

FRAMEWORK TO IMPROVE LABOUR PRODUCTIVITY FOR INDIAN BUILDING PROJECTS

Rahul Sahay*, Ritesh Kumar Agarwal and Koshy Varghese

Department of Civil Engineering, Indian Institute of Technology Madras, Chennai, India

ABSTRACT

This study explores the practice of planning and productivity measurement on Indian building construction sites and suggests a framework to improve the practice. An exploratory study based on observing several projects was initially undertaken and it was found that there was no structured method utilised to analyse and improve productivity during the construction phase. Further analysis of planning practices on 15 building construction projects revealed that while the overall milestone plan was appropriate, the critical path method schedule (macro schedule) had several limitations, which made its relevance for look-ahead planning and coordination of resources questionable. Without an appropriate model for medium term planning, the short-term plans became uncoordinated and resulted in significant wastages. Based on a comparison of observed practices with documented best practices, and constraints unique to projects in India, the gaps in developing CPM based schedule are enumerated and strategies to close the gaps are suggested.

In addition to this top-down approach to develop a realistic CPM based schedule, a bottom up approach to monitor the daily progress against the planned weekly targets is proposed. While the conventional monitoring framework mandates this approach, there were several gaps in practice that were observed. The causes for these gaps are analysed and suggestions to close the gaps are proposed. The proposed framework consisting of the top-down and bottom-up approach is expected to overcome several of the barriers to measure and improve labour productivity on Indian building projects.

Keywords: Building Construction; Look-Ahead Planning; Productivity; Scheduling.

1. INTRODUCTION

The Indian construction industry is labour intensive, and hence labour productivity has a significant impact on the cost and time performance of projects. Until recently project performance was assessed based on cost and as labour was considered inexpensive and usually sub-contracted, the general contractor did not focus on labour productivity. In the last two decades time performance has become increasingly a priority and this has necessitated introduction of systems to plan detailed project schedule and monitor labour productivity performance.

Today, all leading construction contractors in the country have documented systems for project scheduling and labour productivity monitoring. Based on the company specific requirements these systems are customized and typically are referred to by in-house acronyms. The scheduling systems for building projects are largely based on MS Project, while the productivity monitoring system is based on custom developed spreadsheets. Thus, most firms have formally documented procedures for scheduling and productivity monitoring which are broadly aligned with global best practices.

The need for this study arises from observing that (i) although standard documented planning systems were available, the planning practices on sites varied widely, (ii) on most projects the quantity of work done increased dramatically close to a milestone, and dropped after the milestone was passed, (iii) work sampling on site showed that only about 30% of value added work was being done by labour (iv) while

* Corresponding Author: E-mail - rahul17sahay@gmail.com

the data for labour productivity is being collected on a daily basis, only a few sites were analyzing this data for productivity improvement opportunities.

Based on these preliminary observations, the practices of scheduling and labour productivity monitoring on Indian building construction sites are benchmarked with the global best practices. The study does not seek to establish a direct comparison of practices, rather incorporates the unique aspects of Indian project delivery process to develop a framework which would be relevant to Indian construction.

This paper is organized into 7 sections. The next section discusses the literature review followed by research methodology, data collection, problem identification, analysis of problem, developed framework and conclusion.

2. LITERATURE REVIEW

There have been many research studies in the field of finding the factors affecting the labour productivity, methods of effective project scheduling and productivity measurement. However, only a few studies have addressed the details of relationships between the construction project planning, scheduling, labour productivity monitoring and improvement.

Thomas and Sudhakumar (2014) administered a questionnaire survey of project managers, site engineers, supervisors and craftsman in the state of Kerala in India to understand the factors influencing construction labour productivity. The study proved that improper project coordination, poor project planning and scheduling have been perceived by project managers as significantly impairing productivity and project managers emphasize the need for realistic project goals, deadlines, quick review and coordination among participants to improve construction labour productivity.

Absalom *et al.* (2014) administered a field survey investigating the factors influencing labour productivity on construction sites relying heavily on manual labour from contractors, project managers and developers on live construction sites in Kenya. In this study, planning and scheduling ranked second among several factors affecting the labour productivity.

There have been a few guides available for scheduling called GAO Cost Estimating and Assessment Guide (GAO-2009), GAO Schedule Assessment Guide (GAO-2012), Planning and Scheduling Excellence Guide (PASEG) (NDIA-ICPM, 2011), Construction Project Management Guidelines (IS15883, 2013). These guides introduced a set of recommended practices for schedule development. These guides although useful, are generic and do not provide an appropriate level of detail required for site implementation.

Laufer and Tucker (1987) critically examined the US construction planning process and found that for planning to become effective, methods should be changed (e.g. gathering and diffusing of information), policies should be modified (e.g. the role of planning and control), assumptions should be adjusted (e.g. attitude to uncertainty) and the overall philosophy of project management should be re-examined.

Johansen (1996) investigated the planning practices on building projects and found that plans are produced under time pressure and the commitment required for accurate planning is not available. Further, construction managers often ignore the formal project master programme and instead adopt their own approach to planning. Present study investigates how execution team can be involved in planning and a realistic schedule can be achieved and communicated to execution team so the commitment can be ensured.

Subbiah (2012) investigates the factors influencing the success of construction planning using the participant observer approach and found that planning is a process which will be successful only when it is supported by the whole project team and proved that the initial programme which is being developed with the best available information should be continuously monitored and developed to addresses changes and to take corrective actions.

In the present research apart from literature review the data is collected from past construction projects, expert opinions and field study, it is observed that less than 35% of the projects measured labour

productivity effectively and about 4 out of 15 projects analysed the data to monitor and improve labour productivity.

The field study established that the problem with planning and scheduling still exists in Indian construction projects which affect labour productivity.

3. RESEARCH METHODOLOGY

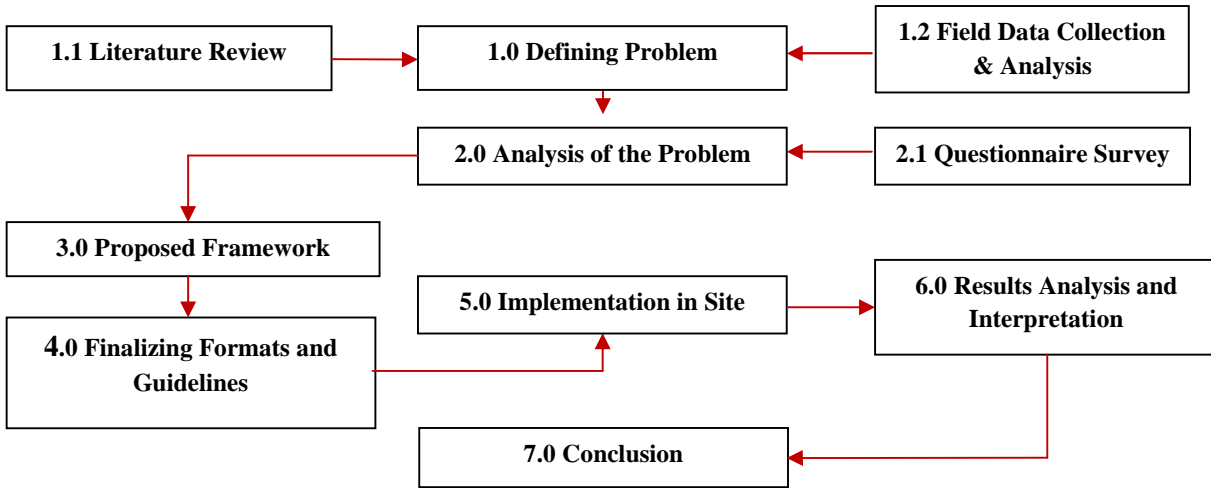


Figure 1: Study Methodology

The methodology used in this study is shown in Figure 1. As shown, the methodology adopted for this study started with review of literature and field data collection and analysis to develop a clear problem definition. Based on a question survey of experienced planners and site engineers the root causes of the problems identified in 1.0 are determined and discussed. The questionnaire survey was administered for 30 planning managers from Indian building construction sites. The structured interviews were conducted for labour contractors and site engineers to find the root causes and impact of the identified problems in various projects. Expert opinions were sought to find a solution to the identified problem. A framework to address the problems is then proposed- this framework is based on benchmarking with the standard global practices while considering the unique aspects of Indian construction. The scope of this paper is limited to discussing the proposed framework. The site implementation and evaluation of the proposed framework is currently under progress.

3.1. DATA COLLECTION AND ANALYSIS

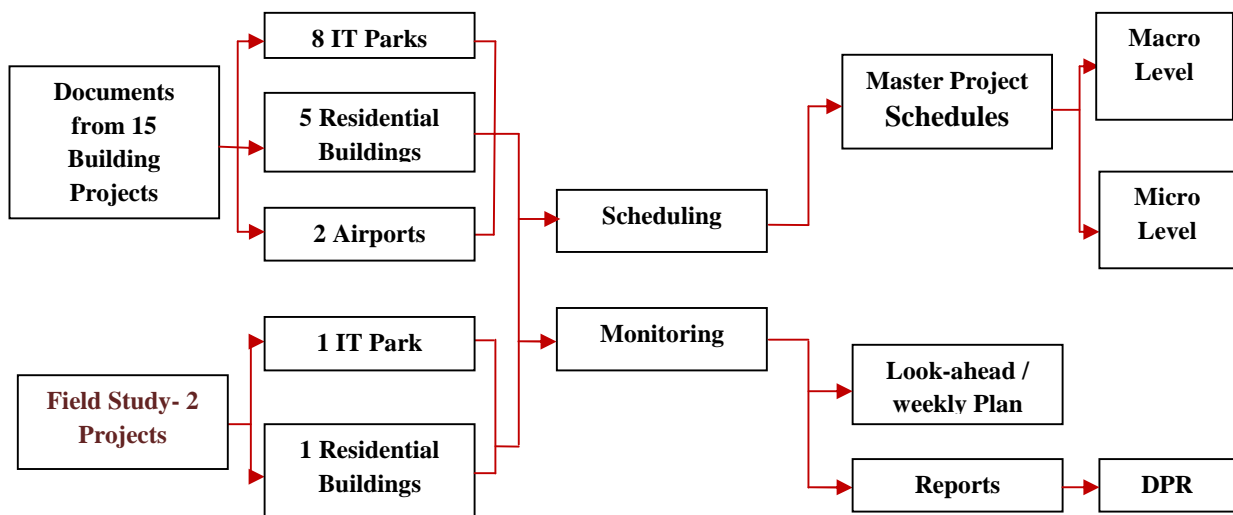


Figure 2: Data Collection Breakdown

The data is collected from 15 building projects of planning reports, labour productivity measurement reports, construction schedules monitoring and reporting schedules as shown in Figure 2. The data collected for the research includes;

- Field study in construction site
- Structured interviews and expert opinions
- Data from current and past projects
- Literature review
- Questionnaire Survey

The field study was done on two ongoing building projects, where the planning process was studied as a participant observer. The method used for measurement of labour productivity analysis was explored and the process of progress monitoring, reporting, and scheduling was critically examined to identify potential problems.

4. PROBLEM IDENTIFICATION

The analysis of data collected and observation from field study revealed that there was no structured method to analyse and improve labour productivity during the construction phase. It was found that there were several reasons for the lack of a structured approach to monitor and improve labour productivity.

One of the key challenges for implementing a structured approach to monitor and improve labour productivity was that the macro-level and micro-level schedule did not represent the actual situation on site. As a result, the execution team did not have accurate information on short-term as well as daily targets. A second key challenge was that on several projects there was no standardised procedure to record and monitor the daily productivity.

To further explore the first issue, schedules collected from all 15 projects were audited based on standard practice such as the GAO Schedule Assessment Guide (GAO-2012). It is revealed that while the overall milestone schedule was appropriate, the detailed CPM schedule had several limitations, which make the schedule irrelevant for look-ahead planning, target setting and coordination of resources. The limitations found in the schedules are enumerated below:

- **Calendar** - Specifically in India, the holiday's changes based on regional basis in countrywide, in schedule calendar the standard calendar were used or the exception for holidays was not made. At the same time, unexpected holidays occurred during progress was not updated in schedule. The work timings for specific construction projects were not defined.
- **WBS** - The Work Breakdown structure followed in scheduling varied widely among construction sites with similar works and the WBS in schedule was different from followed in site execution for Finishing and Mechanical Electrical and Plumbing work.
- **Activity Relationships** - The improper logical precedence linking was a major problem in all the schedules. The schedules contained open-ended activities, which break the logical network sequence and critical path becomes invalid. The start-to-start activity relationship was used in over abundance, which made the schedule unrealistic.
- **Activity Durations** - The duration of activities were decided based on experiences and guesstimation. The labour productivity and construction methods information was not considered for duration estimation.
- **Resource Loading** - The resource loading was not done for the detailed construction schedules, which affected the effective utilization of labour, and labour requirement projection was done on experimental basis.
- **Schedule Updating** - The schedule was not updated and tracked based on the actual site progress. The detailed look-ahead schedules were not followed in accordance with master schedules.

Figure 3 shows the percentage of projects that complied with the standard scheduling practices. It can be seen that while all projects has appropriate milestone schedules, only 4 to 5 projects out of 15 complied with other requirements.

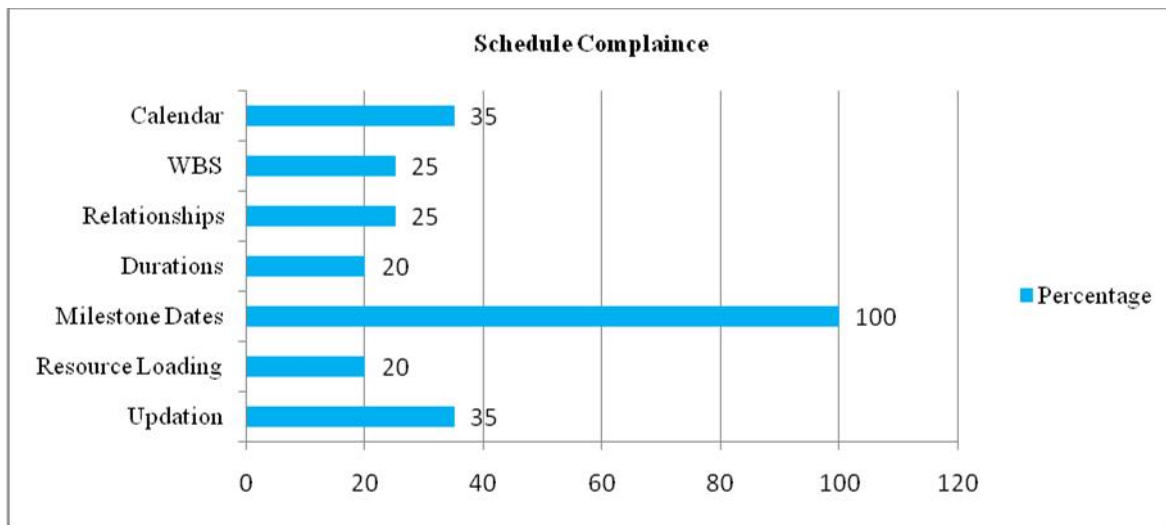


Figure 3: Schedule Compliance Analysis

As mentioned earlier, the second challenge faced in monitoring and improving labour productivity was lack of established procedure for recording daily labour productivity on most sites. Even the sites, which recorded labour productivity on a daily basis (through Daily Progress Report- DPR) did not analyse the data for improving the labour productivity. To further explore this issue the practices of the sites that were recording daily labour productivity was analysed. The following issues were found impede implementing productivity measurement and improvement processes.

- The responsibility of preparing the DPR was with the planning team. As a result, the accurate field data was not reflected in the reports,
- Although the daily quantity and man-hours spent was being recorded, the actual labour productivity was not being calculated and utilised for monitoring,
- The execution plan followed in site was not in accordance with the planned schedule due to coordination gaps between execution and planning team hence the execution team refrained from reporting progress to the planning team,
- Even on projects where labour productivity was being calculated, the labour productivity data was only reported and not considered for improving the productivity.

Interviews of labour contractors and site engineers followed by a detailed analysis of Indian labour conditions found specific constraints, which make planning and scheduling more challenging in the Indian scenario. The factors found are:

- The skill of Indian labour is highly variable, as a result planning and execution personnel are unable to estimate the actual productivity that will be achieved on site,
- On all the sites studied, the labour employed in site is on a sub contract basis, thus the commitment of the labour to a specific project is very low and they tend to abandon the project due to a variety of reasons ranging from taking extended holidays during festival season to marginal increase in wages on other sites this severely disrupts production and productivity,
- The data from the projects studied shows that the labour turnover in the entire cycle of the project was 80 to 100 times that of the peak labour required, this constant turnover has a significant influence on site labour productivity.

To understand these issues at a more detail level further assessment of the situation was done through a questionnaire survey.

5. ANALYSIS OF PROBLEM

To ratify and enumerate the root-causes of the problems faced, a detailed analysis was done. Based on the problems identified, a questionnaire survey was administered to 30 planning managers of Indian building projects and the data from the field study was analysed. Figure 4. Shows a fish-bone diagram in which various categories of problems and their root cause are shown. Only indicative terms are used in the figure, detailed explanations are given below.

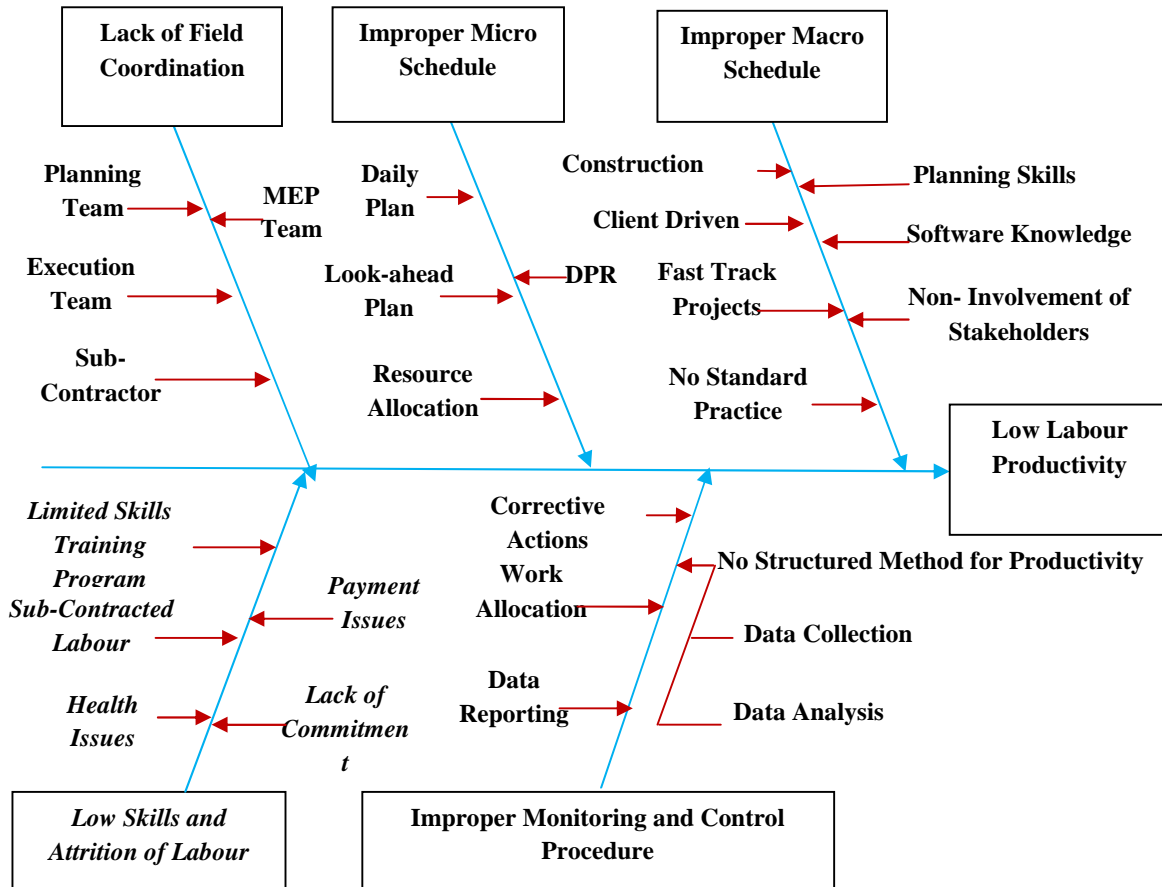


Figure 4: Causes and Effect Diagram of Low Productivity

Analysis for the first key challenge, improper macro and micro level scheduling is done and it was found that the reasons for the improper scheduling are:

- The lack of planning skills of the schedulers was a key reason for improper scheduling. In India, there is no certification of planning engineers, hence most planning personnel lack the knowledge and skills to apply planning concepts to practice.
- The scheduling software used was MS Project in all the sites, but due to inadequate skills and experience on the software effective usage of the tool was not made.
- In project schedule development, the stakeholders were not involved with planning team, which led to development of abstract and infeasible schedules that could not be used by the execution team.
- In scheduling practice, the construction methods used are not considered for deciding activity sequence and durations, this results in poor resource planning and constructability issues.
- The client makes frequent changes in the priority of work to be done with no financial implication to the client. Hence, schedules have to be revised frequently and on an urgent basis. As a result relevance of a detailed schedule is short-lived.

- Most of the building projects were fast track projects; hence, scheduling is done before the completion of design and finalization of construction methods. This results in non-availability of information on quantity and construction methods impede accurate estimation of duration of activity and sequence.
- The DPR followed in sites varied widely without any specific reasons because there was no standardised format specified.
- In most of the projects, the daily action plan, catch-up plan were not prepared and implemented. This led to large volumes of work to completion just before milestone dates. As a result, more resources were assigned to achieve the milestones dates, leading to reduced productivity.
- The available resources like equipments, materials and labour available on site were not allocated and coordinated as per the work to be performed by different stakeholders.
- In the micro level planning, there was no coordination between planning team, the execution team and MEP team for requirement and use of resources, which led to unavailability of resources during execution period.
- The daily work plan was not coordinated and discussed with sub-contractor, which resulted in uncoordinated work practices.

The root cause analysis for the second key challenges, namely monitoring and reporting labour productivity, is as follows:

- The labour productivity data collected by few sites was not analysed and reported because the purpose and use of labour productivity data analysis was not conveyed to the site engineer and foreman. Hence, level of labour productivity was not known and corrective actions were not taken.
- The progress was not monitored and reported because the site execution team on weekly basis did not prepare the look-ahead plan. Therefore, the site engineer and the foreman did not take the ownership in collecting data, monitoring, reporting and improving the same on a continuous basis.
- The daily work planning and labour allocation was done primarily based on ad-hoc requirements this led to uncertainty in execution time and resulted in wastage of resources.
- The labour productivity was not considered as a standard input in management and project decisions, hence there was no standardized process in place for monitoring and controlling productivity.
- The labour skills are low because no skill training is provided to the labour coming to construction sites and labour mainly comes from the agricultural background and rural areas. In India there are limited labour skills training institutes to meet the demand for skilled workers.
- The labour on sites was employed temporarily on sub-contracted basis. Due to that, the same labour was not available for the repetitive work during execution phase as there was no control of general contractor.
- The payment of the bill given by the contractor was delayed due to non-submission of the work measurement to the billing team, which increase the payment period to the labour. In many site due to delay in payment labour was not available.
- The lack of commitment towards work was due to festive seasons, crops harvesting season and personal commitments and the ownership of the work was not taken by the labour as the labour worked on daily wages basis, so labour was not worried about the quantity of work done.
- The labour absenteeism on work was mainly due to health problems faced by the labour in the site and due to lack of basic needs and health facilities provided by sites.

To address above identified problems a framework consisting of top-down and bottom-up approach is proposed. In top-down approach, a comparison of observed practices with documented best practices are

made and constraints unique to building projects in India, the gaps in developing CPM based schedules are enumerated and strategies to close the gaps are suggested.

In the bottom up approach, a structured method is prepared for analysis and improvement of labour productivity. At the same time, to close the gap between monitoring daily progress against planned weekly and monthly targets, a methodology, which can be implemented on site, is documented.

6. PROPOSED FRAMEWORK

After a detailed analysis of problems and its causes for labour productivity, a framework adopting top-down and bottom-up approach is developed considering the unique aspects of Indian project delivery process as shown in Figure 5.

In the top down approach, a standardised approach for developing WBS, sequencing, estimating activity duration, specifying activity relationships, estimating activity duration, resource allocation and scheduling levels are specified based on the global best practices. The detailed work breakdown structure to address complex interdependency in structure, finishing and Mechanical Electrical and Plumbing (MEP) works are enumerated to facilitate correct approach for detailed scheduling based on practical detailed sequence collected from construction sites field study.

The framework scheduling approach involves the site execution team, planning team, construction methods and data from past experiences in development of schedule. The coordination in schedule development and acceptance by site execution team facilitates monitoring of project schedule. Hence, the schedule serves the purpose of appropriate tool for short-term micro planning. The framework does not address the problem of scheduling occurred due to software skills, changes by client and availability of information for scheduling in fast-track projects. These are the broad level problems in construction industry, which is a long time process for improvement.

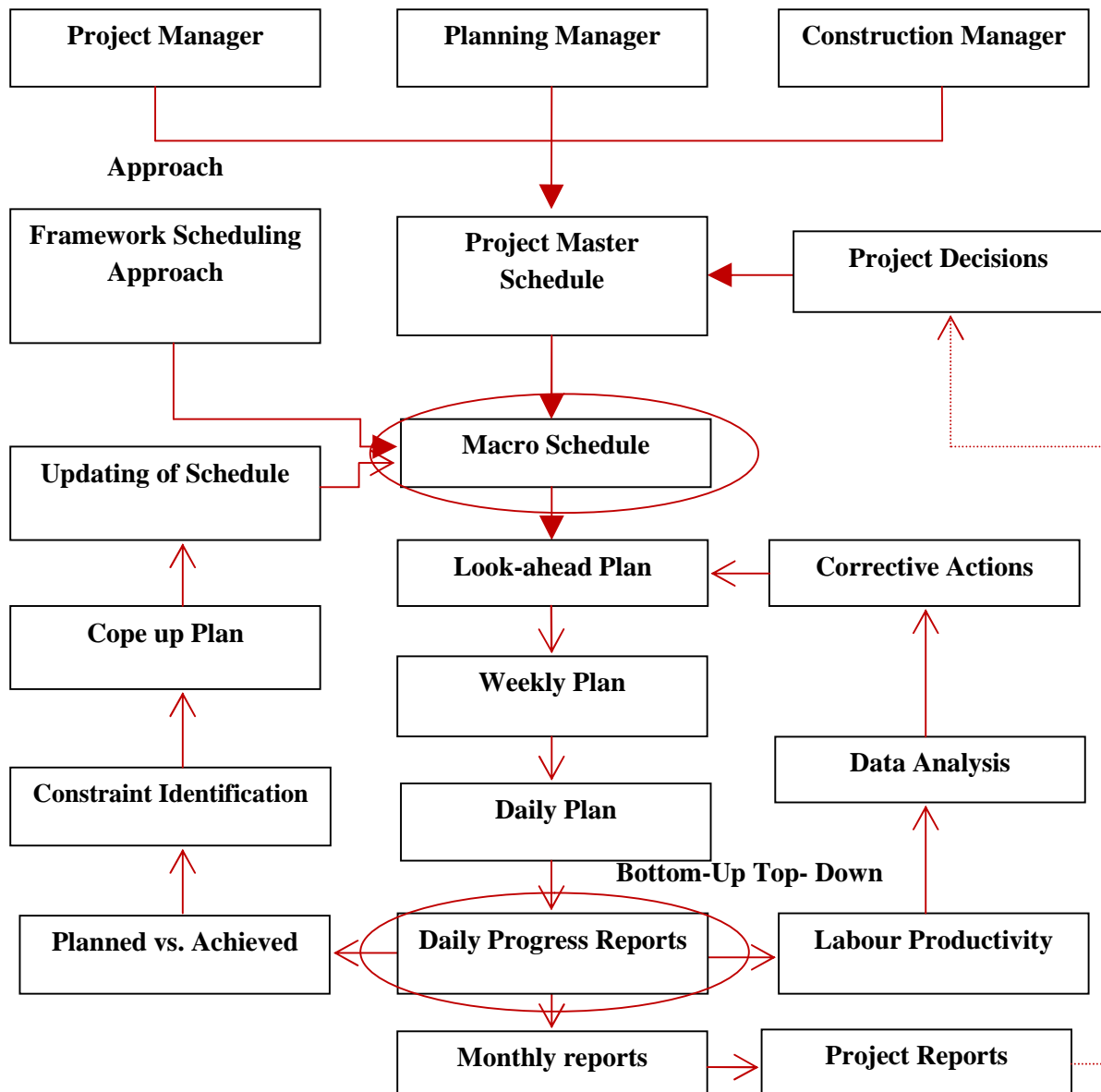


Figure 5: Framework to Improve Planning and Labour Productivity Practices

Based on realistic micro level schedule from top-down approach, the micro level planning (look-ahead schedule) is prepared by the site execution team considering available resources, quantum of work and labour productivity in site. The daily and weekly work plans are prepared from the look-ahead plan. To monitor the planned targets and productivity, in the bottom up approach for data collection, DPR followed in the sites is standardised from which the labour productivity and planned vs. achieved status report is collected and analysed. The planned vs. achieved data is used for further work planning and addressing the constraints causing low productivity. Corrective actions to increase productivity levels are identified based on the analysis and discussions.

The project schedule is updated regularly as per the progress and actual productivity in site; the updated schedule gives accurate detail of project progress and quantity of work done. Labour productivity and progress data are considered as a standard input for decision-making at higher management level. As a part of this work, a manual standardizing all formats and guidelines of developed framework for planning practice, analysis and improvement of labour productivity has been developed and is being implemented in site. The framework does not address the lack of skill and attrition problem in the bottom-up approach.

These problems can be identified from the data analysis but solution to the problems varies according to the site-specific conditions and labour employed.

7. SUMMARY AND FUTURE WORK

This paper presents a study on improving the practice of recording and monitoring of labour productivity on Indian building projects. The two key challenges, improper scheduling and lack of established procedure for productivity monitoring and control are identified and analysis is done to find the root cause of the problems faced. The root causes for low productivity found from the analysis are specific to the Indian sites, which need to be addressed for effective monitoring and control of labour productivity. A framework is proposed adopting top-down and bottom-up approach to overcome root causes. The top-down approach address several gaps in developing a project schedule and a detailed approach is given to close the gaps is suggested. The bottom-up approach proposes establishing a procedure for recording, monitoring and control of labour productivity. In combination with the top-down approach, this is expected to overcome the several limitations in analysis and improving of labour productivity in Indian building projects.

As a part of the on-going work site implementation and evaluation of the proposed framework is being done. The study can also be extended to find ways of overcoming the issues that the proposed framework does not address.

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