000
- Total cost: $10,000, $10,000, $5,000
- Markup: $10,000, $10,000, $5,000
- Total worth: $10,000, $10,000, $5,000
- Pay received: $10,000, $10,000, $5,000
Problem 9.3 (p. 157)

Total cost = $60,000 + $470,000 + $230,000 + $270,000 + $165,000 + $65,000 = $1,220,000
Profit + overhead @ 10% = $122,000
Bid price = $1,342,000

Problem 9.4 (p. 157)