

An Overview of Front-End Planning for Construction Projects

Rohit R. Sarde¹

Mangalwar Peth, Jain Galli, Holi Katta, Miraj

Final Year UG Student, Dept. of Civil Engineering, Sinhgad College of Engineering, Pune, Maharashtra, India

Abstract - Construction projects involve a huge investment and efforts that drive the economy of a nation and world, and are observed as the main contributor to the construction industry. As per the past experience from some unsuccessful projects, the necessity for pre-project planning has been observed. Effective construction project management at the early stages of project (the "front-end") has significant impacts on the challenges posed to construction project managers. These challenges develop from inadequate infrastructure such as transportation systems, electricity supply, and telecommunication systems, environmental hazards, increased project cost and time overruns prior to the commencement of a project, complex bureaucratic contract procedures and political instability. Front-end planning is a project planning practice that effectively addresses uncertainty and unpredictability involved in construction projects. This paper presents detailed information of Front-end planning process, Front-end planning tools and benefits of implementing Front-end planning in construction projects.

Key Words: Construction projects, construction industry, construction project management, front-end planning.

1. INTRODUCTION

Front-end planning is the process of developing sufficient information for owners and investors to address risk and decide to allocate resources in order to maximize the probability of a successful project. Front-end planning is also known as feasibility analysis, conceptual planning, pre-project planning, front-end engineering design (FEED), programming or schematic design and front-end loading (FEL). The project team has to take crucial decisions in the early stages of project which impact the project cost and completion time. Resources expended during the front-end planning stages of a project constitute 10 to 25% of engineering cost and up to 8% of project cost. Front-end planning analyses the risks associated with the project and the specific project execution pathway is defined. Front-end planning enables the project team to have a better control over the project. But, once the execution phase commences the control declines and any changes in project are met with increased costs. The first effort on front-end planning was made by Construction Industry Institute (CII) promulgating Pre-project planning Handbook (1995). It states that pre-project planning or front-end planning leads the project

success by means of reduced project costs, lower deviation in cost, schedule and operating characteristics.

Front end-planning consists of a detailed framework for project planning and scope definition. Project scope definition is a practice of selecting a project and defining it. Project scope definition influences the overall project performance. The level of efforts ensured during scope definition phase defines the success during the design and construction phase. Poor scope definition adversely affects the final costs of a project due to certain changes, lowers the productivity of work force and delays project completion time. Hence, a planning assessment and scope definition tool named as "Project Definition Rating Index (PDRI)" tool is developed by Construction Industry Institute (CII). It measures the current status of front-end planning in a project and identifies areas where inadequate planning is done. This tool also enables to keep a check on the probability of project success. The researchers at the University of Texas at Austin and Construction Industry Institute (CII) have been collecting the relevant information for front-end planning project by using the PDRI. PDRI is available in two versions particularly for Industrial and Building Sectors.

Front-end planning provides a better insight for smarter execution of construction projects. It aligns the business objectives and technical goals to pave the way for intelligent project planning. The developed insight generates confidence that owners or investors capital resources are being deployed efficiently and effectively. The result is project success in the form of lower costs, greater productivity and maximized profitability.

2. FRONT-END PLANNING PROCESS

Front-end planning process constitutes different phases through which a project progresses from initiation to completion. These phases are defined before the work starts on procuring, construction, commissioning and handing over the final product of construction product. Front end planning process consists of the following phases:

- 1) Organization
- 2) Data Generation
- 3) Evaluation of Alternatives
- 4) Project Definition
- 5) Decision

2.1 Organization

Who is in charge? Who has the authority to allocate resources and make changes? What is the project reporting structure? How does the team fit together? This is made clear in the organisation phase of front-end planning. The first step in organization phase consists of creating a project team. The project team has some members having brief involvement, bringing specialist knowledge or supplying specialist components during a particular phase, whilst others, such as owner, investors, project manager or lead consultants are involved in the entire project. It is ensured that team members are selected carefully to give the maximum efforts for the project success. A construction project organisation structure is shown as below:

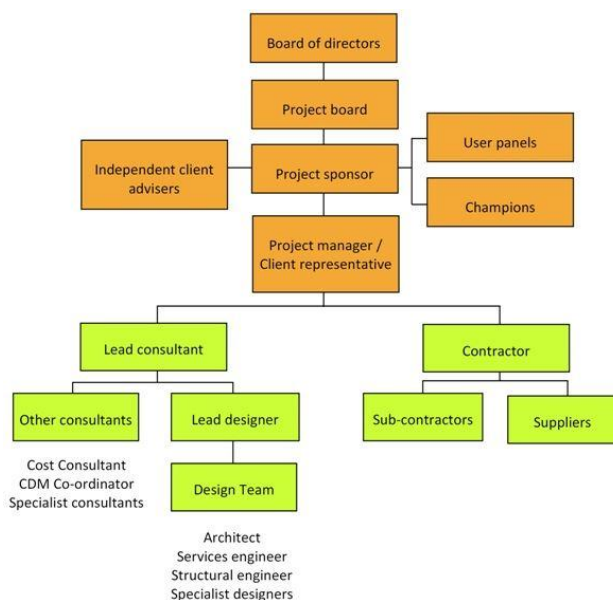


Figure1. Organisational Chart for a Constructional Project

The next step involves drafting the project charter for the planning phase. The project charter contains sections for project scope, deliverables, objectives, stakeholders, milestone schedule, risks as well as business and organizational information.

The final step in organisation phase is to clearly define the roles, responsibilities, and reporting mechanisms. A role and responsibilities matrix can be developed to assign role and responsibility to individuals and to assess whether new appointments will be required in the organisation.

2.2 Data Generation

Analysis for appropriate technology to be deployed is carried out by construction contractor and reviewed by the design professional. The project site information from is filled which consists of project name, engineer-in-charge, project type, date of commencement of project and

completion date, geological data and historical data. Site topography is critical to project planning, design and layout. The project site information is evaluated by project manager. The next step is to prepare conceptual scopes, estimates and schedules which form the crucial part of any project. Various equipments and expert services may be procured for data collection purpose.

2.3 Evaluation of Alternatives

The first step in alternative project evaluation is to identify the alternatives. The range of alternatives is limited to those that would avoid or substantially lessen any of the significant adverse effects of the project, are potentially feasible and would attain most of the basic objectives of the project. The second step is to define the reasonable range of alternatives that will foster informed decision-making. The last step involves a requirement to include sufficient information about each alternative to allow meaningful evaluation, analysis and comparison with the project. Matrices may be used to display the major characteristics of each alternative and significant impacts of each alternative to summarize the comparison. If an alternative would cause one or not more significant adverse effects in addition to those that would be caused by the project are proposed.

Alternatives are influenced by technology, site/location, conceptual scopes and estimates, evaluation based on financial and high level risks.

There are two types of alternatives that may be reviewed:

- (1) Alternatives to the project that are other projects entirely, or other approaches to achieving the project objectives rather than the project or modified project.
- (2) Alternatives of the project that include modified project components, such as alternative project processes and/or modified facilities, layout, plans.

2.4 Project Definition

Project definition is the process of defining the project's purpose and the development of alternative means to satisfy it. The project definition process consists of three stages: determining project purposes, translating those purposes into criteria for assessing alternative designs or solutions, and generating alternative design concepts.

The project definition package includes following elements:

- 1) Analyze project risks
- 2) Document Project scope and definition
- 3) Define project execution approach
- 4) Establish project control guidelines
- 5) Compile project definition package

After the project definition package is prepared it is transformed into a business case and finally submitted to

approval authority. The approval authority then decides whether to proceed with the project or not.

2.5 Decision

The whole purpose of indulging in the decision making process is to make a rational decision. Rational decision making means a tendency that is suitable to the already existing goals within the given conditions and constraints. Decision making is based on the models used by authority. Following are some of the decision making models:

- 1) SWOT Analysis
- 2) Maslow's Pyramid
- 3) Pareto principle
- 4) Monte Carlo simulation
- 5) Decision tree analysis

After the final decision is made, the project execution is commenced along with monitoring activities.

3. PROJECT DEFINITION RATING INDEX (PDRI)

Project definition rating index is a front-end planning tool developed by Construction Industry institute in 1994. PDRI tool measures the degree of scope definition in a project. It is composed of a compendium of scope definition elements to be evaluated. The level of completeness is checked by project team before commencement of construction. After assessment of all the elements, an index is calculated that gives the relative level of definition of project. A complete definition has a lower score.

PDRI is available for both industrial and building projects. PDRI provides an early indication of the probability of project success. The validation is done by testing against actual project results. PDRI has been proven effective for small and large construction projects. PDRI consists of 70 elements grouped into 3 categories as follows:

- 1) Basis of decision/scope (50%)
- 2) Front-end definition/preliminary design (42%)
- 3) Execution approach (8%)

SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
A. BUSINESS STRATEGY (Maximum = 214)							
A1. Building Use	0	1	12	23	33	44	
A2. Business Justification	0	1	8	14	21	27	
A3. Business Plan	0	2	8	14	20	26	
A4. Economic Analysis	0	2	6	11	16	21	
A5. Facility Requirements	0	2	9	16	23	31	
A6. Future Expansion/Alteration Considerations	0	1	7	12	17	22	
A7. Site Selection Considerations	0	1	8	15	21	28	
A8. Project Objectives Statement	0	1	4	8	11	15	

0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies
 1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

Figure2. Elements of Building Project PDRI sheet

Each element has a corresponding detailed description and assigned a weighted score. The more completely an element has been addressed; the lower is its score. The maximum score assigned is 1000. The score which is less than 200 correlates with more successful construction projects.

A1. Building Use

Identify and list building uses or functions. These may include uses such as:

<input type="checkbox"/> Retail	<input type="checkbox"/> Research	<input type="checkbox"/> Storage
<input type="checkbox"/> Institutional	<input type="checkbox"/> Multimedia	<input type="checkbox"/> Food service
<input type="checkbox"/> Instructional	<input type="checkbox"/> Office	<input type="checkbox"/> Recreational
<input type="checkbox"/> Medical	<input type="checkbox"/> Light manufacturing	<input type="checkbox"/> Other

A description of other options which could also meet the facility need should be defined. (As an example, did we consider renovating existing space rather than building new space?) A listing of current facilities that will be vacated due to the new project should be produced.

Figure3. Element A1 Description

Building Project Scope Definition Element (1)	Definition Level Average (2)
E5. Growth and Phased Development	1.9
E4. Stacking Diagrams	1.9
L5. Substantial Completion Requirements	1.9
B4. Design Philosophy	1.9
D8. Special Water and Waste Treatment Requirements	1.9
D1. Site Layout	1.8
E3. Overall Adjacency Diagrams	1.8
K1. Project Quality Assurance and Control	1.7
A4. Economic Analysis	1.7
A5. Facility Requirements	1.7
F6. Building Life Safety Requirements	1.7
J1. CADD/Model Requirements	1.7
B1. Reliability Philosophy	1.7
E6. Circulation and Open Space Requirements	1.7
E7. Functional Relationship Diagrams / Room by Room	1.6
E9. Transportation Requirements	1.6
D3. Civil/Geotechnical Information	1.6
L2. Owner Approval Requirements	1.6
L1. Project Organization	1.6
D7. Site Life Safety Considerations	1.6
A7. Site Selection Considerations	1.6
E8. Loading/Unloading/Storage Facilities Requirements	1.6
C3. Evaluation of Existing Facilities	1.6
D5. Environmental Assessment	1.6
A3. Business Plan	1.5
D4. Governing Regulatory Requirements	1.5
K5. Safety Procedures	1.5
D2. Site Surveys	1.4
A1. Building Use	1.3
A2. Business Justification	1.3

Figure4. Building Elements PDRI score sheet

4. BENEFITS OF FRONT-END PLANNING

The implementation of front-end planning in various construction projects worldwide have following outcomes:

- 1) Reduction in Contractual Disputes: Front-end planning has alleviated the problem of contractual disputes by ascertaining clear objectives and definition.
- 2) Lower design changes: Front-end planning ensures clear procedures for managing and controlling changes to any part of the project will ensure that any changes necessary will have minimal impact on a project.
- 3) Proper material supply: Material shortages are met with contingency plans defined by front-end planning.
- 4) Selection of appropriate contractor: Reputed contractor is selected based on bidding process which eliminates problems related to incompetent contractors. Front-end planning focuses on selection of suitable tender method.
- 5) Ease in financial management: Inadequate funding may lead to delay or stoppage of project. This problem is solved by implementing front-end planning in a project.
- 6) Proper labour supply: Effective training, recruitment and transportation are initiated in front-end planning that resolves problem associated with availability of labours.
- 7) Reduced poor weather problems: Severe weather conditions are taken into account in the contingency plans of front-end planning.
- 8) Improved operational performance and reduced probability of project failures.
- 9) Better achievement of business goals and fewer scope changes.
- 10) Increased predictability of cost and schedule as well as better risk management.

4. CONCLUSIONS

Front-end planning contributes to the improvement of the life cycle of construction. It is efficient in resolving problems associated with successful performance of projects. It is observed that the construction projects which are naturally accompanied by uncertainty and unpredictability due to human or environmental interferences can be better controlled and managed by front-end planning. Front-end planning resolves the issues of selection of project team, inadequate scope definition, risk mitigation and obscure roles and responsibilities. PDRI tool assists front-end planning in achieving resource optimization through a detailed survey. Thus, it is observed that front-end planning maximizes the probability of project success and can be preferred over the traditional approach of construction project planning.

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BIOGRAPHY



1. ROHIT R. SARDE

Currently, I am a Final Year Student (B.E.Civil) at Sinhgad College of Engineering, Pune. I have completed Diploma in Civil Engineering (First Class with Distinction) from Walchand College of Engineering, Sangli in 2013.