

# PRE PROJECT PLANNING : IMPORTANCE IN HOSPITAL PROJECTS

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## Abstract

The importance of pre-project planning in the construction industry and its potential impact on project success has long been acknowledged by industry experts. Most experienced contributors in the project lifecycle understand the importance of early planning pre-project planning particularly in Hospital projects which involves lot of critical services during execution the planning plays a crucial role in sequencing and interlinking of the activities. Inadequate planning results in lot of reworking and since there are lot of services involved in hospital projects any issue during execution in one activity affects the entire set of subsequent activities which ultimately results in cost escalation and time delay which is very critical for hospital projects.

Data for one hospital project is collected and the PDRI scoring is worked out for key activities. A detailed comparative of estimated and actual quantities and cost is worked out and the comparative for the planned & actual project schedule is also done. The reason for the cost escalation and time delay was analysed. Based on the findings the model which can be used during pre project planning to avoid the cost and time escalation is analysed.

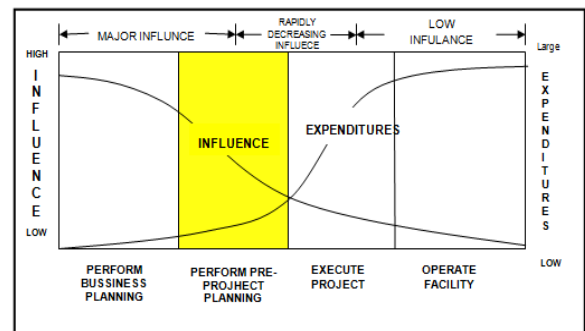
Building Information Modelling (BIM) which is dynamic & beneficial tool to be used for such critical projects is studied and the benefits of using this during pre project planning is analysed. Using BIM in pre project planning stage will help in reducing cost and time delay which occurs in projects particularly in hospital projects. This will also help in execution phase of the projects.

**Index Terms**— Pre project planning, scope definition, Delay impact, Building Information Modelling. (*key words*)

## I. INTRODUCTION (HEADING 1)

The construction industry has recognized the significance of pre-project planning and insufficient or poor pre project planning, which negatively correlates to the project performance, is among the most problems affecting a construction project. Due to poor pre project planning, final project costs can be projected to be higher because of the unavoidable changes which interrupt project pace, result in rework, increase the project time, and lower the productivity as

well as the morale of the work force. How well pre-project planning is done will have a direct impact on the cost and schedule performance, operating parameters of the facility, as well as the overall financial accomplishment of the project.



Hospital project involves much more packages as compared to regular building projects such as residential buildings. It becomes essential to have meticulous planning done during the pre project planning stage. Inadequate or poor pre planning, which negatively affects the project performance, has long been recognized as a significant problem impacting construction projects, hospitals in particular. As a result of poor pre project planning, final project costs are likely to be higher because of changes that break off project tempo, cause rework, increase project time, and lower the efficiency as well as the drive of the field work force. This emphasizes the need of Pre-project planning in hospital projects.

## II. RELATED WORKS

An extensive literature review provides background information on current knowledge related to the research topic.

Yu-Ren Wang, G. Edward Gibson Jr. (2009) – *A study of pre project planning and success using ANNs and regression models*

Through industry project data collection and model analysis, this research intends to examine the correlation between pre project planning and project success. Pre project planning and project performance data from 62 industrial projects and 78 building projects, indicating approximately \$5 billion U.S.D. in total construction cost, is collected and used for this research analysis. Based on the information obtained, pre project planning is identified as having direct impact on the project success (cost and schedule performance). Two techniques were then used to create models for predicting cost and schedule performance: statistical regression analysis, and artificial neural networks (ANNs). The research results provide a valuable source of information that supports better planning in the early stage of the project life cycle and have positive impact on the final project outcome.

Ali Abbas, Zia Ud Din, Rizwan Farooqui (2016) – *Achieving greater project success & profitability through pre – construction planning : A case-based study*

Little research has been performed regarding the pre construction planning (PCP), which is the integration between contractor and designer in the early stages of a project to ease construction. It is very significant for the construction industry stakeholders specially contractors and designers to recognize the importance of PCP. This study analyzed the current selected Design – Built residential, commercial infrastructure, transportation and power plant project. A questionnaire survey was used for this purpose. The results of this research will provide some solid foundation towards design – construction integration to attain maximum efficiency and success in construction industry.

G. Edward Gibson (2003) – *Pre Project Planning Processes*

In the course of the study, the authors concluded that the key practice for developing an effective scope of work for design is to conduct a structured, consistent, and thorough pre project planning process and fully develop a project scope of work. A series of findings that relate to this conclusion are summarized below. Pre project planning and the development of an effective project scope of work are a *process* that must be managed by all organizations that build facilities.

Conrad Boton, Sylvain Kubicki, Gilles Halin (2015) - *4D/BIM Simulation for Pre-Construction and Construction Scheduling*

This paper reported a 4D simulation case study conducted on the Neo Build Innovation Center project in Luxembourg. The first part of the experiment was conducted at the pre-construction phase and aimed at studying the constructability of technical choices and at anticipating sequencing issues in collaborative team meetings. The second part was conducted during the construction phase and the aim was to coordinate the site work, to simulate the logistics and site areas but also to analysis more precisely some construction details.

Hamzah Alshanbari (2010) - *Impact of Pre-Construction Project Planning on Cost Savings*

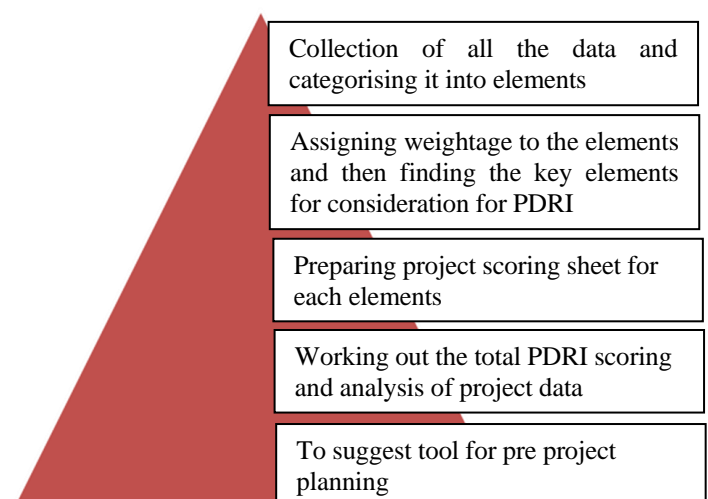
The survey data presented in this research showed many aspects of pre-construction planning starting with which sector of the industry embraces it more and ending up with what is the optimum percentage that can be spent on it. This, of course, does not mean that these conclusions are objective and final. Planning in general is a very subjective matter that can be interpreted in many different ways by many different professionals. The data presented in this research reflects the current understanding of pre-construction planning in the United States.

ByungJoo Park, SeungKyu Yoo, JuHyung Kim, JaeJun Kim (2011) - *The Study on the application of BIM at the Pre Design Stage of Public Projects*

In this paper, how BIM is utilized at the phase of planning was looked into on the basis of the cases of BIM application on public projects. First the work to minimise the damage of green areas and the amount of earth work was conducted and could be reflected on the basic design with writing the amount of a model for earth work to site topography and understanding the amount of cutting the ground and embankment accordingly. On the basis of 3D based drawings it was not only used as a method of communication between the persons involved with public projects but it could be also used as important data to estimate the approximate construction cost. Besides it was an opportunity to improve the efficiency throughout a project by utilising data as essential medium to share up the follow up phase, not limited to the phase of planning.

### III. METHODOLOGY

#### Methodology Flowchart



#### Step 1

The case study was to be selected and accordingly the Construction of Hospital Building project which was project undertaken by Cureall Superspeciality & Radiotherapy Hospital was taken up. Need to collect the initial prepared estimates by the architect and also need to consider the incurred cost for the actual construction. It's very important for analyzing of the data properly. The data received is in a way raw data of all the elements in the project.

#### Step 2

After categorizing the items of work, comes the second step where we have to find the crucial elements which have to be considered to be put in scoring sheet. It is not possible to carry out scoring for all the elements and work out total PDRI score. Hence we find the few crucial category functions on which we have to carry out the PDRI scoring.

#### Step 3 & 4

Then the next step is for scoring sheet for the selected elements, work out the total scoring for all the elements. Need to take into consideration the possible components of all the elements. After finding of the PDRI score work out the cost and time variation is worked out.

#### Step 5

The final step is for further scrutinize the cost and time variation to improve the performance on the future building projects on these parameters. A new model for pre project planning is proposed which will help in reducing the cost escalation and time delay.

### IV. CASE STUDY & DATA COLLECTION

#### A. Brief of the project:

The hospital is devoted to Cancer diagnostics and treatment. The capacity of the hospital is 100 beds. The hospital has 2 bunkers for the radioactive therapy, Trauma center, OPD and Imaging, Nuclear Medicine, Chemotherapy, Bone Marrow transplant unit, Endoscopy, ICU, ITU, Private and Semi-private rooms and 3 operating theaters.

#### B. Data Collection

Data is collected from the ongoing construction site; the work is construction of hospital building.

List of the data collected is as follows:

1. Site Plan
2. Area Statement
3. Floor wise details
4. Features of the project
5. Terms and conditions of contract.

The data will be used to realize the objectives mentioned previously. The analysis of the same, the proposed model to be used during pre project planning for saving in time and cost is worked out subsequently.

### V. DATA ANALYSIS

The purpose of data analysis was to find out the effect on the cost and time for the cold shell package and the reasons for the variation in these parameters. Based on these findings solution is proposed to enhance the pre project planning which will help in reduction in variation of cost and time for critical projects such as hospitals.

Following parameters were analysed in detail :-

1. Detailed Comparative – Tender BOQ v/s Actual Executed cost of work.
2. Summary of Cost variation
3. Summary of time variation
4. PDRI % weightage.
5. Reasons for the delay

To work out the cost variation the cold shell tender package was taken up for analysis. The tender BOQ was compared with the actual executed quantities. Following packages of cold shell tender were compared to work out the variation in cost.

- Excavation & Earth Work
- Concrete Work
- Reinforcement / Structural Steel Work
- Masonry Work
- Plastering Work
- External Works
- Miscellaneous Works
- Extra Items

Similarly to work out the time variation for the cold shell package analysis of the above mentioned packages of the cold shell work were taken up for analysis. The time line prepared during the commencement of work was compared with the actual time required for execution of these packages of the cold shell work.

The summary of the cost in terms of amount and percentage is worked out and also the time variation in terms of days and percentage is worked out.

The PDRI percentage weight age for the packages of cold shell work is worked out based on which the high priority packages are defined and based on the percentage weight age more efforts should be given in pre project planning for these high value packages.

The reasons for the delays and cost variation are also studied to avoid in future projects.

TABLE I. COST VARIATION - TENDER BOQ V/S ACTUAL EXECUTED

Sr. No.	Particular	TENDER BOQ	ACTUAL EXECUTED	Difference in Amount
		Amount in Rs.	Amount in Rs.	
A	Excavation and Earth work	₹ 7,945,000.00	₹ 8,394,463.17	₹ 449,463.17
B	Concrete Work	₹ 56,716,000.00	₹ 58,290,232.34	₹ 1,574,232.34
C	Reinforcement / Structural Steel Work	₹ 29,280,000.00	₹ 39,534,557.77	₹ 10,254,557.77
D	Masonry work	₹ 9,180,000.00	₹ 9,494,370.76	₹ 314,370.76
E	Plastering Work	₹ 1,867,000.00	₹ 1,565,012.04	₹ -301,987.96
F	External Works	₹ 3,969,750.00	₹ 1,303,779.27	₹ -2,665,970.73
G	Miscellaneous works	₹ 2,229,786.00	₹ 550,874.51	₹ -1,678,911.49
H	Waterproofing Works	₹ 6,130,000.00	₹ 3,532,319.00	₹ -2,597,681.00
Ex	Extra Items		₹ 6,007,833.16	₹ 6,007,833.16
	<b>Total Amount</b>	<b>₹ 117,317,536.00</b>	<b>₹ 128,673,442.01</b>	<b>₹ 11,355,906.01</b>

TABLE II. TIME VARIATION – SCHEDULED V/S ACTUAL

Sr. No.	Particular	Scheduled Start	Scheduled Finish	Delay in Days
		Actual Start	Actual Finish	
A	Excavation and Earth work	22/Mar/15	14/Apr/15	155
		10/Mar/15	17/Sep/15	
B	Concrete Work	2/Apr/15	23/Sep/15	221
		1/Apr/15	1/May/16	
C	Reinforcement / Structural Steel Work	15/Apr/15	5/Sep/15	236
		2/Apr/15	28/Apr/16	
D	Masonry work	18/Jun/15	18/Oct/15	246
		12/Jul/15	20/Jun/16	
E	Plastering Work	18/Jun/15	15/Nov/15	246
		12/Jul/15	18/Jul/16	
F	External Works	1/Apr/16	15/Jun/16	128
		15/May/16	21/Oct/16	
G	<b>Delay in days</b>			<b>246</b>
H	<b>Delay in %</b>			<b>55%</b>

TABLE III. PDRI % WEIGHTAGE

Sr. No.	Particular	Tender BOQ	Percentage Weightage
		Amount in Rs.	
A	Excavation and Earth work	₹ 7,945,000.00	6.77
B	Concrete Work	₹ 56,716,000.00	48.34
C	Reinforcement / Structural Steel Work	₹ 29,280,000.00	24.96
D	Masonry work	₹ 9,180,000.00	7.82
E	Plastering Work	₹ 1,867,000.00	1.59
F	External Works	₹ 3,969,750.00	3.38
G	Miscellaneous works	₹ 2,229,786.00	1.90
H	Waterproofing Works	₹ 6,130,000.00	5.23
	<b>TOTAL AMOUNT</b>	<b>₹ 117,317,536.00</b>	<b>100.00</b>

A. Reasons for Cost and Time over run:

- ❑ Assumption of Strata
  - Estimated hard rock was 6200 Cu.m. whereas the actual executed quantity is 8445 Cu.m.
  - The time required for completion of excavation was exceeded by 155 days
  - The rock was very hard and tough to cut
  - Space was confined since very marginal space around the excavated area was available in the plot
  - Restrictions in working hours due to MIDC area – limited time slot for working
  - Entire basement excavated area was flooded by rain water for almost a month due to continuous rains
- ❑ Variation in reinforcement steel quantity
  - Estimated quantity of reinforcement steel was 460 MT where as the executed quantity was 598 MT
  - Manpower deployed by the Contractor for reinforcement steel was with respect to 460 MT.
- ❑ Waterproofing methodology and commercial impact
  - As per tender SETCO membrane methodology was proposed by the consultant for the cold shell water proofing work. Subsequently the client requested to the Architect to change the item to crystalline method of waterproofing with Krystol internal membrane for Kryton.
- ❑ Hematite concrete material non availability
  - Initially the hematite material was not available and took more time for procurement. Also the trial mix design took lot of trials and time to arrive on the final mix design for hematite concrete.
- ❑ Storage area and space constraint
  - There is limited space to work. Confined space available for excavation and concrete machinery.
  - Plot area is 3100 Sq.m. and maximum area is utilized for construction on Ground Floor.
- ❑ Statutory Approvals for Authorities
  - Initially client has obtained permission as per 1.5 FSI. After that they applied for 2.5 FSI but authorities sanctioned only 2.0 FSI. Meanwhile work was held up due to changes required to be made due to FSI change

The total variation in cost and time is as under:

Variation in Cost : ₹ 11,355,906.01 (9.68%)  
Variation in time : 246 Days

After analysing evaluation of the comparative statements of the BOQ's and the reasons for over run in cost and time it was observed that one of the major reasons for this overrun is

less efforts in pre project planning specifically pre construction planning.

Hospital projects are much complex projects compared to other building projects. The over run in time and cost directly affects capital expenditure and the revenue recognition for project. These projects are capital intensive projects and it is essential that there should not be any cost overrun and at the same time the facility need to be commissioned as scheduled. The revenue generation is directly linked to the commissioning of the facility. Any delay in commissioning of the facility results in delay in revenue generation and affects the margins. Also the interest servicing starts which affects the profitability.

The way out for overcoming the cost and time overrun is going for using **Building Information Modelling (BIM)** during the pre project planning stage.

BIM (Building Information Modeling) is a better answer that manages all information of supplies and facilities broadly throughout the life cycle of a building, including planning, design, construction, maintenance, etc. Now BIM has progressed to 4D (Time Schedule) & 5D (Cost).

BIM is a virtual one-to-one mapping technology that is used to store & retrieve all kinds of multidimensional building information. BIM based services helps the customer to accomplish the required Project Control, Save substantial Cost and Time, lessen risk, build effectively and efficiently, faster and smarter.

**BIM Benefits:**

- Savings of 5-8% in project cost
- Streamlines project timelines
- Accurate Cost Estimations

**BIM Advantages:**

- ☐ 3D Model
  - Release Error free drawings
  - Not just drawings. Information rich drawings
  - Resolve conflicts (MEP, Structural, HVAC..)
  - Improved Collaboration
  - Carry everything in your mobile (Autodesk 360)
  
- ☐ 4D: Time – Streamlines Project Timelines
  - New dimension is linked to the 3D model: **Time**
  - Optimizes construction schedule
  - Schedule, Materials & Manpower integration during different timelines
  - Ability to monitor Actual vs Planned progress of the project
  - Ultimate communication tool to convey the project scope, steps & outcome
  
- ☐ 5D: Cost – Accurate Cost Estimates
  - Integration of Design, Schedule & Cost estimation
  - Cost estimation accuracy to within 3%

- Upto 80% reduction in time taken to BOQ
- Cost implications on different design alternatives
- Dynamic integration of cost takeoffs during the lifecycle of the project

**Analysis of advantages of BIM for this project**

The cost for BIM for such scale of project is approx Rs. 10/- per Sq.ft.

Area of this project :	1,18,332.00 Sq.ft.
Cost of BIM implementation @ Rs. 10/ Sq.ft. :	Rs. 11,83,320.00
Cost overrun :	Rs. 1,13,55,906.00
Cost of Project :	Rs. 11,73,17,536.00
Savings @ minimum 5% (accurate BOQ) :	Rs. 58,65,876.00
Cost benefit after deduction BIM cost :	Rs. 46,82,556.00
Cost benefit in terms of percentage :	4%

Similarly there would have been advantage in saving the time due to optimized construction schedule, better monitoring of actual v/s planned and minimised reworking.

**VI. CONCLUSION**

The early planning phase of capital facility projects is the main focus of the research intended in this work. How well pre-project planning is done will have an effect on cost and schedule performance, operating characteristics of the facility, as well as the overall financial success of the project. The process of pre-project planning comprises of a complete framework for detailed project planning and includes scope definition. As mentioned earlier Hospital projects are complex projects compared to other building projects and hence it is essential to complete such projects within the budget and timelines. The key variable in projects is the cost and time which is more important in hospital projects since these projects are capital intensive and are directly linked to the revenue generation from the project.

These parameters of the hospital project were studied in detail and the analysis was done. The reasons for the delay and cost escalation were studied. PDRI percentage weightage for the packages of cold shell work are worked out. Based on the data analysis and findings BIM model is proposed to be used during pre project planning stage.

Following are the key conclusions of this project:

- The study shows that concreting and steel reinforcement work is having more PDRI % weightage, 48.34% & 24.96% respectively, which can be found out by ABC analysis but exact contribution is calculated by PDRI.
- In hospital projects plastering and miscellaneous items does not impact significantly on time & cost which is having only 1.59% and 1.90% weightage.

- Quantity worked out by conventional method deviated a lot resulting in cost escalation.
- By using BIM there would have been a saving of 4% in the cold shell package for the hospital project taken up for case study mainly due to working out accurate quantities.
- The impact of cost saving will be more if we take into consideration the rest of packages mainly finishing work and MEP services work.

Using BIM on project will not only help in pre project planning but it will be of immense help during construction stage as well.

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