Estimation of Cash Flow from Value of Work Done for Construction Projects in India

G Dhamodaran, K.R.Divakar Roy

ABSTRACT--- Background/Objectives: To estimate the Cash Flow from Value of Work Done (VoWD) for a Construction project in Indian environment

Methods: Deducting mobilisation advance and retention amounts from total Value of Work done completion.

Results/Findings: Can be implemented at construction industries especially for the process plant construction projects.

Conclusion/Application: 'Cash flow estimation every month in part of construction progress calculation' can be implemented in construction industries which helps Client organization to arrange required fund in advance.

Keywords: Value of Work Done (VoWD) - a quantitative project performance value which is calculated based on the Earned Value Method (EVM)

I. INTRODUCTION

Cost management is one of the important aspects of Effective project management like Scope management, Time management, Change management, Risk management and Communication management. Budgeting and monitoring the budget and ensuring effective cost control system implementation are keeping a control on the project with which cost overrun of the project can be controlled. At the same time, monitoring cash flow is critical to ensure the seamless execution of the project throughout the entire construction period. The budgeted cost will be spent in distributed manner and will not be of linear. Some system should be in place to ensure allocation of the required cost on time. Any delay in arrangement of fund will interrupt the construction work hence required amount should be estimated and provided to management in advance to allow time for sourcing.

Construction product transportation is a physical activity involved in the flow of things between the point of origin and the point of consumption in order to meet requirements of customers or corporations. Money is important resource like man, machine and material for any of the project which supports day to day operation of construction execution. Because of inadequate cash flow to support construction many of the projects failed or delayed. Delayed fund arrangement delays the project and on the other hand early arrangement of fund Costs Company to pay huge financing charges. As cash is the resource arranged by management, it is regarded as management resource. Cash flow management is based on controlling, updating, monitoring and forecasting the cash flow. During the project progress, many financial related decisions would be taken to ensure the project completion on time. These decisions are being taken based on the cash flow forecasts. Hence accurate cash flow projection is important.

II. PRESENT METHOD BEING FOLLOWED IN THE INDUSTRY

Currently the traditional method getting some estimate figures from the contractors and conveying the same with some safety margin to Project Manager for funding arrangement. Project Managers request the same with Management and Management is arranging the same with some financing agencies or from banks in the form for loans. While approaching the financing institutes, the projection given by the Project Manager is considered as the basis and accordingly fund is released. Due to inaccurate forecasting, either facing shortage of cash or left with unused money.

It flows from the client to the contractor and on to the subcontractors and suppliers. It is beneficial for clients to know the cash flow plan in advance, to arrange funding sources accordingly, and ensure smooth functioning of the project (Kenley, 2003). Similarly, accurate cash flow forecasting is essential for the survival of any contractor at all stages of the work.

A. Classical methods

The procedure of the classical method can be seen in any text book of Project management. This is prepared by tabulating periodic payments and receipts using the project Gantt chart as basis.

B. Mathematical methods

Many researches developed mathematical models based on various assumptions. Khosrowshahi has proposed a mathematical model for forecasting of project expenditure by identifying variables associated with the physical shapes of expenditure profiles for different types of projects. This is suitable only for contractual negotiations.

Park, Han & Russell have attempted to estimate cash flows by categorization of different project activities on the basis of time lags involved between their physical occurrences of different stages.

Jarrah, Kulkarni & O’Connor collected actual cash flow data in form of monthly account summary reports for various projects under Texas Department of Transportation. The sample consisted of different category of projects such as construction and replacement of bridges, new non-freeways, road overlay and rehabilitation of existing roads.
landscapes, scenic enhancements, widening of freeways etc. Projects were further classified in different cost ranges. Based on the scatter chart of payments against time for different projects in a given category, a fourth degree polynomial regression analysis was used to obtain the cash flow curves that turned out to be characteristic ‘S’ shaped for most of the projects.

Although statistical significance could not be proved due to limited availability of data, a feasible approach for cash flow prediction was established. He has suggested a set of new measurements and indicators based on contract prices and financial accounts for the proposed ‘contractor cash flow’ model in line with the ‘earned value’ measurements and indicators in view of possible integration of both systems. Wages and benefits is an important motivators of the employees working in civil construction companies.

There are many more research papers by various researchers trying to get the accurate model and are either too ideal conditional projects or involve more calculations which generally not being followed in many projects. Currently there is no any standard model to estimate the cash flow.

If the employers fails to fulfill the salary structure company level of performance will not improve as expected by the higher authorities. Functioning of a well-established organization need the hard work of employees. Recruitment and selection is a long-lasting one and a central aspect of HR Management. There was lot of problems needs to be handled by the HR department. Labor welfare facilities are an important tool to increase the productivity of the employees in any organization.

Salary along will not motivate the employees, so in addition to the company must provide some welfare benefits to their employees. This paper investigates the impact of Internal Locus of Control on personal variables and job related factors. The primary research strategy employed was the survey strategy. Researcher is very much interested on emission rates to know which mode of transport if more eco-friendly and remove logistical problems. SICAL Logistics has recently started a new project named Coastal RORO service as a part of their green logistics.

**III. PROPOSED METHOD TO CALCULATE CASH FLOW FORECAST FROM VALUE OF WORK**

To predict the cash flow requirements, the terminologies and types of cash flows are to be understood to accurately estimate the cash flow.

**A. Definitions**

**Advanced payment**

This is amount of money paid to the contractor for mobilization purposes. Then, it is deducted from running bill of contract progress payment. Facilitating this mobilization advance improves the contractor cash flow during his initial period of contract and ensures them to mobilize completely. However this strategy to be used only for projects which require expensive site preparatory requirements like contractor office, contractor labor camp, warehouse, batching plant, fabrication shops, material storage yard, etc.

**Retention**

Retention is the percent of money retained by the owner from every invoice by deducting before making the payment to contractor against certified invoice. This is to ensure the performance of the work performed by the contractor to minimum period after completion of the work. The accumulated retention amount will be paid to the contractor after completing the guarantee period varies from 12 months to 24 months in Indian conditions.

**Running account bills**

This is amount of money equivalent to the work performed by the contractor which will be as per the contractual provisions of the contract. Rate for every activity will be defined in the contract along with the quantity to be executed. Upon completion of certain quantity from the Bill of Quantities, for every month contractor will raise the invoice against the certification. After receipt of the invoice this will be certified and will be paid in next month.

**B. Major Terminologies**

**Contract**

Contract shall mean the agreement between Company and Contractor as set out in Scope of Works document, Completion Schedule, Contract Price or Contract Value, General and Special conditions all as may, from time to time, be supplemented or otherwise modified in accordance with applicable provisions.

**Contract Value**

Contract Value shall mean total Contract Price payable by Company to the Contractor for rendering the service in accordance with the agreed price schedule.

**Contract Schedule or Schedule**

Schedule shall mean the time schedule for performing Contract services and will be changed from time to time if required.

**C. Estimating the Cash Flow from VOWD**

**Mobilization advance**

This is the amount to be given to the Contractor for his mobilization expenses. Contractor is required to establish his office, warehouse, labor camp, fabrication shop, storage yards, testing laboratories etc. To set up these infrastructure facilities, Contractor requires certain amount which is generally in India it varies from 10 to 15 % and mostly it is of 10% of the contract value. This will be paid generally in the 1st month. Accordingly Cash Out can be expressed as a step function as below.

\[
CO=10\% \text{ of Contract Value for the first month} \\
CO_i=MA X CV \text{ if } i=1 \\
\]

Where,

\[
CO_i=\text{Cash Out for ith month} \\
\]
CV=Contract Value  
MA=Mobilization Advance in %  
i=Month

**Progressive payments**

Total Contract Value will be paid to the contractor with respect to their progress. After completing the work in every month, Contractor periodically once every month he raises invoice based on the joint measurement sheet with field engineers. This invoice will be settled within some stipulated time which will be generally 30 days in Indian conditions. From this certified amount, the percent of mobilization advance paid on 1st month will be deducted proportionately to be percent of Mobilization advance paid.

\[ CO_i = MA \times CV \text{ if } M=1 \]
\[ = \left[ \sum (P_{ij} \times CR_j) \right] \times (1-MA) \text{ if } 1<M<n \]  
(2)

Where,
COi=Cash Out for ith month  
Pij=Activity wise Physical progress certification for ith month  
CRj=Contract Rate for respective activity  
MA=Mobilization Advance in percentage of Contract Value  
i=Month  
n=Project Duration excluding Performance guarantee period

Further, this Cash Out to be adjusted with retention amount.

**Retention Amount**

The portion of amount which is retained by client to ensure the performance of the facility which was built by the contractor. Upon end of performance period, this entire amount will be released to the Contractor. Accordingly the Cash Out can be estimated as below

\[ CO_i = MA \times CV \text{ if } M=1 \]
\[ = \left[ \sum (P_{ij} \times CR_j) \right] \times (1/(1-MA)) \text{ if } 1<M<n \]
\[ = R \times CV \text{ if } M=m \]  
(3)

Where,
COi=Cash Out for ith month  
Pij=Activity wise Physical progress certification for ith month  
CRj=Contract Rate for respective activity  
MA=Mobilization Advance  
i=Month  
n=Project Duration excluding Performance guarantee period  
R=Retention Amount in % of Contract Value  
m= 1\text{st} month after completion of performance guarantee period

**IV. ESTIMATING CASH FLOW FOR A SAMPLE PROJECT & RESULTS**

**A. Cash Out estimation based on the progress with effort earned weightage**

This can be seen from a small example and we can forecast the Cash Out. The efforts required for each of the activity are tabulated and the contribution to overall project man-hours are individual weightage for each of the activity. These productivity norms are majorly depends on technologies involved, machineries employed etc. The tabulated productivity norms are generally being followed in India.

**Table-1: Total Bill of Quantities and their weightages**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Activity</th>
<th>Scope</th>
<th>UoM</th>
<th>Unit Rate</th>
<th>Contract Value</th>
<th>Effort Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Concreting</td>
<td>12000</td>
<td>CUM</td>
<td>75</td>
<td>90000000</td>
<td>40%</td>
</tr>
<tr>
<td>2</td>
<td>Structural Steel Fabrication</td>
<td>4000</td>
<td>MT</td>
<td>120</td>
<td>48000000</td>
<td>22%</td>
</tr>
<tr>
<td>3</td>
<td>Structural Steel Erection</td>
<td>4000</td>
<td>MTR</td>
<td>95</td>
<td>38000000</td>
<td>17%</td>
</tr>
<tr>
<td>4</td>
<td>Piping Fabrication</td>
<td>12000</td>
<td>ID</td>
<td>3.5</td>
<td>4200000</td>
<td>2%</td>
</tr>
<tr>
<td>5</td>
<td>Piping Erection</td>
<td>10000</td>
<td>MTR</td>
<td>4.5</td>
<td>13700000</td>
<td>7%</td>
</tr>
<tr>
<td>6</td>
<td>Equipment Erection</td>
<td>4500</td>
<td>MTR</td>
<td>50</td>
<td>2250000</td>
<td>10%</td>
</tr>
<tr>
<td>7</td>
<td>Electrical Cable Laying</td>
<td>1500</td>
<td>MTR</td>
<td>1</td>
<td>1500000</td>
<td>0%</td>
</tr>
<tr>
<td>8</td>
<td>Instrumentation Cable Laying</td>
<td>3000</td>
<td>MTR</td>
<td>1</td>
<td>3000000</td>
<td>0%</td>
</tr>
<tr>
<td>9</td>
<td>Painting</td>
<td>14000</td>
<td>SQ.MTR</td>
<td>3</td>
<td>4200000</td>
<td>2%</td>
</tr>
</tbody>
</table>

The weightages above are calculated based on the effort required to complete each of the activity. Each activity in the Bill of Quantities are measured in different unit of measurement (UOM) and it is necessary to convert them into one measurement entity. Only man-hour effort or the money to be spent can substitute this requirement.

These above calculated weightages are useful for progress calculation and for the each of the activity there will be defined rates in Contract. These rates can be used to arrive the cost weightage for each activity to be carried out for the project which will be used for estimating the cash flow and other financial decisions.

**B. Cash Out estimation based on the progress with cost weightage**

The cost weightage is depends on the quantum of each activity and its respective contractual rate as effort based weightage depending on quantum of the work and its respective productivity norms. Accordingly, we can tabulate the above table to arrive to the cost weightage.

**Table-2: Total Bill of Quantities and their weightages**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Activity</th>
<th>Scope</th>
<th>UoM</th>
<th>Unit Rate</th>
<th>Contract Value</th>
<th>Cost Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Concreting</td>
<td>12000</td>
<td>CUM</td>
<td>75</td>
<td>140000000</td>
<td>38.92%</td>
</tr>
<tr>
<td>2</td>
<td>Structural Steel Fabrication</td>
<td>4000</td>
<td>MT</td>
<td>200</td>
<td>80000000</td>
<td>21.62%</td>
</tr>
<tr>
<td>3</td>
<td>Structural Steel Erection</td>
<td>4000</td>
<td>MTR</td>
<td>15000</td>
<td>60000000</td>
<td>36.22%</td>
</tr>
<tr>
<td>4</td>
<td>Piping Fabrication</td>
<td>12000</td>
<td>ID</td>
<td>1000</td>
<td>12000000</td>
<td>3.34%</td>
</tr>
<tr>
<td>5</td>
<td>Piping Erection</td>
<td>10000</td>
<td>ID</td>
<td>100</td>
<td>17500000</td>
<td>4.73%</td>
</tr>
<tr>
<td>6</td>
<td>Equipment Erection</td>
<td>4500</td>
<td>MTR</td>
<td>12000</td>
<td>54000000</td>
<td>14.60%</td>
</tr>
<tr>
<td>7</td>
<td>Electrical Cable Laying</td>
<td>1500</td>
<td>MTR</td>
<td>200</td>
<td>3000000</td>
<td>0.88%</td>
</tr>
<tr>
<td>8</td>
<td>Instrumentation Cable Laying</td>
<td>3000</td>
<td>MTR</td>
<td>250</td>
<td>750000</td>
<td>2.04%</td>
</tr>
<tr>
<td>9</td>
<td>Painting</td>
<td>14000</td>
<td>SQ.MTR</td>
<td>300</td>
<td>14000000</td>
<td>0.38%</td>
</tr>
<tr>
<td>10</td>
<td>Painting</td>
<td>14000</td>
<td>SQ.MTR</td>
<td>300</td>
<td>16000000</td>
<td>0.38%</td>
</tr>
</tbody>
</table>

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The rates tabulated above are indicative and not as per any real Contract. But the rates are approximately similar to the rates given in Contracts issued in India.

C. Comparison between plan and actual values of effort based estimation and Contractual rate based estimation

We consider one plan and actual scenario for the sample data and we can compare the values. The table below shows Plan and actual values of the bill of quantities. The planned quantities are planned while planning for the project and the actual quantities are estimated at end of every month or week as agreed with the management. Forecasting of the quantities can be done at the end of every period.

Table-3: Plan and Actual values of progress with effort weigthages

<table>
<thead>
<tr>
<th>Activity</th>
<th>Plan</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Erection</td>
<td>10.00%</td>
<td>3.93%</td>
</tr>
<tr>
<td>Piping Fabrication</td>
<td>7.36%</td>
<td>7.18%</td>
</tr>
<tr>
<td>Structureal Steel</td>
<td>13.23%</td>
<td>13.26%</td>
</tr>
<tr>
<td>Electrical Cable</td>
<td>17.15%</td>
<td>17.06%</td>
</tr>
<tr>
<td>Painting</td>
<td>18.62%</td>
<td>18.98%</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>14.13%</td>
<td>14.10%</td>
</tr>
<tr>
<td>Laying</td>
<td>9.58%</td>
<td>9.82%</td>
</tr>
<tr>
<td>Total</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

The estimated Cash Out are as below. First two rows are plan and actual values from progress values considering mobilisation advances. Second two rows are values of performance guarantee amount pro-rated to all balance months till project completion and this will be released after completion of performance guarantee period. Third two rows are by making the adjustments of performance guarantee from the previously mobilisation adjusted derivate.

Table-4: Cash Flow out percentages based on effort based weightage

<table>
<thead>
<tr>
<th>Activity</th>
<th>Effort</th>
<th>Plan</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Erection</td>
<td>10.00%</td>
<td>3.93%</td>
<td>3.78%</td>
</tr>
<tr>
<td>Piping Fabrication</td>
<td>7.36%</td>
<td>7.18%</td>
<td>7.09%</td>
</tr>
<tr>
<td>Structureal Steel</td>
<td>13.23%</td>
<td>13.26%</td>
<td>13.21%</td>
</tr>
<tr>
<td>Electrical Cable</td>
<td>17.15%</td>
<td>17.06%</td>
<td>16.93%</td>
</tr>
<tr>
<td>Painting</td>
<td>18.62%</td>
<td>18.98%</td>
<td>18.82%</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>14.13%</td>
<td>14.10%</td>
<td>14.08%</td>
</tr>
<tr>
<td>Laying</td>
<td>9.58%</td>
<td>9.82%</td>
<td>9.74%</td>
</tr>
<tr>
<td>Total</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

D. Comparison between plan and actual values of effort based estimation and Contractual rate based estimation

The actual cash flow will be only based on the cost and not based on the effort based progress. Hence, the cash out to be estimated based on the cost weightages. To derive this the progress calculations, the bill of quantities considered in the Contract needs to be used for estimating the progress.

Table-5:Plan and Actual values of progress with cost weightages

We can recalculate the Cash Out values based on the cost weightages as below

Table-6:Cash Flow out percentages based on effort based weightage

From these comparison, the weightages are nearly similar and every time whenever we forecast the quantities, the cash out also can be easily estimated based on the equations indicated above.

These above results being represented graphically as below for the Contract rate based plan and actual values of Value of Work Done (calculated based on rate) and the Cash Flow.

From these two graphs the estimated cash out can be estimated. This estimation to be regularly calculated and to be projected to the management depends on the forecast which will help him in estimating.
V. CONCLUSION

As this reduces lot of man-hour efforts and time this method can be encouraged for many of the construction projects. Also this helps in forecasting accurate cash flow and supports management in arranging the cash required in advance. Change Orders arises out of change in scope are to be added to the Contract Value after approval and the same procedure will be followed while dealing with these approved Change Orders.

Further the method explained above can be extended to other pre-construction activities like, engineering, ordering, manufacturing, delivery etc. The entire estimation is not taking care of the taxation part and is to be added before projecting to the management.

REFERENCES


AUTHORS PROFILE

G Dhamodaran received his Bachelor Engineering in Mechanical Engineering from Bharathiar University Coimbatore and Master Engineering in Manufacturing Technology from PRIST University, Tanjavur since 1997 and 2011 respectively. He is currently a PhD Student in AMET University, Chennai. His research interest is in Construction Project Progress Monitoring and Measurement.

Dr KR Divakar Roy received his Bachelor Engineering in Mechanical Engineering from Andhra University, Visakapatnam and Master Engineering in Industrial Engineering from Andhra University, Visakapatnam since 1974 and 1985 respectively. He received his PhD in 2009 from Andhra University for his research topic “Growth Strategies for an integrated steel- A System Dynamics Approach. Published many number of papers and attended various national and international conferences. Fellowship in Institute of Engineers (India).