

Best Practices in Scope Definition for Small Capital Projects

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Abstract

Poor scope definition is the leading cause of capital project cost and schedule overruns, and small projects are no exception. For over 20 years, organizations around the world have utilized the Project Definition Rating Index (PDRI) methodology to improve scope definition during front end planning. It is the most successful open industry standard available and proven to deliver increased cost and schedule certainty, with over \$96 billion in projects benchmarked by the Construction Industry Institute (CII).

Over the past two years, CII has published two new PDRI templates to help organizations improve scope definition in small industrial and infrastructure projects. This paper will introduce the PDRI methodology and explain how it helps small project efficiently achieve a well defined scope and improve project performance.

I. Introduction

Small capital projects with limited complexity represent up to 70% of the projects in an organization's capital program¹, yet minimal emphasis has historically been placed on adopting front end planning and scope definition best practices. Poor scope definition is the leading cause of project cost and schedule overruns, and small projects are no exception. We assume small projects carry lower risk than large projects, but the the cumulative effect of limited front end planning can have a significant impact on the overall bottom line.

In the industrial and infrastructure sectors, small projects are largely undertaken to address compliance requirements (health, safety or environmental), planned equipment replacement and upgrades, or modifications that will achieve a process improvement or de-bottlenecking. This presents several challenges including:

- **Project sponsor availability.** Operations & Maintenance leaders are often the project sponsor, but face tremendous pressure and time constraints. They appreciate that projects must have clear scope requirements, but often struggle to know just how, or in what format to best communicate requirements.
- **Complex stakeholder communication.** Small projects typically have many more stakeholders than routine maintenance. Achieving a well defined scope requires effective communication between Operations & Maintenance, project management, engineering, external consultants and contractors, health and safety, environmental, legal, and sometimes more.
- **Interfaces & Coordination.** Small projects require careful coordination with existing operations, and other ongoing projects at the same site.

Adopting a proven methodology for assessing scope definition during the front end planning of small projects is a proven strategy to improve project performance, and long term operational performance of assets. This paper introduces the Project Definition Rating Index (PDRI) and

¹ "Front End Planning Tool: PDRI – Small Industrial Projects," Research Summary 314-1, Construction Industry Institute, 2015.

how it is being successfully used in the front end planning of small industrial and infrastructure projects to:

- Improve cost and schedule certainty
- Increase team alignment
- Provide better transparency on risks
- Identify gaps and provide teams with action items

II. Front End Planning for Small Capital Projects

Front End Planning Phase-Gate Process

CII defines Front End Planning as achieving sufficient scope definition to address risk and make a decision on committing resources to maximize the potential for project success.

The three phases of front end planning are:

- **Feasibility**, which is primarily focused on defining business objectives and identifying potential alternatives.
- **Concept**, concerned with evaluating and selecting the best alternative.
- **Detailed Scope**, which is focused on defining the technical scope of the project, further developing project execution plans, and developing a cost estimate and schedule for project authorization.

In small projects, schedules are often compressed resulting in overlapping phases (as shown in Figure 1 below), limited scope development, and less formal gate reviews.

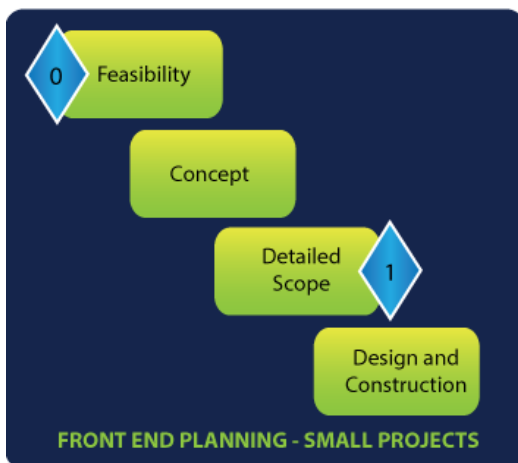


Figure 1. Typical Front End Planning Process for Small Projects

What is a Small Project?

CII defines small projects using nine complexity indicators² shown in Table 1 below.

Complexity Indicator	Small Industrial	Small Infrastructure
Total installed cost	Less than \$10M	More than \$20M
Construction duration	3 – 6 months	6 - 12 months
Level of funding	Regional or corporate	Regional or corporate
Project visibility	Moderate	Moderate
No. core team members	7 – 9	7 – 9
Availability of core team	Part-time	Part-time
Extent of permitting	None to minimal	None to minimal
Types of permits	Local, provincial	Local, provincial

Table 1. Complexity Indicators for Small Projects

Small industrial projects include:

- Process-related projects that affect production rate, efficiency, quantity or quality of a product.
- Non-process-related projects that are ancillary to production processes, but don't directly affect the quantity or quality of a product.

Small infrastructure projects include replacement and upgrade projects such as:

- People and freight – roads, canals and rail
- Fluids - water distribution, sewer lines, storm water
- Energy - utilities, communication lines, data lines

III. Project Definition Rating Index (PDRI)

PDRI Overview

PDRI is a methodology used by capital projects to measure the degree of scope definition, identify gaps, and take appropriate actions to reduce risk during front end planning. PDRI is used at multiple stages in the front end planning process. As a project progresses, identified gaps will continue to be addressed until a sufficient level of definition (measured using the PDRI score) is achieved for the project to proceed to detailed design and construction.

CII is the developer of PDRI. They are a non-profit research organization of more than 140 owners, engineering contractors, suppliers and academic institutions.

CII is committed to developing and sharing best practices in construction project management with the industry at large.

PDRI is comprised of a checklist of critical scope elements used to conduct a project scope review with participation from all key project stakeholders. The elements are described at a level of detail that all team members can understand. They span the basis of project decision, basis of design and the execution approach of the project.

² "Project Definition Rating Index – Small Industrial Projects," Implementation Resource 314-2, Construction Industry Institute (CII), 2015.

Each element is weighted according to the relative risk that it poses to successful project execution. During the scope review, project team members are encouraged to engage in open and honest discussion on each element to identify outstanding risks and gaps, and score its level of definition.

PDRI is one of the **most comprehensive risk management tools** available for front end planning.

PDRI Benefits for Small Projects

Using the PDRI methodology will help your project teams improve scope definition, become better aligned, provide transparency on identified gaps, and vastly improve confidence in cost and schedule estimates. With small projects the primary focus for PDRI is:

- As a planning checklist. PDRI templates are often used to augment or expand on existing planning checklists.
- As a team alignment tool, especially between an owners O&M team, project team and the selected design contractors.
- As a tool to measure progress on scope definition.

Improving scope definition helps equip all project stakeholders to better mitigate risks identified in PDRI reviews, predict future issues, and overcome huge and costly problems down the road.

CII has benchmarked the impact of the PDRI practice on over \$96 billion in projects showing significant improvements in cost and schedule certainty when projects achieve a well defined scope prior to execution³. CII research shows that small projects with better scope definition (lower PDRI scores) outperformed projects with poorly defined scope, with up to⁴:

- 16% cost savings
- 15 % in schedule reduction
- 3 % change orders

PDRI Templates

Industry validated project templates are available for three industry sectors:

- Industrial projects including power plants, chemical plants, oil & gas production, water, waste treatment, and manufacturing
- Building projects such as offices, schools, medical facilities, institutional buildings and research facilities, AND
- Infrastructure projects that involve linear construction with extensive public interface and environmental impact. Examples include railways, pipelines, transmission and distribution.

PDRI is used for both greenfield (new construction) and brownfield (renovation and revamp) projects. Today, project templates are available for small, large, and mega-projects.

Who uses PDRI?

Asset Owners are the leading users of PDRI. However, engineering firms, architects and contractors engaged in front end planning also use PDRI as an alignment tool in the development of an Owner's business objectives, to clarify design requirements, and coordinate execution planning.

³ "Adding Value Through Front End Planning," Special Publication 268-3, Construction Industry Institute, 2012.

⁴ "Front End Planning Tool: PDRI – Small Industrial Projects," Research Summary 314-1, Construction Industry Institute, 2015.

Structure of PDRI

The PDRI methodology supports a comprehensive assessment of scope definition. Templates are organized in three sections for systematic assessment of the:

- Basis of Project Decision – the business objectives and drivers
- Basis of Design - processes and technical information required
- Execution Approach - for executing the project construction and closeout

Each section is broken down into categories and elements. The element is the lowest level of the index where the assessment of scope definition is conducted.

PDRI Elements

Through the research and collaboration of hundreds of organizations, CII has developed standard element descriptions to help generate a clear understanding of expectations for development of scope. Many element descriptions include a checklist of sub-elements that help clarify the concepts and identify specific items for consideration.

The element example shown in Figure 2 for “Project Objectives Statement” comes from the PDRI for Small Industrial Projects template.

A.1 Project Objectives Statement

The project objectives statement should clearly define why the project is being performed and its value to the organization. Project objectives and priorities for meeting the business drivers should be documented and shared. The relative priority among cost, schedule and quality should be outlined. Key stakeholders (e.g., owner/operations, environmental/permitting, design/engineering, procurement, construction, commissioning/startup, and external stakeholders) should be engaged to ensure the project is aligned to the applicable objectives and constraints. The following should be considered:

- Objectives:
 - Safety/Security
 - Quality of product/Quality of Life
 - Performance/Capacity
 - Environmental/Sustainability
- Stakeholders understanding of the objectives, including questions or concerns answered
- Constraints or limitations placed on the project which if not addressed or overcome, could adversely affect the project's ability to meet objectives (e.g., space, operations, timing, funding)
- Other user defined

**** If this is an instance of a Repetitive Program ****

- Ensure compatibility of project objectives with program objectives

Close

Figure 2. Example Element Description

A full list of the element can be found in:

- Appendix A – PDRI for Small Industrial Projects
- Appendix B – PDRI for Small Infrastructure Projects

When to use PDRI in Small Projects

PDRI can be used at multiple points during front end planning, and normally coincides with the completion of a phase. With small projects, there are two recommended points for PDRI assessments:

- **Early Review.** Conducting a PDRI early in front end planning before the end of the feasibility phase helps project teams in:
 - Identification of projects that do not align business objectives
 - Aligning the team on project objectives
 - Identifying high priority project deliverables such as long lead items
 - Identifying risks and helping to eliminate late surprises in planning
- **Final Review.** A final PDRI helps project teams:
 - Identify gaps or poorly defined areas of scope
 - Identify action items that must be addressed
 - Understand risk areas of the project

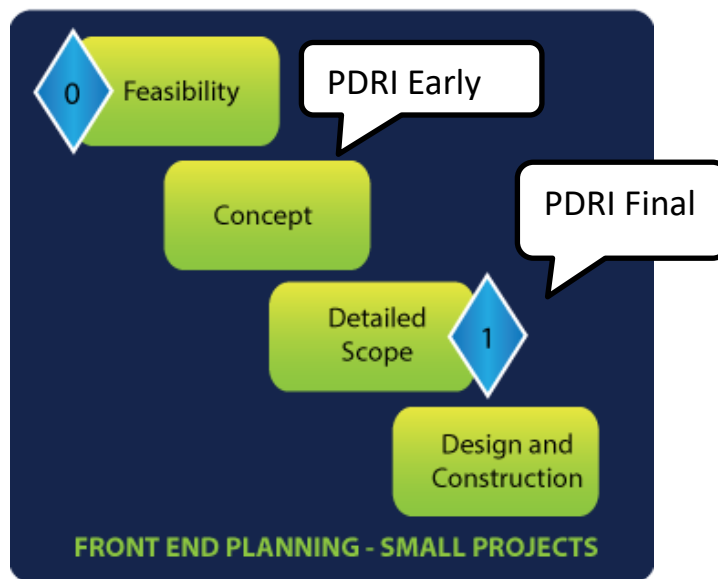


Figure 3. Application of PDRI in Small Projects

Assessment Process

A PDRI session is a facilitator-led meeting that is conducted with all key project stakeholders. For each element, the facilitator introduces the element requirements and leads the group in objectively:

- discussing their progress on definition,
- identifying gaps and action items
- assigning their current definition level

A co-facilitator (scribe) captures the element definition level and documents the gaps and action items identified during the group discussion.

Scoring

Each element is assigned a definition level from 1 (completely defined) to 5 (undefined). Elements that are not applicable are scored 0 and excluded from the total calculation.

Each element's definition level corresponds to a score based on its relative risk to project performance. The rollup of all element scores provides a PDRI total score between 70 to 1,000 points.

Target Scores

The PDRI total score will decrease as scope definition increases during front end planning of a project. For small projects, CII recommends projects proceeding to detailed design and construction achieve a Final Review **PDRI score of less than 300** for optimal cost and schedule performance.

A low PDRI score (less than 300) represents a well-defined package that corresponds to an increased probability of project success. The score is not the most important output of PDRI. The score is a continuum, is relative to timing and only as valid as the effort or seriousness applied by the project team.

Tools to Support PDRI

Over the past 20-years, the supporting tools for PDRI have evolved from a paper-based checklist to PDRI spreadsheets. The spreadsheets make it simpler to facilitate, and tally scores for up to 41 elements in small projects.

Organizations that implement PDRI as a standard practice in their project management process also use the Carve for PDRI application shown in Figure 4. This supporting application provides visibility on the level of scope definition for all projects in a portfolio, and allows for configuration of PDRI element descriptions to meet their specific business needs.

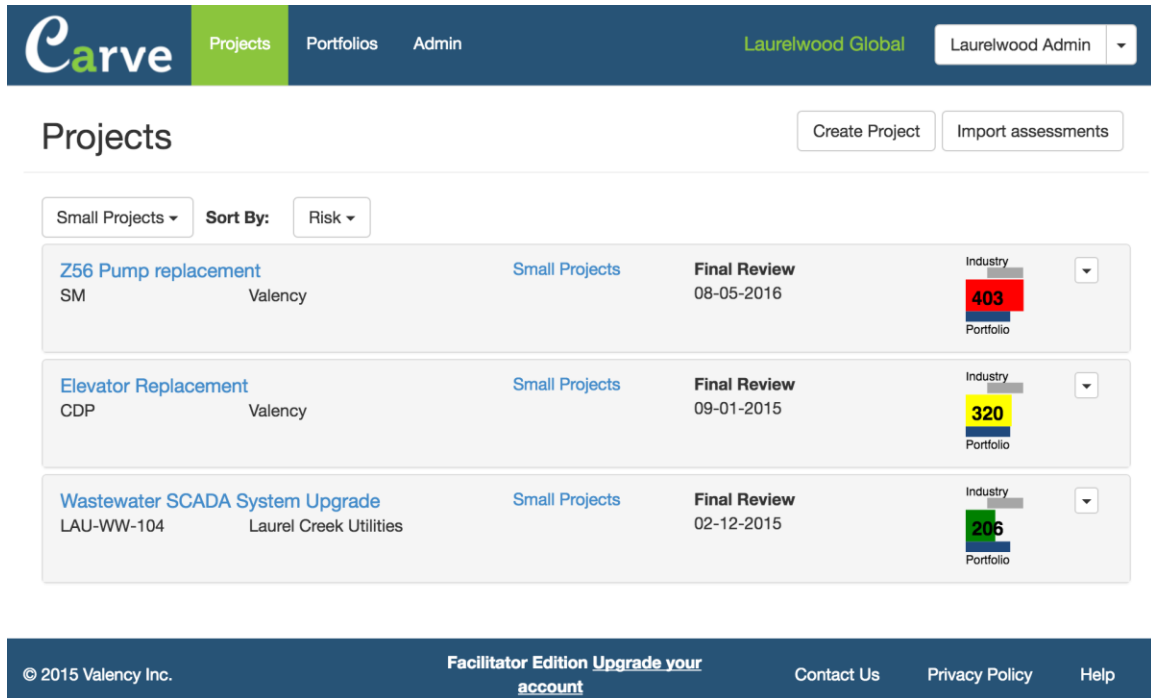


Figure 4. Carve for PDRI Project Dashboard

Summary

PDRI is a proven methodology that helps project teams efficiently achieve a well defined scope and improve project performance. CII's development of PDRI templates for small industrial and infrastructure projects fills an important void to support front end planning on up 70% of projects delivered every year.

About Valency

Valency implements best practices from the Construction Industry Institute (CII) that are proven to dramatically improve capital project performance. We are a leading Registered Education Provider with the Construction Industry Institute (CII) and the Project Management Institute (PMI) and specialize in implementation of CII best practices including front end planning, team alignment, risk management, and change management.

Learn more at www.valencyinc.com.



Appendix A. PDRI for Small Industrial Project Checklist

Section 1.1 Basis of Project Decision	Section 1.2 Basis of Design	Section 1.3 Execution Approach
A. Project Alignment A.1 Project Objectives Statement A.2 Project Strategy and Scope of Work A.3 Project Philosophies A.4 Location	C. Design Guidance C.1 Lead/Discipline Scope of Work C.2 Project Design Criteria C.3 Project Site Assessment C.4 Specifications C.5 Construction Input	G. Execution Requirements G.1 Procurement Plan G.2 Owner Approval Requirements G.3 Distribution Matrix G.4 Risk Management Plan G.5 Shutdown/Turnaround Requirements G.6 Precommissioning, Startup, & Turnover Sequence Requirements
B. Project Performance Requirements B.1 Products B.2 Capacities B.3 Processes B.4 Technology B.5 Physical Site	D. Process/Product Design Basis D.1 Process Safety Management (PSM) D.2 Process Flow Diagrams (long) With Heat and Material Balance D.3 Piping and Instrumentation Diagrams (P&ID's) D.4 Piping System Stress Analysis D.5 Equipment Location Drawings D.6 Critical Process/Product Items Lists	H. Engineering/Construction Plan and Approach H.1 Engineering/Construction Methodology H.2 Project Cost Estimate H.3 Project Accounting and Cost Control H.4 Project Schedule and Schedule Control H.5 Project Change Control H.6 Deliverables for Design and Construction H.7 Deliverables for Project Commissioning/Closeout
	E. Electrical and Instrumentation Systems E.1 Control Philosophy E.2 Functional Descriptions and Control Narratives E.3 Electrical Single Line Diagrams E.4 Critical Electrical Items Lists	
	F. General Facility Requirements F.1 Site Plan F.2 Loading/Unloading/Storage Requirements F.3 Transportation Requirements F.4 Additional Project Requirements	

[0] = Not Applicable [1] = Complete Definition [2] = Minor Gaps [3] = Some Gaps [4] = Major Gaps [5] = Poor Definition

Appendix B. PDRI for Small Infrastructure Projects Checklist

Section 1.1 Basis of Project Decision	Section 1.2 Basis of Design	Section 1.3 Execution Approach
A. Project Alignment A.1-Need and Purpose Statement A.2-Key Project Participants A.3-Public Involvement A.4-Project Philosophies A.5-Project Funding A.6-Preliminary Project Schedule	C. Design Guidance C.1-Lead/Discipline Scope of Work C.2-Project Codes and Standards C.3-Topographical Surveys & Mapping C.4-Project Site Assessment C.5-Environmental and Regulatory Considerations C.6-Value Analysis C.7-Construction Input	G. Execution Requirements G.1-Land Acquisition Strategy G.2-Utility Adjustment Strategy G.3-Procurement Strategy G.4-Owner Approval Requirements G.5-Intercompany and Interagency Coordination
B. Project Requirements B.1-Functional Classification and Use B.2-Physical Site B.3-Dismantling & Demolition Requirements	D. Project Design Parameters D.1-Capacity D.2-Design for Safety and Hazards D.3-Civil and Structural D.4-Mechanical and Equipment D.5-Electrical and Controls D.6-Operations and Maintenance	H. Engineering/Construction Plan and Agreements H.1-Design/Construction Plan and Approach H.2-Project Cost Estimate and Cost Control H.3-Project Schedule and Schedule Control H.4-Project Quality Assurance & Control H.5-Safety, Work Zone and Transportation Plan H.6-Project Commissioning/Closeout
	E. Location & Geometry E.1-Schematic Layouts E.2-Alignment and Cross-section E.3-Control of Access	
	F. Associated Structures & Equipment F.1-Support Structures F.2-Hydraulic Structures F.3-Miscellaneous Elements F.4-Equipment List	

[0] = Not Applicable [1] = Complete Definition [2] = Minor Gaps [3] = Some Gaps [4] = Major Gaps [5] = Poor Definition