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Financial Projection as a Planning Tool on Construction Projects: Cash Flow Analysis and S-Curve Valuation for a Residential Development Scheme

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Abstract

The adequacy of financial control in a construction firm signifies a hallmark of its ability to avert failure. A construction firm's financial standing is, however, an agglomeration of its cash flow management at the project level. Cash inflows and outflows are the core financial management elements on construction projects, needed to ensure sufficient liquidity that is necessary to keep the project running. Cash flow analysis and valuation for a project scenario for a residential development scheme were carried out using the S-Curve and Sawtooth analytical approach. The analysis shows the computation of the cumulative gross valuations based on work done, monthly payments received by the contractor; cumulative costs incurred, monthly costs incurred, and monthly retention amounts. S-curves were plotted using an MS Excel spreadsheet for Value-time, Cost-time, and a 4-week payment delay in meeting cost. Also, the Saw-tooth red and the Saw-tooth black were graphically represented. The shape profile of the S-curves empirically corroborates the presumption that the cumulative expenditure on any construction project normally approximates an S-shaped curve. For valuation purposes, the value of work due for payment at specified time frames can be then read from the S-curve, less previous payments. The Sawtooth red showed the cash-flow balance at the end of each month, just before payment is received, while the Sawtooth black showed the cash flow in terms of balance, at the point payment is received. Delays and variations are however not accounted for. The accuracy of this method of cashflow analysis and valuation thus depends on the accuracy of the planning forecast. S-curves are therefore only useful for giving the client/contractor, a forecast of their likely cashflow requirement over the project duration and as a financial projection mechanism.

Keywords: Cash flow, cost forecast, financial projection, planning, s-curves, valuation

INTRODUCTION

The availability of cash is fundamental to the survival of construction firms. This is against the backdrop of the high level of insolvency in the construction industry (Arditi, et al., 2000) [1]. The adequacy of financial control in construction firms signifies a hallmark of its ability to avert failure. Construction businesses fail for lack of cash as a production management tool for supporting their day-to-day activities. Cash flow analysis is, therefore, necessary for business and resource planning, for analysing the financial stance of a company, and to manage a company's resources including staff, plant, and buildings. A construction firm's financial standing is, however, an agglomeration of its cash flow management at the project level. Cash flow forecasting may thus be considered at the company as well as at the project

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level (Navon, 1996) [2]. In construction, cash flow management is essential for both the client and the contractor, as it is considered the lifeline for successful project execution. Poor cash flow projection can lead to unrealistic bid prices by the contractor. While for the project owner, it can cause financing loopholes which may undermine the successful completion of a project on time. Poor cash flow prediction can thus result in funding hiccups which will inevitably mar project execution and pose an undue strain on the project team members (Cooke and Williams, 2009) [3]. Cash flow projections are generated with respect to project plans and constitute the fundamental basis of project cost control. Typically, projects go through various development phases, with cost estimates generated at each phase. Cash flow predictions are necessary to finance funding decisions at each phase of the project, with increasingly sophisticated and more accurate predictions made as the project advances. For a project to be successful, a positive cash flow is crucial because it ensures payment of liabilities (expenses) without the need for expensive borrowing from financial institutions.

LITERATURE REVIEW

Cash Flow on Construction Projects

The movement of funds into and out of a company or enterprise is known as cash flow. It is typically measured over a predetermined time frame. Positive cash flow, also known as money in or value flow, is the term used to describe money entering a firm or project and is recorded as cash received. Negative cash flow, also known as money outflow or cost flow, is the term used to describe payments made to a firm or project. The difference between the aforementioned constitutes the net cash flow. Money flows into a project from sources such as monthly payments on contracts, retention released on practical completion, retention released after the defects liability period, bank loans, shareholders' funds invested in the business, and proceeds from the sale of company assets. Money outflow is from sources such as payment to suppliers; head office running costs, management staff salaries, payment for plant hire, payment to subcontractors, and labour payments. Other sources of cash outflows are temporary site accommodation, land rental, utilities including water and electricity, insurance, tax payments, servicing costs as well as interest on loans.

Cash inflows and outflows are the core financial management elements on construction projects, needed to ensure sufficient liquidity necessary to keep the project running (Ross et al., 2013) [4]. On construction projects, the contractor relies on progress payments from clients to provide cash (money in) and this helps to pay for wages, materials, subcontractors, and other expenses (money out). Cash flows from the client to the main contractor, consultants, specialist contractors, or other direct appointments. Cash also flows from the main contractor to subcontractors and suppliers, and also from subcontractors to their suppliers and specialists. On a typical project, the contractor prepares a cash-flow forecast for predicting cash inflow, cash outflow, and net cash flow. With these forecast values, the contractor’s monthly payments and costs can be reasonably predicted. At the project level, cumulative value forecasts are periodically made over the project duration (Liu and Wang, 2010) [5]. A cumulative value forecast is prepared from the pre-tender programme or construction programme and is used for assessing the client’s and the contractor’s cash/funding requirements (Jarkas and Haupt, 2015) [6]. This is often a requirement during tender submission.

A cash-flow forecast provides an early warning when there may not be enough liquid funds. Hence, management is informed in good time to allow mitigation strategies to be put in place, such as arranging alternative funding (Kishore et al., 2011) [7]. A strong cash flow provides the money to make investments that will save financial resources later. Typically, construction plants hired at high rates can be purchased. An accurate assessment of what must be paid to the contractor and when (during what periods) is made possible by a cash-flow forecast. In order to monitor the flow of money and adhere to the contractual deadlines for paying the contractor, the employer's bank or funder must be informed of draw-downs. Banks and funding sources frequently ask for a draw-down timetable at the

start of any project. To make sure that the contractor's draw-down requests are consistent with the original cash-flow estimate and to provide an explanation if they deviate, banks frequently engage bank monitoring specialists (typically quantity surveyors) (RICS 2011) [8]. Monitoring the progress of the work on site in relation to the established schedule is one of a quantity surveyor's most frequent uses of a cash-flow forecast (Park, 2004) [9]. A cash-flow estimate based on the agreed-upon schedule is frequently requested by the employer at the beginning of a contract. Such a forecast is useful for assessing whether the contractor is on programme or not (Khanzadi, et al., 2017) [10].

Valuation of Construction Projects

Valuations are carried out on construction projects for the purposes of making interim payments to contractors and assessing the progress of works relative to cash flow forecasts. As Chen et al. (2005) [11] assert, a regular disbursement of interim payments is critical for contractors' survival. Contractors, therefore, bill their employers based on work done to date, and the employers pay the contractors the appropriate progress payments. The progress payments or interim payments generate the contractor's income flow, which is the contractor's earnings in monetary terms. Cooke and Williams (2009) [3] identified different methods of valuing construction work for the purposes of interim payments, including stage payments, single payment upon completion of the project; third-party certification, and milestone payments. Stage payments are agreed-upon sums paid to the contractor at agreed-upon intervals, regardless of how things go on the job site, in order to meet a deadline. As opposed to a single payment paid after the contract is finished, this. Cooke and Williams (2009)[3], however, noted that although this method of valuation provides high predictability of cash flow, it is prone to low accuracy of the actual work done to date. According to Ross and Williams (2013), this arrangement is often used in design and build contracts, whereby the employer knows what and when payments are due, but there is a risk of overpaying or underpaying the contractor. The milestone payment method of valuation relies on pre-agreed amounts that are paid to the contractor upon completion or achievement of pre-agreed elements/tasks (milestones), such as completion of substructure, walls, or roof. Ross and Williams (2013) were however of the view that although they provide high predictability of payments, there is a low certainty to the client of when such payments may become due. This is so that the contractor may request payment after the milestone has been reached. On the other hand, progress payments are included in the third-party certification method of valuation of on-site work when the value of the job is appraised (measured) at pre-agreed intervals. By visiting the site and evaluating the worth of preliminary work, completed work, completed work, on-site materials, etc., the works completed on site up to this point are measured and valued. The contractor and employer's quantity surveyors then agree on the measurements and amounts. Ross and Williams (2013) therefore asserted that this payment mechanism provides the most accurate assessment of works performed on site to date.

METHOD OF STUDY

Cash flow analysis and valuation for a project scenario were carried out. A project scenario is deployed to demonstrate how to calculate: the cumulative gross valuations based on work done; monthly payments received by the contractor; cumulative costs incurred; monthly costs incurred and monthly retention amounts. Making a cash flow projection for a high-end home development plan is required in the scenario. The project has an eight-month completion timeline, a £3,300,000 contract value, and a six-month defects liability period. On the project, the contractor's profit and overhead are projected to be 7%. At the conclusion of each calendar month, interim payments will be provided depending on work completed. There is a 3% retention on the contract. The cumulative net valuation sums are displayed in Table 1 in accordance with the contractor's work programme. The four-week billing period is stipulated in the contract terms.

Then, using an MS Excel spreadsheet, the following S-curves are plotted: Value-time curve, cost-time curve, and cost-meeting cost with a 4-week payment lag. Also, the Saw-tooth red and the Saw-tooth black are graphically represented.

Table 1. Cumulative Net Valuation (Forecast).

Valuation Nr.	Cumulative net valuation (£)
Month 1	98,940
Month 2	279,360
Month 3	431,650
Month 4	824,500
Month 5	1,164,000
Month 6	1,843,000
Month 7	2,366,800
Month 8	2,764,500
Month 9	3,089,450
Month 10	3,250,500

RESULTS

The cash flow analysis and valuation for the project scenario are presented in a tabulated format (Table 2), with columns A to E.

Table 2. Cash flow analysis and valuation.

Valuation Nr	Cumulative Gross Valuation (A)	Cumulative Net Valuation (B)	Monthly Payment Received (C)	Cumulative Amounts Retained	Monthly Retention Amounts	Cumulative Cost Incurred (D)	Monthly Cost Incurred (E)
Month 1	102,000	98,940	98,940	3,060	3,060	95,327.1028	95,327.1028
Month 2	288,000	279,360	180,420	8,640	5,580	269,158.8785	173,831.7757
Month 3	445,000	431,650	152,290	13,350	4,710	415,887.8505	146,728.972
Month 4	850,000	824,500	392,850	25,500	12,150	794,392.5234	378,504.6729
Month 5	1,200,000	1,164,000	339,500	36,000	10,500	1,121,495.327	327,102.8037
Month 6	1,900,000	1,843,000	679,000	57,000	21,000	1,775,700.935	654,205.6075
Month 7	2,440,000	2,366,800	523,800	73,200	16,200	2,280,373.832	504,672.8972
Month 8	2,850,000	2,764,500	397,700	85,500	12,300	2,663,551.402	383,177.5701
Month 9	3,185,000	3,089,450	324,950	95,550	10,050	2,976,635.514	313,084.1121
Month 10	3,300,000	3,250,500	161,050	49,500	3,450	3,084,112.15	107,476.6355
Month 16	3,300,000	3,300,000	49,500	0	0	3,084,112.15	0
Total			**3,300,000**		**99,000**		**3084112.15**

Column A shows the forecast cumulative gross valuations from months 1 to 10. Month 16 is mentioned to imply that after six months, any flaws will have been fixed and the contractor will receive the second half of the retention. The Figures are gross valuations or assessments. Gross here indicates the total amount of money due before retention is deducted.

- Column B displays the total net valuation after deducting the retention (3%) rate. However, because half of the retention is released at practical completion, there is a 1.5% retention for the tenth month. Only one fifth (1.5%) is kept.
- Column C indicates the monthly payments received. These are figured by taking the current cumulative net valuation and subtracting the sum of the prior payments.
- The cumulative net costs are projected in Column D; the figures in Column B have been modified to exclude profit. The net costs were calculated using the following equation: Value / (1% plus profit %).
- Monthly costs are computed by subtracting the sum of earlier charges from the current cumulative cost, as shown in Column E.

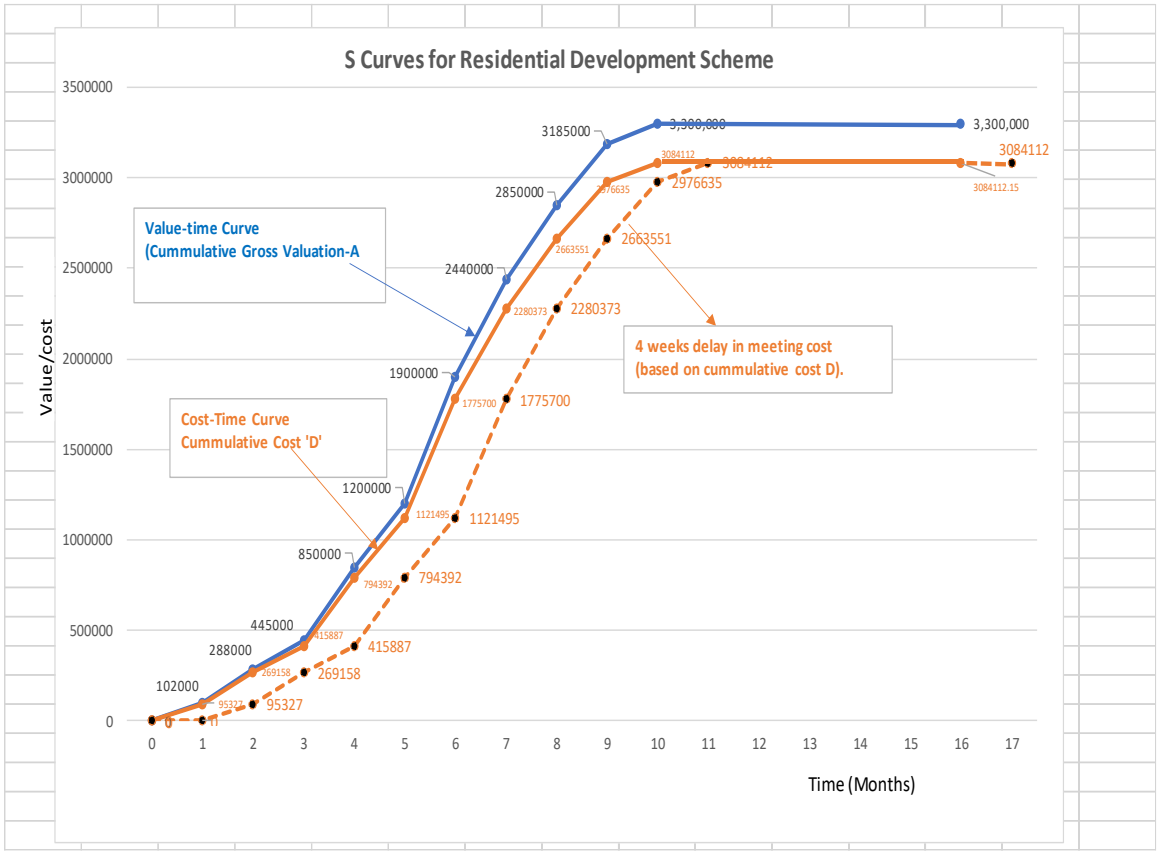

Figure 1. Value-time, Cost-time curve, and a 4-week payment delay in meeting cost S-curves.

Figure 1 shows the Value-time S-curve; Cost-time S-curve and a 4-week payment delay in meeting cost, whereby the data (valuations) in Table 2 are plotted against the contract period. The S-curves corroborate the presumption that the cumulative expenditure on any construction project normally approximates an S-shaped curve. The value of work due for payment at specified time frames is then read from the S-curve, less previous payments. This approach achieves better accuracy than the empirical S-curve, which is however only a guide because it does not account for differences in individual projects. Furthermore, it is not suitable for projects where provisional sums are front-loaded and not evenly spread. Typically, using the empirical quarter-third S-curve as a basis for the interim valuation exercise, requires that the initial total project cost (£6,995,050) is profiled into 3 parts.

A more realistic approach will require basing the S-Curve on the project program. The application of this method is thus only as good as the accuracy of the planning forecast, as delays and variations are not accounted for (Kaka, 1996; Kishore, et al., 2011) [7]. S-curves are therefore only useful for giving the client/contractor, a forecast of their likely cashflow requirement over the project duration and as a part of the project financial/cost control mechanism.

- The Sawtooth red (−) (or cash flow before payment is received) represents an outflow (or a negative cash flow) or, in other words, indicates the cash-flow balance at the end of each month, just before payment is received. This is because, at the start of a project, the contractor will need to make some payments (representing costs) to the supply chains before it gets its first payment from the client. Typically, Workers who are paid daily, weekly, or monthly are paid salaries at the conclusion of the first month. Since they are involved in planning and operational tasks for mobilisation, monthly paid site employees may also get wages before the project begins.
- The cash-flow balance at the end of the month, right after payment is received, is known as the Sawtooth black (+) (cash-flow balance after payment received).. This reflects a positive (+) cash flow or incomings.

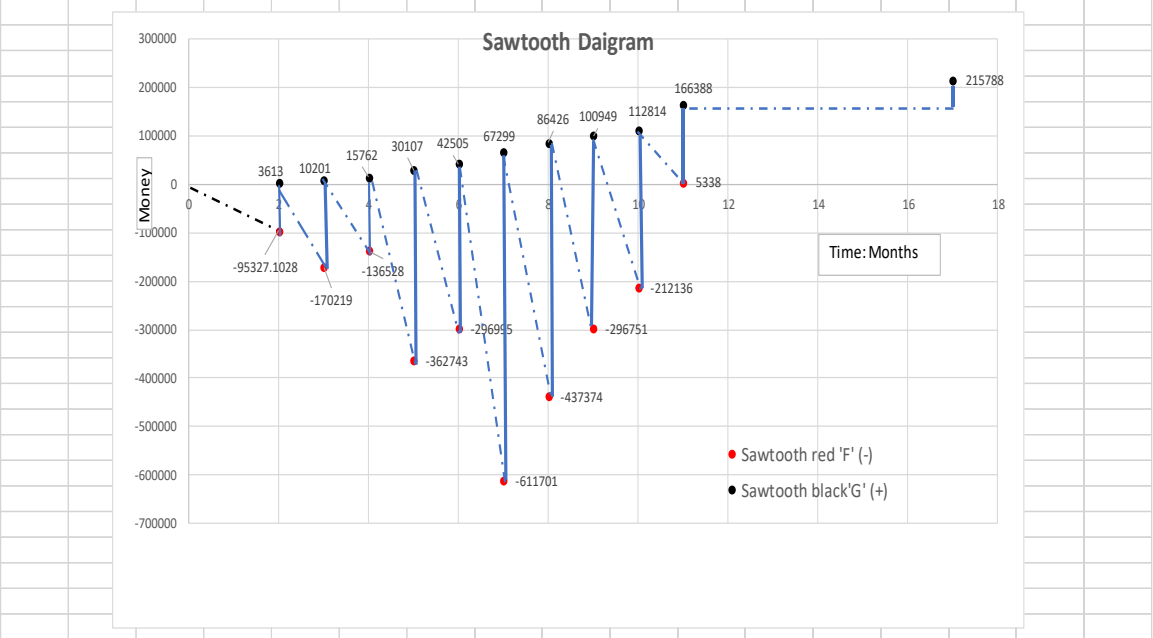

Figure 2. Saw-tooth red and saw-tooth black cash flow analysis.

Figure 2 graphically represents the Saw-tooth red and the Saw-tooth black.

CONCLUSION

This paper has carried out cash flow analysis and valuation of a project scenario for a residential development scheme using the S-Curve and Sawtooth analytical approach. The cash flow forecast provided may not necessarily provide a precise/clear-cut forecast of reality in a construction project situation, due mainly to the wide range of risks/uncertainties associated with construction projects. The unpredictability associated with construction projects and potentially influential variables, specific to individual construction projects, invariably affect the level of precision attainable with cash flow forecasts. Two such reasons are:

i. The inability to integrate unplanned costs triggered during the construction phase: Cash flow forecasts are often carried out at the pre-tendering stages. As such, they do not account for time delays and earned values and may not be amenable to integrating costs triggered by scope creep, variation/change orders, etc. Also, estimating errors may not have been accounted for.
ii. Individual client behavioural tendencies: Unanticipated influences such as delayed payments, may play out in practice. As such, the likelihood of attaining full compliance with the initial planning is minimal. Discrepancies between the contractor's forecasted interim measurements/payments and actual progress are thus highly probable.

Irrespective of the level of precision attainable due to these factors, cash flow analysis using S-curves is necessary for business and resource planning at the project level and is essential for both the client and the contractor. S-curve cash flow predictions are thus useful in making necessary financing and funding decisions at the planning phase of a project, prior to the availability of increasingly sophisticated and more accurate predictions that will be made as the project advances.

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