4th International Conference on Science, Technology and Management
India International Centre, New Delhi (ICSTM-16)
15th May 2016, www.conferenceworld.in ISBN: 978-81-932074-8-2

ENHANCING THE SUCCESS OF CIVIL INFRASTRUCTURE PROJECT IMPLEMENTATION; BY ADEQUATE CASH FLOW DISTRIBUTION FOR CIVIL BULK ITEM INVENTORY USING ABC ANALYSIS: AN APPROACH FOR INCREASING COUNTRY ECONOMY

Sharli Arora[1] , Sandeep Sharda[2]

[1]Student-MBA I[st] year, Department of Mechanical Engineering (Management stream), Rajasthan Technical University, Kota, Rajasthan, (India),

[2]Research Scholar & Faculty, Department of Mechanical Engineering, Rajasthan Technical University, Kota, Rajasthan, (India)

ABSTRACT

Historic aspect of project success and failure during implementation is not hidden. Numbers of projects globally, do not complete during execution there are several reasons for the same. In India there are several projects do not complete, delay long or partial complete (under hold) could not fulfilling the objectivity and hence a giant loss of economy front and in vain recourse. Exercise indicates the following background or scenarios could be the reasons for the above:

1. *Civil Infrastructure projects – Incomplete, Delayed long or under hold*
2. *Enhanced cost of project due to legal and other prior sanctioning of projects – not viable*
3. *Product manufacturing projects due to delay in technical knowhow importing*
4. *Oil & Gas upstream and downstream projects due to financial disagreement terms*
5. *Higher cash flow pumping during introduction phase of project and legally hold at later stage*

(This is in case of civil infrastructure projects especially resident complex and other govt. funded projects where the incurred cash flow in complete loss and utilized resources go in vain.)

Cash flow analysis not only determines actual profit at the end of the project, but also estimates required cash resources or cash balances at the end of every month. Cash flow analysis is important in managing a construction project; however, it requires extensive information that is not immediately available to the general contractor.

Key Words: Cash Flow Analysis, Construction Materials, Cost Control, Inventory Control.

I. INTRODUCTION

Managing and forecasting the cash inflows and outflows of a construction project is crucial to ensuring the success of a project. Due to contractual payment delays and retention of cash inflows many construction projects have negative net cash flows until the very end of construction when the final payment is received. Mismanagement of cash flow can result in times when cash availability is critically low, which could disrupt the project or even result in bankruptcy for the contractor. The Surety Information Office concluded that the contractor's inability to forecast cash flow is the primary accounting issue that results in financial default. Despite being an essential component of project management, very few tools have been developed to expedite or facilitate the cash flow process. Although there are spreadsheet-based software tools available to aid in performing cash flow analysis, these applications require an extensive procedure prior to getting to the cash flow analysis. Cash flow forecasting relies on a time-phased expense plan for each activity throughout the life of the entire project. This time-phased expense plan is essentially a project schedule with expected costs assigned to each activity (a cost-loaded schedule). This cost-loaded schedule is dependent on the anticipated planned values of each construction activity, the estimated duration of each activity and the sequencing of all the activities. Subsequently, the cost estimations and scheduling estimates are dependent on the quantity takeoff. Consequently, cash flow analysis cannot be completed until the entire quantity takeoff, estimation, and schedule are completed. Once the contractor has a time-phased expense plan, further values such as payment lags and retentions must be considered before the contractor is finally prepared for cash flow analysis. This process, which requires collecting a large amount of information, is known to be tedious and can be improved upon with technological advancements. Cash flow analysis can generally not be performed until after the project is already awarded to the contractor because of the large time requirement to complete the process. Being able to predict when a project will put the most strain on cash resources, however, could be a powerful forecasting tool during the bidding stages of a project. [1], [3] & [6]

II. LITERATURE REVIEW

Inventory is the supply of raw materials, partially finished goods called work-in-progress and finished goods, an organization maintains to meet its operational needs. It represents a sizeable investment and a potential source of waste that needs to be carefully controlled. It managers keep too much inventory on hand, they will waste money storing it and lose money it inventories are damaged or stolen. Research on cash flow analysis has been focused on making cash flow analysis more accurate and more detailed. Many of the early cash flow models in the 1970's did not account for the time lag between cost payments. The model suggested by Park et al adjusts the weight percentage of cost categories compared to the remaining budget through the project duration based on actual work performed and actual earned values. Although their research offers a more accurate way to manage cash flow during project construction, it neither expedites the cash flow process nor allows the contractor to perform cash flow analysis earlier in the project life cycle. Carrying cost refers to the total cost of

holding inventory. This includes warehousing costs such as rent, utilities and salaries, financial costs such as opportunity cost, and inventory costs related to perish ability, shrinkage and insurance. [9] & [8]

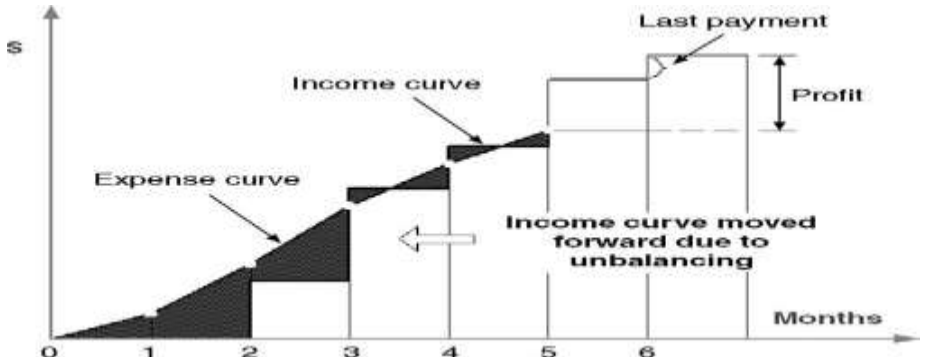

Figure: 1: Cost Payment Curve [6], [8]

III. FRAME WORK & METHODOLOGY

3.1 Methodology is based on conceptual frame work on S Curve performance and descriptive study of a sample of data.

3.2 Purpose of Review

This definitely indicates to put more emphasis towards adequate and practical solutions and enhancing the success of projects in figures during implementation. Success means projects should complete in all respect and delivering the desired or required objectives.

In this regards based on the practical experience by author in the field of project implementation and has envisaged the following are the basic cause of the delay, incomplete projects:

a. Lack of adequate planning & scheduling steps of projects

b. Inadequacy of breakdown structure of project

c. Lack of work expertise for developing planning and scheduling using software

d. Ineffective integrated communication of interdisciplinary activity (e.g. foundation completed but delayed in information hence equipment erection delayed.)

e. A lack of dedicated responsibility matrix- In Mega projects especially.

3.3 Lack of adequate cash flow

Successful implemented projects reveal that the cash flow graphical representation in most of the cases follow the S- Shape Curve. Smoothen the shape of S Curve for cash flow indicated that cash flow in beginning phase of projects should be very low (10-20 % of total cash flow- 20 % of activity as per scheduling duration should complete), in the beginning of major implementation stage to major implementation stage it should follow a smooth and rapid cash flow (30-70 % of total cash flow- and 30-70 % activity should complete as per schedule). Finishing and close out stage should follow constant and a very small percent of cash flow however

activities number wise are more and schedule duration wise less. Hence most of the activities of multidisciplinary are at the completion stage.

At the closure stage of project a dip in the S Shape curve indicates a reverse of Cash Flow due to materials reconciliation (means return of left out material and this will reverse a small cash flow)

3.4 Need to overcome above- Enhancing Skills

In view of above, to enhance the successful implementation of projects epically civil infrastructure and mega industrial projects as well following skill upgrade could realize.

a. Skill learning of civil technical software,
b. Project planning software
c. Dedicated knowledge of cash flow in Project Management with its fundamentals
d. Session on TQM tools specially "Fish bone Diagram" –a Quality tool for effective analysis for project problems

This could lead for proven track of achieving it. Construction engineers, managers, infrastructure firms as well as professional students at institutions need to enlarge their skills towards increasing projects completion productivity, employability and country economy.

3.5 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.

• 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 invoices 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 49implement 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. [1] & [5]

3.6 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 % using data from Steps 1 and 4.

• Step 6: Calculate periodic and cumulative cash flow.

• Step 7: Plot cash flow curve.

In this research the current material management practices are investigated. Material management is not just a concern during the monitoring stage in which construction is taking place. Decision about material procurement may also be required during initial planning and scheduling stage. Secondly during execution inventory control technique should be monitored periodically so as to maintain flow of material to avoid the delays. Basically this research is divided in two parts such as first one Qualitative analysis & second Quantitative analysis. Qualitative analysis: This analysis is carried out using MSP software for analyzing planned and actual material consumption through S curve analysis. Reasoning over the deviations curve is the s shaped graph produced by the the cumulative expenditure of certain parameters (man-hours cost) against time and it is the representation of project path. This analysis is carried for comparison of planned and actual cost for material. [8] & [2]

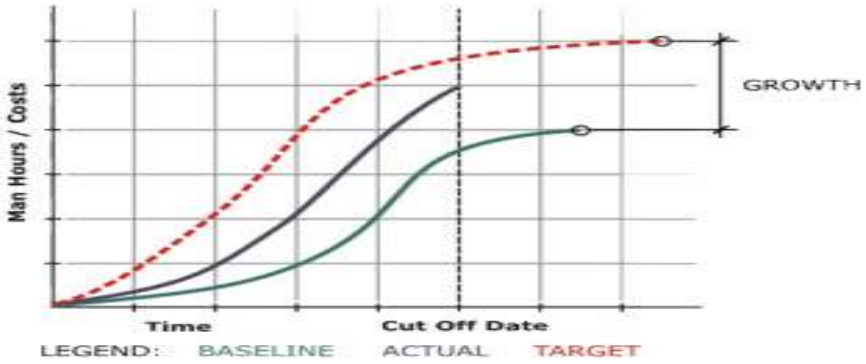

Figure 2: Comparison between planned and actual cost of material. [2]

3.7 ABC Analysis

The grouping of all materials used in production into materials which require the highest attention, materials which require medium attention and materials which require the least attention such that the control mechanism

be focused on selective class of materials is called selective inventory control. Literally, thousands of items are kept in inventory. Periodic reviews of inventories of items have to be taken under for effective inventory control. An equally critical analysis of all items is very expensive and time consuming. Material classification with reference to a particular function under examination is the solution. Among the methods that are available for the purpose of classification, ABC analysis is most commonly used. This method is very well suited for the construction industry and is also being used vary widely. The organization was not following any of the control techniques for the particular project. [6] & [7]

3.7.1 Procedure for ABC analysis:

1. List all the client free issue consumable materials items used in the project along with unit price and quantity consumed annually.
2. Compute the Annual Usage Value (AUV) of each material item.
3. Arrange the items in the ranking order of AUV and compute the cumulative percentage units consumed and cumulative percentage of AUV for each item.
4. Graph is plotted between cumulative percentages of unit's vs cumulative percentages of items. [1], [4] & [5]

3.8 S-Curve analysis:

Material management is not just a concern during the monitoring stage in which construction is taking place. For variation observed between the planned and actual material consumption S-curve analysis is formulated. The deviations of the quantities is produced by the cumulative expenditure of certain parameters (Material cost) against time and it is the representation of project path. This analysis is carried for comparison of planned and actual cost for Class A material items. [2] & [7]

a. The Class A material items used in the project plan period is considered from the material classification of items (ABC analysis).
b. The cost variance is computed for these material items which is given by Cost Variance = (BCWP – ACWP) Where, BCWP – Budgeted Cost of Work Performed and ACWP – Actual Cost of Work Performed.
c. Cost Performance Index is calculated using the formula, Cost Performance Index = BCWP/ACWP
d. These variations of Class A material items used in the project plan period is considered along with planned and actual consumption of material items as a function of cost.
e. Compute the cumulative planned and cumulative actual cost of Class A material items for the same period.
f. Graph is plotted between the cumulative planned and cumulative actual costs of Class A material items for the same period.
g. A graph showing S-Curve for the Class A material items are plotted. [3], [9] & [8]

IV. ANALYSIS BASED ON FRAME WORK STUDY

From the ABC analysis following conclusions can be made,

- Class A materials – 4 items (70% of AUV)
- Class B materials – 9 items (25% of AUV)
- Class C materials – 20 items (5% of AUV)

Table I: Cost variance and Cost Performance Index for Steel

Class A materials constitute of Concrete, Steel and Vitrified tiles.

Rebar Steel TMT 8mm - FE500					
Sl No.	Period	Planned Cost (BCWP	Actual Cost (ACWP)	Cost Variance (BCWP-ACWP)	Cost Performance Index (BCWP/ACWP)
1	Jan-15	1671067	1641864	29203	1.018
2	Feb-15	1856741	1824293	32448	1.018
3	Mar-15	835533	820932	14602	1.018
4	Apr-15	1485393	1459434	25958	1.018
5	May-15	1856741	1824293	32448	1.018

Table II: Cost variance and Cost Performance Index for Concrete

RMC - M20 Grade					
Sl No.	Period	Planned Cost (BCWP	Actual Cost (ACWP)	Cost Variance (BCWP-ACWP)	Cost Performance Index (BCWP/ACWP)
1	Jan-15	2762960	2736393	26567	1.010
2	Feb-15	3190346	3159669	30676	1.010
3	Mar-15	920987	912131	8856	1.010
4	Apr-15	2672667	2646968	25699	1.010
5	May-15	3190346	3159669	30676	1.010

TABLE 3: Cost variance and Cost Performance Index for Vitrified tiles

Tiles Vitrified 600mm x 600mm Polished					
Sl No.	Period	Planned Cost (BCWP	Actual Cost (ACWP)	Cost Variance (BCWP-ACWP)	Cost Performance Index (BCWP/ACWP)
1	Jan-15	1303968	1217037	86931	1.071
2	Feb-15	1825555	1703852	121704	1.071
3	Mar-15	1043174	973629	69545	1.071
4	Apr-15	521587	486815	34772	1.071
5	May-15	521587	486815	34772	1.071

Figure 2: S-Curve Analysis for Steel

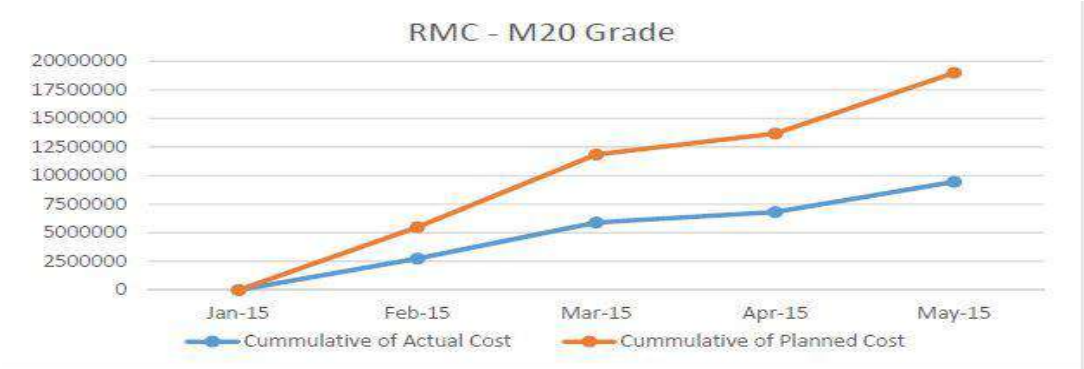

Figure 3: S-Curve Analysis for concrete

Figure 4: S-Curve Analysis for Vitrified tiles

V. CONCLUSION

1. From Table 1, Table 2 and Table 3 the Cost Variance values for the Class A materials are positive. It indicates the project has a cost under run i.e. the cost incurred is less than the planned or budgeted cost.

2. The S – Curve graphs which are obtained from the plots, Figure 2 for Concrete, Figure 3 for Steel and Figure 4 for Vitrified tiles indicates that there is a certain variation between planned and actual cost. The first important observation is that the variation is less at initial stage. Secondly as the project progresses with the period of time the variation between planned cost and actual cost against time also increases.

From the above study made, we can conclude that materials for the project, which is a very important resource if properly managed and handled, can vary the cost of the project to a large extent, especially Class A material items. If strictly followed the measures to handle the materials properly and efficiently for a construction project, it can reduce the total material cost of the project. The S – Curve graphs which are obtained from the plots graphs indicates that there is a certain variation between planned and actual cost. These costs are less at initial stage. This S-Curve analysis recognizes that there is too much increase in material cost during actual execution.

VI. FUTURE SCOPE

1. Study could be extended for the bulk materials for mechanical, electrical, Instrumentation & general items used in mega chemical and petrochemical projects.
2. Analysis for cash flow could also be carried out for project equipment procurement & installation during project execution.

REFERENCES

[1] Ammer D. S., "Materials Management as a Profit Centre", Harvard Business review, Jan.-Feb, 1969, pp 72-82, reprinted in Production Management Series, Part II, pp 148-158.

[2] Krishna Bedi, "Production and operations Management", 2nd ed., Oxford University press, pp. 316-374, 2007.

[3] A.K. Chitale and R.C. Gupta, "Materials Management", Text and Cases, 2nd ed., Prentice-Hall of India Pvt. Ltd., pp.56-70, Sep., 2006.

[4] Jose Roberto and Marco Aurelio, "Spare Parts inventory Control: a literature review", Producao, vol. 21, pp. 656-666, 2011.

[5] Max Muller, "Essentials of inventory management", 10th ed., American Management Association, pp. 115-143,2003

[6] S. Choudhary "Project Management", Tata-McGraw-Hill. Pp. 234-238, 2008

[7] "Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse" by Gwynne Richards (Warehouse and Material Handling),2008

[8] Steve Chapman, Tony Arnold, Ann Gate wood and Lloyd Clive; "Introduction to Materials Management", pp. 231-239, 2007

[9] Bruce T. Berkley "Project Management in new product development", Tata-McGraw-hill,pp. 145-155, 2007.