Forecasting of Cash Flow in Construction Projects by Using Computational Tools

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Abstract: *Cash flow forecasting is very important for any kind of business. An overall picture of outgoing & incoming cash flows is achieved by the cash flow forecast. The purpose of this study is to evaluate the cash flow forecast for a particular project using proposed software to improve the cash flow forecasting. The current practice of companies of using spreadsheets for cash flow forecasting is difficult to reinforce and is also time- consuming. A more effective software is proposed to take all these possibilities on a dynamic basis.*

Keywords: **Cash flow, spreadsheet comparison, forecasting, ERD, software modules.**

1. INTRODUCTION

The contractor's cash flow should be accurate, practical and realistic in construction industry. The advantage is to maintain competitiveness. That's why many business organizations mostly practice multiannual cash flow forecasts in their business strategy. Financial planning is the key to survive in construction field. It has been observed that lack of capital is one of the most leading reasons of business failures and because of it many successful companies have become bankrupt. When it comes to construction industry, owner and contractor parties are involved to complete the project, and it is important for both to manage cash flow forecasting efficiently. It is known that before the completion of project, the project undergoes several stages. From the contractor's point of view, he would receive payment from the owner after completing certain milestones. So, there is possibility that the contractor would receive the payment 30 to 60 days after the expenses would have incurred. So, the contractor should plan and cover its' costs.

2. LITERATURE REVIEW

All Mostafa Khanzadia *et al.* [1] showed how to obtain probabilistic cash flow forecasting model using Bayesian Belief Networks (BBNs) to avoid bankruptcy of contractors. Here, possibility to produce more tangible probabilistic cash flows were also determined. The advantages & disadvantages of conventional methods like fuzzy logic, artificial neural networks, weights of categories, system dynamics were studied here.

Samer Ezeldin *et al.* [2] analyzed optimization of the cash-flow requirements for large engineering portfolios from the contractor's point of view and a computational model was developed. The model made use of Python language. It also used front run and back run calculations for scheduling calculations done by critical path method.

Giovanni Margarido Righetto *et al.* [3] used Mathematical formulations based on mixed integer linear programming and robust optimization techniques for supporting tactical

cash flow management decisions. The formulation considered investment options with two or more grace periods for redemption.

Ceren Oral, G. Cenk Akkaya [4] aimed to find negative impact of negative cash flow patterns and trends and their impact on construction process. The data collection showed that almost all construction companies in Dubai face negative cash flow. The shortage often covered 30-70% of project duration and hence was most likely to occur in second half of project's life cycle.

James M.W *et al.* [5] studied an Innovative model to predict company failure. The authors in this paper used two different techniques to handle two different sampling techniques to handle imbalanced datasets and the same being tested.

Khalil I. Al-Joburi *et al.* [6] showed the negative cash flow trends and patterns and their impact on construction performance by categorizing the civil structures on the basis of their construction value. The subjects were divided into Dubai studio city, commercial building, residential villa, and residential buildings. Different graphs of percentage of work completed versus amount of payment, monthly versus cumulative cash flow balance, expenses versus income profile were illustrated.

Hyung Keun Park [7] suggested that forecasts cash flow should be done in planning stage to manage liquidity crisis effectively. It showed calculation of the best cash flow by taking into consideration time lag, item costs for construction projects. This gave the idea of comparison of the incoming and outgoing cash with respect to the billing time

Ra'ed Jarrah *et al.* [8] investigated Texas Department of transportation (TxDoT) to give a solution to the problem of organizing budget to ensure that there are sufficient funds for all projects. The data was organized into project categories and sub-categorized into project amounts. A computer program was developed to implement the results of investigation of Texas department for transportation.

Ammar P. Kaka [9] presented how variables are needed to calculate cash flow of individual contracts. Test conducted demonstrated how contractor's cash flow is highly sensitive to risk, variations, cost variances, duration overrun and under measurement.

Hyung- Ken Park [10] introduced development of project-level cash flow forecasting model in construction stage based on the planned earn value and the cost from a general contractor's view on jobsite. The cost categories were classified to compile resources with almost same time lags that were based on contracting payment conditions and credit times given by suppliers.

Mark L. Defond *et al.* [11] showed how the analysts tend to forecast Cash flows for firms with more heterogeneous accounting devices relative to their industrial peers, high capita intensity leading stock to poor financial health. It describes that the market participants can use cash flows to interpret the information in earnings and assess firm viability. The researcher predicted that demand for cash flow forecasts depends on the accounting, operating and financial activities, to determine relative usefulness of cash flows in interpreting earnings and firm viability.

R. Navon [12] stated the basic concept of cash flow. He also carried out a survey of six contractors as to who prepared the cash flow, the method used and its accuracy. Because the model was not developed with a specific company in mind, the default values were determined on the strength of a comprehensive literature survey and so the values have a large range.

Singh S and Lankanathan G. [13] considered most common prevailing conditions of contract and credit conditions in the computation of cash flow. The illustrated features incorporated along with application for cash flow planning.

P.A. Thomas [14] suggested that the realistic way to model inflation was to incorporate cost and price escalation in all charges associated with the project. The author didn't adjust the charges defined for each individual activity. It also showed that realistic interaction of time and money is wholly dependent on correct definition of costs and revenues.

George Suckariah [15] used the three basic functions of construction operations that is estimating, scheduling and cost control. The micro-computers were used to help perform

these functions. By using spreadsheet programs, micro-computers can provide estimators and construction managers an efficient control system.

3. METHODOLOGY

The study is about preparing a forecast of cash flow for construction projects by using the factors that affects successful completion of the cash flow forecast of a construction project. The purpose of the study is to understand how much beneficial and accurate is the use of the proposed software to predict the cash flow. There is more to cash flow management than simply understanding how much money is in a company's bank account. Cash flow forecasting plays an important role, giving the opportunity to estimate the amount of money flowing in and out of business over a given period (here monthly). Producing a cash flow forecast used to be a time-consuming, complex task, becoming outdated almost immediately. With the proposed cash flow forecasting software, that will all change. The use of software to monitor the inflow and outflow of such minute works helps to have an eye on the flow of cash. A good hand on the formulas helps to obtain near accurate values of the cash flow. The values obtained can be shared with top management, site engineers, supervisors for keeping the project on schedule and comparing the estimated and actual values and take timely action as required.

The steps involved for cash flow forecast process is given below.

Step 1. Enter the required constants in the software.

Step 2. Input the obtained values from the site.

Step 3. Estimate the outflow by following the software instructions.

Step 4. Plan finances as per the result obtained

4. DATA COLLECTION

From the previous research conducted by the author, the following data has been collected:

4.1 Project study details

1. Name Of Company : A.B.L
2. Project Name: Construction of minor bridges between chainage 16700 to 33000 of Wardha-Yavatmal section in connection with Wardha - Nanded New BG Rail Line Project.
3. Cost of Project: 12 Crores
4. Project duration: 24 months
5. Owner : Central Government, India
6. Location : Wardha, Maharashtra
7. Type of Structure :Infrastructural

The figure below shows the comparison between the cashflow forecast prepared in conventional manner of spreadsheets to the actual cashflow expenses. The formulas are very complicated and time consuming if the cells change. For the people who aren't acquainted with features of excel, it is very overwhelming. Formulas have to be entered every single time and detailing is not possible. Also the real time monitoring is not possible and one month is needed for the comparison between the forecasted and the actual values.

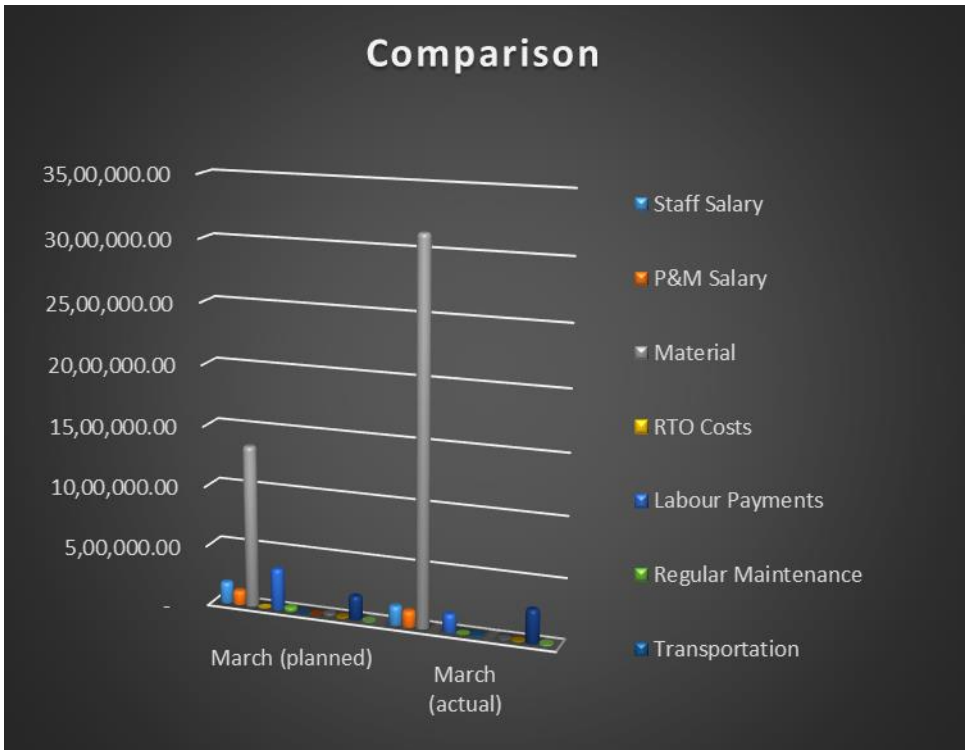


Fig 1: Comparison of Forecast & Actual values of cash flow by conventional method

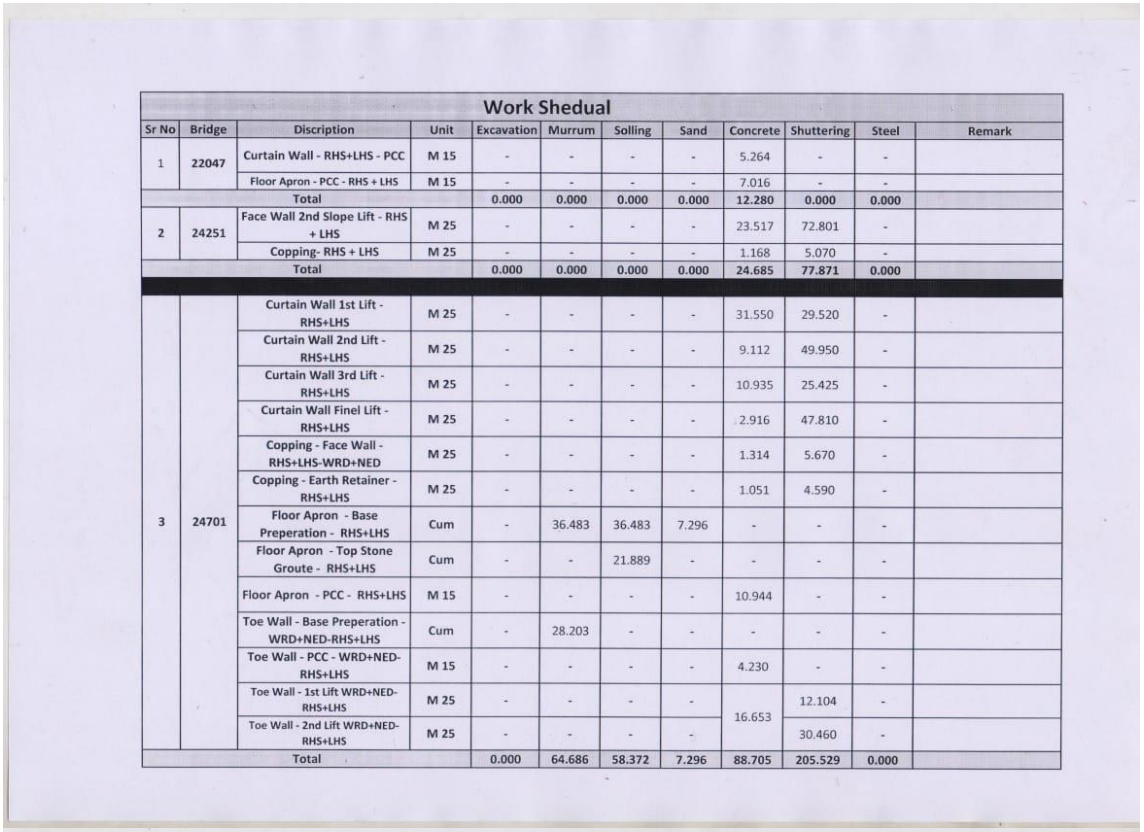
5. DEVELOPMENT OF SOFTWARE

There's more to cash flow management than simply understanding how much money is in a company's bank account. Cash flow forecasting plays an important role, giving the opportunity to estimate the amount of money flowing in and out of business over a given period (here monthly). Producing a cash flow forecast is a time-consuming, complex task, if done by the conventional methods. With the proposed cash flow forecasting software that will all change. According to the scenario of Indian construction industry, plenty of data is available in the form of experiences, statistical records, and some data are generated through questionnaires and interviews. The following factors were found out to be most important:

1. **Schedule of project activities**

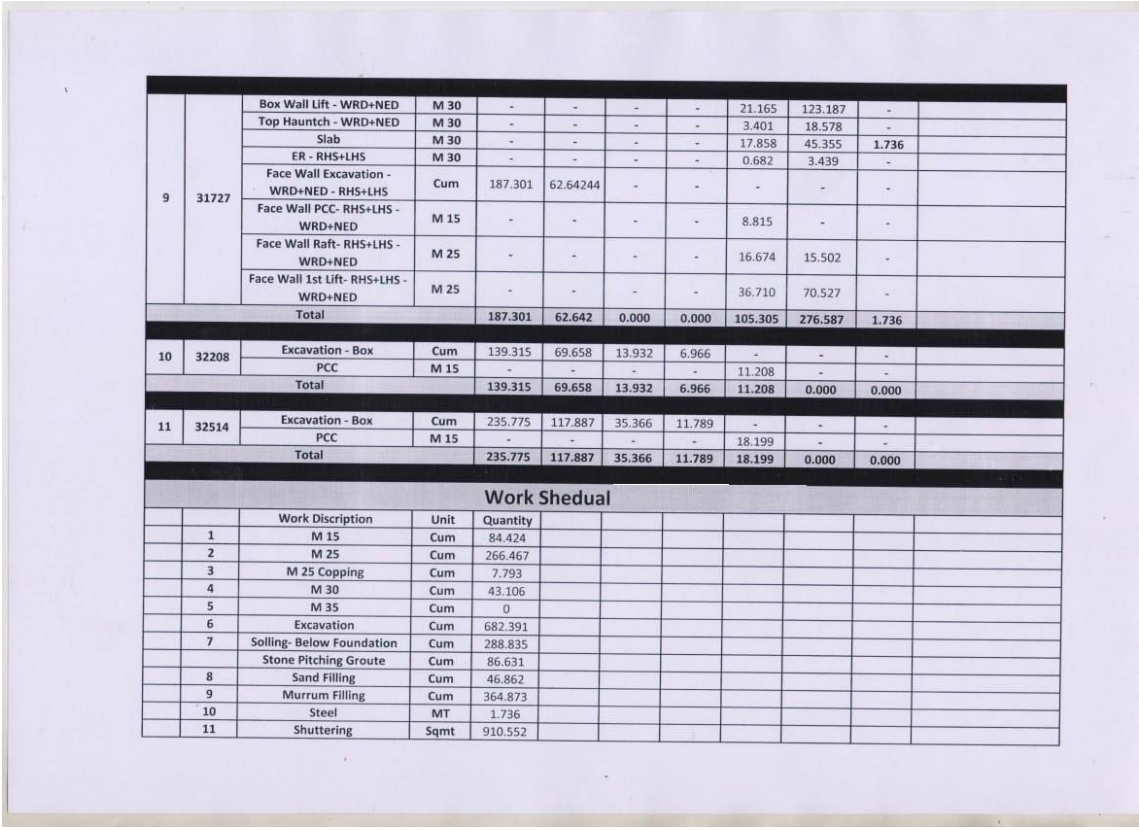
In most of the projects, a project schedule is created in the initial stage of the project. It is from this schedule that the progress of the project is determined. The work that would be done in the particular month can be calculated by a healthy co-ordination between the project owners, engineers and the performing contractor. The schedule prepared should be such that work is neither delayed nor more than that can be in practice.

Given below is the projection given for the ROB for a particular month.



Work Shedual

Sr No	Bridge	Discription	Unit	Excavation	Murrum	Solling	Sand	Concrete	Shuttering	Steel	Remark
1	22047	Curtain Wall - RHS+LHS - PCC	M 15	-	-	-	-	5.264	-	-	
		Floor Apron - PCC - RHS + LHS	M 15	-	-	-	-	7.016	-	-	
		Total		0.000	0.000	0.000	0.000	12.280	0.000	0.000	
2	24251	Face Wall 2nd Slope Lift - RHS + LHS	M 25	-	-	-	-	23.517	72.801	-	
		Copping- RHS + LHS	M 25	-	-	-	-	1.168	5.070	-	
		Total		0.000	0.000	0.000	0.000	24.685	77.871	0.000	
3	24701	Curtain Wall 1st Lift - RHS+LHS	M 25	-	-	-	-	31.550	29.520	-	
		Curtain Wall 2nd Lift - RHS+LHS	M 25	-	-	-	-	9.112	49.950	-	
		Curtain Wall 3rd Lift - RHS+LHS	M 25	-	-	-	-	10.935	25.425	-	
		Curtain Wall Finel Lift - RHS+LHS	M 25	-	-	-	-	2.916	47.810	-	
		Copping - Face Wall - RHS+LHS-WRD+NED	M 25	-	-	-	-	1.314	5.670	-	
		Copping - Earth Retainer - RHS+LHS	M 25	-	-	-	-	1.051	4.590	-	
		Floor Apron - Base Preperation - RHS+LHS	Cum	-	36.483	36.483	7.296	-	-	-	
		Floor Apron - Top Stone Groute - RHS+LHS	Cum	-	-	21.889	-	-	-	-	
		Floor Apron - PCC - RHS+LHS	M 15	-	-	-	-	10.944	-	-	
		Toe Wall - Base Preperation - WRD+NED-RHS+LHS	Cum	-	28.203	-	-	-	-	-	
		Toe Wall - PCC - WRD+NED-RHS+LHS	M 15	-	-	-	-	4.230	-	-	
		Toe Wall - 1st Lift WRD+NED-RHS+LHS	M 25	-	-	-	-	16.653	12.104	-	
		Toe Wall - 2nd Lift WRD+NED-RHS+LHS	M 25	-	-	-	-		30.460	-	
		Total		0.000	64.686	58.372	7.296	88.705	205.529	0.000	
4	28192	Floor Apron - Base Preperation - RHS+LHS	Cum	-	-	-	6.768	10.153	-	-	
		Floor Apron - RHS+LHS - Top Stone Groute	Cum	-	-	40.610	-	-	-	-	
		Flexible Apron - RHS+LHS	Cum	-	-	147.834	-	-	-	-	
		Total		0.000	0.000	188.444	6.768	10.153	0.000	0.000	
5	29399	Face Wall- 4th & Finel Lift - NED - RHS+LHS	M 25	-	-	-	-	22.49	62.166	-	
		Copping - Face Wall - RHS+LHS-WRD+NED	M 25	-	-	-	-	1.460	12.270	-	
		Copping - Earth Retainer - RHS+LHS	M 25	-	-	-	-	1.037	4.320	-	
		Total		0.000	0.000	0.000	0.000	24.987	78.756	0.000	
6	30041	Wing Wall - 2nd Slope Lift upto Finel- WRD+NED - RHS+LHS	M 25	-	-	-	-	41.374	131.776	-	
		Curtain Wall PCC - RHS+LHS	M 15	-	-	-	-	6.682	-	-	
		Curtain Wall 1st To Finel Lift - RHS+LHS	M 25	-	-	-	-	44.752	131.51	-	
		Floor Apron - Base Preperation - RHS+LHS	Cum/M 15	-	-	40.220	8.044	12.066	-	-	
		Floor Apron - Top Stone Groute - RHS+LHS	Cum	-	-	24.132	-	-	-	-	
		Wear Coat	M 25	-	-	-	-	12.700	1.004	-	
		Total		0.000	0.000	64.352	8.044	117.574	264.290	0.000	
7	31110	Copping - Face Wall - RHS+LHS-WRD+NED	M 25	-	-	-	-	1.369	5.898	-	
		Copping - Earth Retainer - RHS+LHS	M 25	-	-	-	-	0.394	1.62	-	
		Total		0.000	0.000	0.000	0.000	1.764	7.518	0.000	
8	30562	Excavation - Box	Cum	120.000	50.000	15.000	6.000	-	-	-	
		PCC	M 15	-	-	-	-		-	-	
		Total		120.000	50.000	15.000	6.000	0.000	0.000	0.000	



9	31727	Box Wall Lift - WRD+NED	M 30	-	-	-	-	21.165	123.187	-	
		Top Hauntch - WRD+NED	M 30	-	-	-	-	3.401	18.578	-	
		Slab	M 30	-	-	-	-	17.858	45.355	1.736	
		ER - RHS+LHS	M 30	-	-	-	-	0.682	3.439	-	
		Face Wall Excavation - WRD+NED - RHS+LHS	Cum	187.301	62.64244	-	-	-	-	-	
		Face Wall PCC- RHS+LHS - WRD+NED	M 15	-	-	-	-	8.815	-	-	
		Face Wall Raft- RHS+LHS - WRD+NED	M 25	-	-	-	-	16.674	15.502	-	
		Face Wall 1st Lift- RHS+LHS - WRD+NED	M 25	-	-	-	-	36.710	70.527	-	
Total				187.301	62.642	0.000	0.000	105.305	276.587	1.736	
10	32208	Excavation - Box	Cum	139.315	69.658	13.932	6.966	-	-	-	
		PCC	M 15	-	-	-	-	11.208	-	-	
Total				139.315	69.658	13.932	6.966	11.208	0.000	0.000	
11	32514	Excavation - Box	Cum	235.775	117.887	35.366	11.789	-	-	-	
		PCC	M 15	-	-	-	-	18.199	-	-	
Total				235.775	117.887	35.366	11.789	18.199	0.000	0.000	

Work Shedual

		Work Discription	Unit	Quantity
	1	M 15	Cum	84.424
	2	M 25	Cum	266.467
	3	M 25 Copping	Cum	7.793
	4	M 30	Cum	43.106
	5	M 35	Cum	0
	6	Excavation	Cum	682.391
	7	Solling- Below Foundation	Cum	288.835
		Stone Pitching Groute	Cum	86.631
	8	Sand Filling	Cum	46.862
	9	Murrum Filling	Cum	364.873
	10	Steel	MT	1.736
	11	Shuttering	Sqmt	910.552

Figure 2: Projection given for ROB

1. BOQ rates of these activities

The BOQ amount plays the most important role as it is upon this point that the whole cash flow forecast circles upon. To obtain that, we need BOQ rates. BOQ rates are finalized at the time of tender certification. The rates are to be kept with due consideration given to the above and below percentage. On multiplying this BOQ rate with the above given projected quantity, BOQ amount is obtained. The point of extra items is something which needs to be pondered upon as in most of the projects, extra items approval needs to be taken from the owner and many a times, the total extra items are billed and paid against.

Estimated Quantity x BOQ Rate = BOQ Amount (1)

2. Material constants

To know the material required to perform the activities, the researcher suggests to use the rate analysis concept directly. This would require the constants for each material that will be consumed in the working of activity. The same can be obtained from Mix designs, Structural designs, IS codes and experience of field.

Material Constant/unit quantity x Quantity of activity= Quantity of material required (2)

3. Material delivery period

This factor indicates how many times the material would be required to be ordered against the balance stock to perform the given work.

Material required= Theoretical material quantity – available balance stock on site (3)

Within how many days the material is expected to be delivered will give an idea whether the work will be as per the schedule as delay in the supply of material will delay the progress of work, thus increasing the time and hence the cost indirectly.

4. Payment schedule of supplier and labors

This refers to the cash credit period that is provided by the supplier against the purchase of items. The CC period differs from supplier to supplier based on the mutual interest, relation between the supplier and the purchaser and also the cost of the item. At the same time, payment done to labors is mostly done weekly as observed by the researcher. Hence this will need to be considered in the outflow.

Labor payment = Labor rate x Work done (4)

5. Previous outstanding payment schedule

If the cash credit system exists then surely there would be outstanding payment too. The balance payment's date if due in this month will also be enlisted in the cash outflow. The most efficient method would be analyzing all the payment which are due to be paid and the cash credit period that was allowed at the time of purchase. Placing the values accordingly would give a better idea about the outflow. However, this will be very time-consuming and cumbersome if proper monitoring is not done.

6. Staff salary and date

The staff is the backbone of all the work that takes place. On one hand, the labors are paid weekly, while the staff is paid monthly. ESIC, PF and the gross cutting also needs to be done. An average of 4% salary for technical staff and 2% can be considered as an average.

7. Maintenance & RTO cost

The machineries employed on site bring out a lot of expenses if not repaired in the initial stage itself. Apart from this, the insurance, and RTO costs also matter a lot. Transportation of heavy machineries from site to site also need to be considered. However, even though the researcher tried to give a formula for the expenses needed in the maintenance of vehicles, a hard-core formula couldn't be developed as the breakdown of machinery is completely unpredictable. But the researcher has an idea that the machinery expenses can be related to the machinery's age, site conditions, availability of spare parts locally. Unless a more defined idea isn't available, a fixed value based on previous actual values is directly put in the forecast.

6. RESULT

The figure below is the result obtained after calculating the major factors affecting the cashflow of a construction project. A lot of things are unpredictable in construction field, starting from the market price to the natural calamities. But the flow of cash needs to be monitored right from the start or else it may lead to serious problems. It is necessary to show the flow of cash when it comes to financial institutions. The previous methods though easy to use have given many limitations. Owing to other few factors, the small-scale contractors prefer to forfeit the benefits of making forecast for cash flows in their regular work. Few prefer staying back considering the comfort zone that they have put themselves thus unseeing the adverse effects of not having a foresight of the cash flow

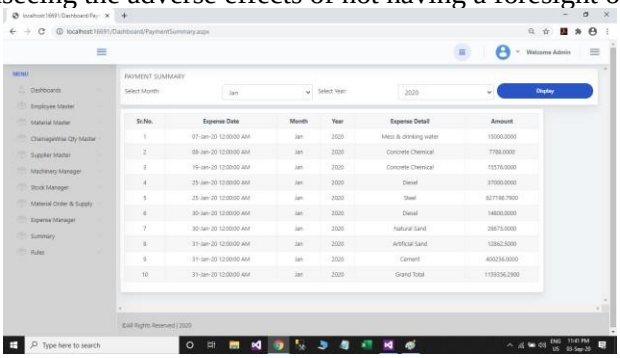


Figure 3. Summary of outflow

7. Conclusion

Accordingly, builders and contractors cannot afford to stay in the dark and to stay in the race they have to upgrade and equip themselves with the latest advancements in technologies. The conventional method of using spreadsheet rather not using any at all, showed a variation of 60% to the actual expenses for a particular month. The proposed software had a difference of -5% to the actual expense.

The conventional spreadsheet doesn't consider the cash credit time which is taken care of in the proposed software. This is the main reason for variation of 65% in the material expenditure. The miscellaneous expenses are taken repeatedly based upon the previous month's performance. Here, the miscellaneous expenses though not formulated, can come to a conclusion by taking into consideration the activities to be performed in this month. However, this requires good expertise.

Also, the formulas are difficult to develop and time-consuming in spreadsheet. A more Effective software takes all these possibilities into account not just once, but on a dynamic basis, continually monitoring trends. The auto-generation of summary eliminates the waiting of a particular period say 30 days until the actual work is completed. If the various department heads are given authority to edit and change the real time values, perhaps a more real-time data can be acquired. This is a limitation observed in spreadsheet due to which the forecasted values of cash flow are not accurate.

The software can be developed in future to give the graphic representation of real time comparison of forecasted and actual values. The employment module and a formulation to calculate the minor expenses not evaluated here, can also be developed to bring the results more close to the reality.

Although no-one can predict the future, the proposed software will give a confidence and knowledge of which factors have most impact to help remove or reduce uncertainties. Based on the result of analyses, the proposed model will be more accurate, flexible and simpler than the traditional methods to a contractor at construction site who is not oriented with financial knowledge

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