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Techniques for Improving the Profitability of Small and Medium Scale Construction Firms

Rohit Paygude[1]* Prof. Nitin Morey[2]

[1] PG Student, Department of Civil Engineering, JSPM'S BSCOER, Pune, India

[2] Associate Professor, Department of Civil Engineering, JSPM'S BSCOER, Pune, India

Abstract – The profitability level of construction industry (Small, medium and large) is mostly depending upon three factors they are labour characteristics, management systems/software and external issues. Different researchers have determined different factors that influence construction productivity. Understanding the level of productivity, it is important to develop innovative practices and techniques to improve construction productivity. In this project we compare traditional and proposed approach in terms of Planning, controlling and execution with latest case study. In this Project Autodesk take off is used for Planning, primavera is used for Execution and Build trend is used for Control. This report includes systematic literature reviews on productivity in construction industry for small, medium and high organizations. The report gives review on different method which is used for measurement of construction productivity, factors affecting and theories on improvement of construction productivity such as labor factor, management factors and external factors, the report further reviews on the different innovations which are made for improvement in construction productivity. On reviews it is noted that there are lot of different methods and strategies for improvement of construction productivity but they differs from site conditions and the factors which influence construction productivity. In this project we can compare latest and traditional approach for G+9 and G+6 residential building located at Dudulgaon PCMC.

Key Words – Labor Productivity, Construction Management Software, Construction, External Issues, Materials Management and Safety, Primavera Approach.

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1. INTRODUCTION

1.1 Construction Industry Scenario in India

Construction industry is world's most largest and challenging industry in India. Human resource has a strategic role in increasing productivity in construction industry. With the effective and optimum use of human resources can help in productivity growth. The construction projects are mostly labour based with basic use of hand tools and equipment's in which labour cost consists of about 30% to 50% of total project cost [1]Indian construction industry is one of fastest growing sector globally. The construction sector gives second largest employment after agriculture. India shares about 8% of total GDP and also provides employment to around 35 million peoples directly or indirectly [2] In construction industry one of the biggest problems faced is of unskilled labour which implies in productivity loss and impacts on cost overrun and schedule daily. Labour productivity is one of important factor which affects physical progress of construction project.

1.2 Background

The contribution of Indian construction industry to GDP is about 8 % on an average in last 5 years (Planning Commission of India 12th five-year plan, 2015). Indian construction industry provides employment approx. 41 million persons and it is ranked second in providing jobs after Agriculture sector in India. The construction sector is the 2nd largest producer of jobs in India after Agriculture and still the employment generation and the economic importance of the sector, it encounters issues such as low productivity, delays in completion of projects and lack of professional practices in the industry.

1.3 Motivation

The Indian construction sector grows significantly over the past 15 years and enjoyed the benefits of growing economy and FDI funds through other developed countries but still face the issue of low construction productivity, delay in completion of projects and a number of projects experience cost

overrun. Construction industry majorly falling in the following domains or sub-sectors is:

- **Buildings:** Residential buildings, Commercial and Institutional buildings.
- **Infrastructure:** Road, Rail, telecommunication systems, urban infrastructure, Dams, Canals, airports, power systems, and sewage & drainage systems.
- **Industrial:** Type-specific industrial construction, Power plant construction, nuclear plant construction and another type of construction.

1.4 Objective of the project

1. To implement qualitative approach over conventional approach on different firms.
2. To apply standard project plan. (planning-execution-control) PEC Approach.
3. To Improves quality of work.
4. To save cost and maximize profitability.
5. To Ensures environmental friendliness.
6. To Enhance Brand value of the firm.

1.5 Scope of the project

In this project we are doing 3 different case studies with latest and traditional approach for G+7/ G+9/ G+6 residential buildings. located at **Dudulgaon, PCMC.**. We used a qualitative research method and applying PEC Approach means Qualitative Approach over Conventional Approach in different segments of construction activity mainly men, machinery and material in different situations and try to counter attack the problem or we can say improve the profitability of firms. This topic is mainly based on suburbs around Pune and belongs to small and medium construction projects in it.

2. LITERATURE SURVEY

Inta Kotane et. al. In the circumstances of globalization, the assessment of the companies' business performance becomes crucially important for small and medium-sized enterprises (SMEs). Despite a wide variety of the methods for evaluation of the companies' financial performance offered by the theory of economics, the issue on what is the optimal method to be chosen and to be applied by the company to manage efficiently the enterprise is still up-to- date.

Piotr waśniewski et. al. The performance measurement system is one of the determinants which creates an enterprise's value, and is supposed to leading to an enterprise maintaining or improving its performance in the long term per spective. Small enterprises do not understand the need to measure their performance or the potential benefits that come from this measurement. The aim of the article is to present a framework of a perform mince measurement system for small enterprises with a practical verification of its assumptions.

Farah Margaretha et. al. The objective of this research is to examine factors affecting profitability such as firm size, firm age, growth, lagged profitability, productivity, and industry Affiliation of SMEs firm listed in Indonesia Stock Exchange. Source of data used in this study is secondary data based on index pefindo 25. The results showed that firm size, growth, lagged profitability, productivity and industry affiliation significantly effect on profitability. While the variable firm age does not significantly influence profitability.

Mahmood Mokhtariani et. al. The construction industry in most countries worldwide is characterized by extreme competitiveness, high risk, and usually low profit margin in comparison with many other industries. The major reason for this intensive competitiveness Is the relative ease of entry into the construction industry compared to other industries, even for people or companies with little capital investment? Furthermore, to find a new project, construction firms have to participate in a competitive bidding process, as it is not generally possible for them to induce demand for their services.

Olanrewaju Abdul Balogun et. al. The contribution of Small and Medium-sized Enterprise (SME) sector in economic development, job creation and income generation has been recognized worldwide. These contributions are effectively articulated in South Africa construction industry discourse. However, the main problem limiting the SMEs sector to contribute fully in the mainstream economy is the shortage of finance. This study examines the impact of firm characteristics in access to credit by the South African SMEs in the construction industry. A deductive methodological approach was used to examine this problem.

Rodney A. Stewart et. al. Research has indicated that the economic activity of small firms has increased substantially in the past twenty years (Hughes 1997). The employment growth rate has also been greater in small firms than large organizations offering further evidence of the importance of the small firm sector (Enterprise in Europe 1994). Small firms have offered lessons to large organizations in terms of surviving within a volatile environment, and provided a focus for

economic and management enquiry (Hughes 1997). A paradox however exists in many sectors.

Amanuel Girma Yismalet et. al. Construction cost management is the most important function for project success, and the construction project performance is generally expressed in terms of cost and its variance from the budget. However, it has not been effectively used due to the presence of a large quantity of data with many complex interrelationships.

Lutfi Abdul Razak et. al. Applying the General-to-Specific modeling on World Bank Enterprise Survey data for 266 economies, this report models five performance indicators based on 80 potential factors derived from firm characteristics, finance, informality, infrastructure, innovation, technology, regulation, taxes, trade and workforce concerning small and medium enterprises (SMEs).

Abdulrahman Bageis et. al. The aim of the present report is to explore basic factors that assist new and existing small and medium sized construction enterprises (SMEs) to be successful. This report reports on the results of a preliminary study that examined these factors globally. Then the report examines the findings in the context of construction contracting firms operating in Saudi Arabia (SA).

3. METHODOLOGY

In this project we use **Proposed approach** for project management and to reduce cost and increase business profitability in Indian Construction Industry for Small and medium firms. The crucial factor in successful implementation of a construction project not only depends on the quality & quantity of work, but also largely depends on availability of resources. All activities involved in the project require certain amount of resources. Each activity is allocated with a specific resource and must be completed within the time limit, otherwise it may adversely affect the overall duration of the project. The time and cost are directly dependent on the availability of resources. The time required may be determined by dividing the productivity associated with the resources used on the activity into the defined quantity of work for the activity. The best combination of resources to use for performing a construction activity is based on contractor's ability to identify the interdependencies of the various resources. Here we compare same site (Aditya Construction Dudulgaon) using traditional approach and resource constrained approach then we analyse different parameters and how our proposed approach is better for small and medium construction firms in India. Resource Constrained Approach is a philosophical concept.

a. Methodology Adopted

This report introduces a comprehensive framework for resource management particularly related to manpower as resource element in construction domain. In this project we use **Resource Constrained Approach and PEC approach** for project management andto reduce cost and increase business profitability in Indian Construction Industry for Small and medium firms this study is carried out as below phases. Here we compare same site (Aditya Construction Dudulgaon) using traditional approach and resource constrained approach then we analyse different parameters and how our proposed approach is better for small and medium construction firms in India. **In this Project Autodesk take off is used for Planning, primavera is used for Execution and Buildtrend is used for Control.**

PLANNING – EXECUTION - CONTROL APPROACH (PEC).

1. Autodesk Takeoff-

Autodesk Takeoff building cost estimating software helps make material costing faster, easier, and more accurate. Cost estimators can create synchronized, comprehensive project views that combine important information from building information modeling (BIM) tools such as Revit® Architecture, Revit® Structure, and Revit® MEP software together with geometry, images, and data from other tools. Automatically or manually measure areas and count building components, export to Microsoft® Excel®, and publish to DWF™ format.

Features

1. Takeoff in minutes automatically
2. Perform a takeoff on an entire building information model (BIM) in just minutes through integration of 2D and 3D design data.
3. Greater flexibility than typical databases or spreadsheets
4. Perform interactive examination of 3D models for material cost estimating purposes.
5. Dynamic counting
6. Count and quantify design data quickly and easily.
7. More efficient manual takeoff
8. Supports the takeoff of JPG, TIF, PDF, and other "non-intelligent" image formats.
9. Share, query, and clarify

10. Generate quantities linked to specific objects. Mark up and "round-trip" your comments.

11. Faster and more insightful quantity reports

12. Create summaries and detailed quantity surveying reports quickly and easily.

1.1 Planning in Construction Management:

It is the process of selecting a particular method and the order of work to be adopted for a project from all the possible ways and sequences in which it could be done. It essentially covers the aspects of 'What to do' and 'How to do it'.

b) Scheduling in Construction Management:

Scheduling is the fitting of the final work plan to a time scale. It shows the duration and order of various construction activities. It deals with the aspect of 'when to do it'.

Importance of construction project scheduling:

Scheduling of the programming, planning and construction process is a vital tool in both the daily management and reporting of the project progress.

c) Organizing:

Organizing is concerned with decision of the total construction work into manageable departments/sections and systematically managing various operations by delegating specific tasks to individuals.

d) Staffing:

Staffing is the provision of right people to each section / department created for successful completion of a construction project.

e) Directing:

It is concerned with training sub ordinates to carryout assigned tasks, supervising their work and guiding their efforts. It also involves motivating staff to achieve desired results.

f) Controlling:

It involves a constant review of the work plan to check on actual achievements and to discover and rectify deviation through appropriate corrective measures.

g) Coordinating:

2. Primavera is used for Execution. It is main phase in construction development.

Project Management in **Primavera software** is the planning, organizing, securing, and execution of the resources needed to complete a project on time and within budget. The main purpose of project management is to achieve all of the project goals while taking in to account the constraints of the project. Typical constraints associated with a project are time, scope, and budget. The secondary goal of project management is to streamline the project management process ensuring that resources are allocated correctly and all the processes are streamlined to make sure the project is completed on time and within the budget.

The 5 Phases of the Project Management Lifecycle

The phases associated with project management fall into five categories including:

1. initiation

2. planning

3. execution

4. controlling

5. closing

Phase 1: Initiation

The initiation phase of the project management lifecycle involves the initial startup processes of a project. This phase is where the project's scope and purpose are defined, justified, and implemented.

A. Team members and managers are appointed

B. The feasibility of the project is studied

C. Documentation is collected

D. The project office is set up

Primavera software helps streamline the initiation phase by offering the ability to store documents, configure the project team member's access, and provide an overall phase review before the planning phase begins.

Phase 2: Planning

The planning phase is the most crucial stage of the project management lifecycle. This phase is where the project documents are finalized in Primavera P6 software and given to the project team members to be used to complete the project. The planning of a project falls involves the creation of five smaller plans including:

1. the project plan

2. resource plan

3. financial plan

4. quality plan

5. acceptance and communications plan

In Primavera P6, the planning phase is started by creating a work breakdown structure, forming a cost loaded schedule, assigning the resources to the project, and establishing a baseline.

Phase 3: Execution

The project execution phase is where the work is started and completed. Once the project plans are set, construction begins on the project and the processes are compared against the baseline throughout the building of the project. The project team members use Primavera P6 software to

- Report Work in Progress
- Status the Schedule
- Compare Projected Start/ Finish Date Against Actual Start/Finish
- Compare Projected Cost Against Actual Cost
- Compare Projected Resource Usage Against Actual Resource Usage

Phase 4: Control

The control phase of the project management life cycle is where the project team members look at the results and decide whether the project is on track or behind schedule. The project team members then use a project management tool, such as Primavera P6 software, to analyze the schedule and evaluate the project. The team members will compare the baseline schedule against the actual schedule and make a recommendation to improve the health of the project. If the project is behind schedule, the project team members will go into the Primavera software application, modify the project data, and then re-forecast the schedule. Then, the team members can go into Primavera P6 software and utilize the Claimdigger functionality to outline the changes made between the two schedule updates.

Phase 5: Closing

The closing process is the final phase of the project management life cycle. In this phase:

1. project team members document lessons learned

2. determine if the project can be used as a baseline for other projects

3. deliver the final product to the stakeholders

Builder trend-

In this Project Build trend is used for Control. Builder trend is a construction management system for home builders, remodelers, specialty contractors and general contractors. It combines project scheduling, project management, financial management, customer management and service management in a single suite. Builder trend + QBO vs. QuickBooks Premier Contractor Edition. builder trend with QuickBooks Online integration gives you full financial capabilities, including anytime/anywhere online access, fully loaded mobile apps, great client communication features and construction management tools that really simplify the process. Builder trend is cloud-based construction project management software for homebuilders, remodelers and specialty contractors.

3. Resource Constrained Approach for Money, Manpower, Material and Machinery (Proposed Methodology)

Figure No 5: Resource Constrained Approach for Money, Manpower, Material and Machinery

1. Money/ Project Cost
2. Manpower
3. Machinery
4. Material

4. CASE STUDY AND RESULT AND DISCUSSION

4.1 Tools and techniques

The construction projects have become so vast and complex that the application of information technology has become inevitable. Companies started developing software's for project management such as Primavera P6, P3, Suretrack, MS project, etc.

This study involves monitoring and controlling the project using Primavera P6. The progress at site must be incorporated in the Primavera schedule and updated. These updates needs to be thoroughly monitored using Primavera.

Tools and techniques involved in this process are:

- **Earned value management (EVM)**

Earned value management is a commonly used method of performance measurement. It integrates scope, cost, and schedule measures to help the project management team assess and measure project performance and progress. This technique requires the formation of an integrated baseline against which performance is measured for the duration of the project. This can be effectively done in Primavera. The project performance baseline is used to measure, monitor, and control overall cost performance on the project.

- **Work performance measurements**

The calculated cost variance, schedule variance, CPI, values for WBS components, in particular the work packages and control accounts, needs to be documented and communicated to stakeholders.

Steps involved in monitoring and control of this project are

1) Creating an ideal schedule: To create a schedule for any project, first step is to collect data available for the project. Subsequently the following steps can be followed in Primavera.

2) Enterprise project structure (EPS): Create the structure of the company with its branches, which is executing the project. This is known as Enterprise project structure (EPS).

3) Organizational breakdown structure (OBS): After the EPS, OBS is created which is a hierarchy that reflects the persons responsible forth projects in the enterprise.

4) Creating new projects: A project is a set of activities and associated information that constitutes a plan for creating a product or service. The project is created under the respective divisions in EPS and assigned the person in charge from OBS to it. The project can be given planned start and must finish dates. The project is assigned a calendar which can be global, resource or project calendar.

5) Work breakdown structure (WBS): WBS is a hierarchy of work that must be accomplished to complete a project. Each project has its own WBS hierarchy with top level WBS element being equal to that of each EPS node or project. Each WBS element may contain more detailed WBS levels, activities, or both.

6) Defining activities: Activities are the fundamental work elements of a project and form the lowest level of a WBS and, are the smallest subdivision of a project. An activity has the following characteristics like activity ID, name, start and finish dates, activity calendar, activity type, activity codes, constraints, expenses, predecessor and successor relationships, resources, roles etc.

7) Relationship between activities: To from a network, the activities should be connected to each other, which is done by assigning preceding and succeeding activities with significant relationship to the activities.

   - Finish starting (FS) relationship.
   - Finish finishing (FF) relationship.
   - Start to start (SS) relationship.
   - Start to finish (SF) relationship.

8) Determining activity duration: When planning the work, the duration is entered in the original duration field. The actual duration can only be entered for the activities, which are completed.

9) Activity dates: The following are the types of activity dates available in the primavera; actual start, actual finish, planned start, planned finish.

10) Activity cost: The activity cost is the sum of all the cost incurred to complete the activity.

11) Creating baselines: A simple baseline plan is a complete copy of the original schedule which provides a target against which a project's performance is tracked.

12) Updating schedule:

- If the project is progressing exactly as planned, then only needed to estimate progress.
- If the project is not progressing as planned many activities are starting out-of- sequence, actual resource use is exceeding planned use, and then update should be done for activities and resources individually.
- Most projects contain some activities that progress as planned and some which do not. In this case, the best method is to combine the two updating methods.

13) Tracking: Tracking window is used for monitoring a project's progress using different types of layouts such as labor costs, project cost, resource forecasting, resource allocation unit wise and cost wise.

14) Earned value: Earned value is a technique for measuring project performance according to both project cost and schedule. The technique compares the budgeted cost of the work to the actual cost.

15) Claim digger: The claim digger is a schedule analysis tool that enables a company to generate a report that compares selected data fields in a revised project and a corresponding baseline.

16) Project thresholds: Project thresholds consist of parameters assigned to WBS elements; they are used to monitor projects and generate issues.

17) Project issues: Project issues are the problems within a schedule that must be addressed before the project can be completed. They can either be created by thresholds or manually.

4.2 Preliminary steps to be done in updating

Choose project. Maintain baseline. Then add and save a copy of current project as a new baseline B1. Then choose Project baseline as B1 and assign primary baseline as B1. Daily updates to be made:

4.3 Schedule analysis and forecasting

Schedule variance (SV)

It determines whether a project is behind or ahead of the schedule. It is calculated by subtracting planned value from the earned value.

Schedule variance = Earned value (EV) -Planned value (PV)

The Schedule Variance can be expressed as a percentage by dividing the schedule variance (SV) by the planned value (PV):

SV% = SV / PV

Schedule performance index (SPI)

It indicates efficiency with which the project team is using its time.

Schedule performance index = Earned value / Planned value Time estimate at completion {EAC (t)}

We can generate a rough estimate of when project will be completed Estimate at complete {EAC (t)} = (BAC/SPI)/ (BAC/months)

BAC = Budget at completion

4.4 Cost analysis and forecasting

Cost variance (CV)

It shows whether a project is under or over budget.

Cost variance (CV) = Earned value (EV) - Actual cost (AC)

This number can be expressed as a percentage by dividing the cost variance (CV)by the earned value (EV). CV% = CV / EV

Cost performance index (CPI)

It is one of the clearest indicators of the cumulative cost efficiency of the project. Cost performance index (CPI) = Earned value (EV) / Actual cost (AC)

4.5 Ideal baseline for Project

An ideal baseline B1 was created in Primavera for the case study. The work breakdown structure, activities and steps for activities are being discussed here. The structure for the baseline is presented from the WBS levels. In WBS a level may be again sub divided. Activities come under the WBS.

4.6 Delay analysis

The following reasons were observed during this thesis work, which can be held responsible for delays;

Lack of knowledge about advanced tracking methods and software's.

1. Insufficiently skilled staff.
2. Lack of proper fund flow throughout the project progress
3. A major portion of labor force was from West Bengal and Orissa. Regional festivals in these areas cause sudden delays in work progress.
4. Even though delay due to monsoon rain was already accounted in the baseline schedule, unexpected extension of monsoon caused further delay in project progress.
5. Sand unavailability due to legal restrictions.
6. Late delivery of resources.

4.7 Comparison of existing approach and proposed approach- Case Study 1-

Site details- - OM Apartment Dudulgaon Pune. Name of the Building: om Apartment Description: Residential Building

Building Floor- G+9

Address: Dudulgaon,PCMC MH, INDIA.

Society Name: OM Apartment

Contact Person: Mr. Chinmay Saste. Tel No: +91 9049222382.

Main steps involved in Building construction work apart from initial planning are

7. Mobilization
8. Piling
9. Column& beam concreting
10. Slab & stair concreting
11. Post concreting works
12. Masonry work
13. Plastering
14. Flooring, dadoing
15. External wall plastering
16. Finishing

Built up area: 97700 Sq ft Floor to Floor height : 3.35m

Height of Plinth: 0.50 m above Ground Level Depth of Foundation 1.50 m below Ground Level. External Walls: 250 mm thick including plaster Internal Walls: 150 mm thick including plaster Parapet Walls: 250 mm thick including plaster

1. Earned value analysis

The earned value of the work has been calculated after including the actual cost of each activity inclusive of expenditures. The following details were obtained from calculations using data obtained from Primavera P6

Table No 1. Results Obtained From PEC Approach.

Sr. No.	Project Budget (BAC)	Rs 5,07,81,495
	Planned Value (PV)	Rs 4,79,17,756
	Earned Value (EV)	Rs 4,26,24,087
	Actual Cost (AC)	Rs 4,05,63,038
	Schedule Variance (SV) SV=EV-PV	Rs 52,93,669
	SV%=SV/PV	-11.05%
	Schedule performance Index(SPI) SPI=EV/PV	0.89
	Total Duration	21 Months
	Estimate at Complete	23.6 Months
	Cost Variance (CV) CV=EV-AC	20,61,048
	CV%=CV/EV	4.84
	Cost Performance Index(CPI) CPI=EV/AC	1.05
	Estimate to Complete	Rs 73,54,718

Table No 2. Results Obtained From Traditional Approach

Sr. No.	Project Budget (BAC)	Rs 5,07,81,495
	Planned Value (PV)	Rs 3,85,17,812
	Earned Value (EV)	Rs 5,28,36,954
	Actual Cost (AC)	Rs 4,05,63,038
	Schedule Variance (SV) SV=EV-PV	Rs 13,80,858
	SV%=SV/PV	-3.7
	Schedule performance Index(SPI) SPI=EV/PV	1.3
	Total Duration	28 Months
	Estimate at Complete	23.6 Months
	Cost Variance (CV) CV=EV-AC	1473916
	CV%=CV/EV	0.23
	Cost Performance Index(CPI) CPI=EV/AC	1.30
	Estimate to Complete	Rs 28,54,774

Here we compare conventional approach and primavera approach project budget is same in both scenario i.e. Rs 5,07,81,495. Planned value in Primavera approach is Rs 4,79,17,756 and in conventional approach is Rs 5,04,17,812. After calculation of SPI% it will clearly defines that it denotes 0.89 in Primavera approach and 1.3 in

conventional approach so here we conclude that total duration required less time in Primavera approach and more time required in conventional approach along with estimate cost also.

Table No 3: Total Duration Conventional Vs. PEC Approach.

Sr. No	Total Duration	Duration (Months)
1	Conventional Approach	28
2	Primavera Approach	21

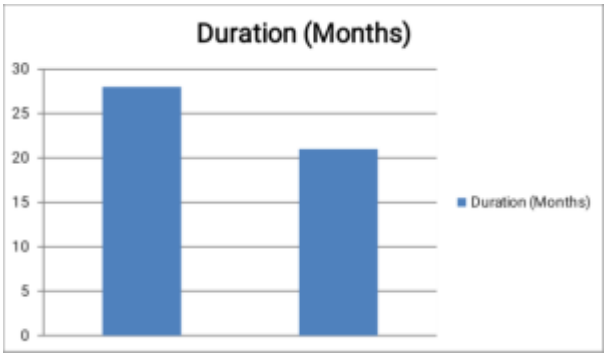

Figure No7: Total Duration Conventional Vs. PEC Approach.

Table No 4: Total Estimate cost Conventional vs. PEC Approach.

Sr. No.	Total Duration	Cost (Cr.)
1	Conventional Approach	2.52
2	Primavera Approach	1.82

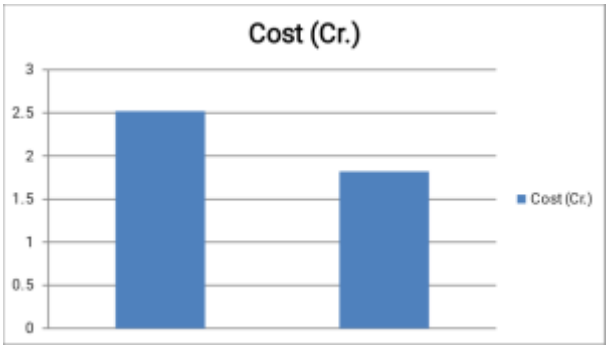

Figure No 8: Total Estimate cost Conventional vs. PEC Approach.

1. S Curve

It is graphical representation of financial cash flow of a project. It is derived from activity usage profile, and it shows an "S" like shape, flatter at the beginning and end and steeper in the middle. This shows that costs involved in the project is low in the beginning as well as in the end, whereas it increases at a rapid rate when the project is in its middle stage.

2. S Curve

It is graphical representation of financial cash flow of a project. It is derived from activity usage profile, and it shows an "S" like shape, flatter at the beginning and end and steeper in the middle. This shows that costs involved in the project is low in the beginning as well as in the end, whereas it increases at a rapid rate when the project is in its middle stage.

CONCLUSION

From the above literature it is concluded that there are many methods of increasing productivity and profitability in construction industry. There is enormous study on the methods which improve the profitability which consists of material tracking, healthy and safe working condition and effective management systems. It is seen that some methods are more efficient in the context of increasing productivity. In this project we compare case study with qualitative (PEC APPROACH) and traditional approach for G+7/G+6/G+9 residential building located at **Dudulgaon, PCMC**. There is a need for exploring more efficient strategies for improving the productivity as well as profitability of the small and medium construction firms. It has been noted that increasing the profitability by such above methods have reduced cost and time but haven't create an effective baseline in the field of construction industry. It will also useful for small and medium construction firms in India.

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Corresponding Author

Rohit Paygude*

PG Student, Department of Civil Engineering, JSPM'S BSCOER, Pune, India

payguderohit@gmail.com