



Project Definition Rating Index



Small Infrastructure Projects



Implementation Resource 314a-2



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PDRI:
Project Definition Rating Index –
Small Infrastructure Projects

*Research Team 314a, Project Definition Rating Index –
Small Infrastructure Projects*

Construction Industry Institute

Implementation Resource 314a-2

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Foreword

Welcome to the *PDRI: Project Definition Rating Index – Small Infrastructure Projects*. CII Research Team (RT) 314a, PDRI–Small Infrastructure Projects, developed this resource to address a critical industry need. With this publication, CII has filled a gap in its Front End Planning body of knowledge. This document and its accompanying Excel-based tool will help project teams develop scope definition on small infrastructure projects, whether they involve new construction, renovation/revamp, or both. This book complements Implementation Resource (IR) 268-2, *PDRI–Infrastructure Projects*, which was developed specifically to assess the scope definition of large, complex infrastructure projects. Two other PDRI tools also focus on large, complex projects: IR155-2, *PDRI–Building Projects*, and IR113-2, *PDRI–Industrial Projects*. One other PDRI tool focuses on small projects: IR314-2, *PDRI–Small Industrial Projects*. (Note that at publication, no small-project PDRI version exists for the building sector.)

Past work by CII, published in 1991 and 2003, described the difficulty of defining the term “small project.” The RT-314a research investigation defined small projects as those generally valued at less than \$20 million (U.S. dollars) in expenditure, with construction durations of between six and 12 months, and of less overall complexity than large projects, based on several indicators; yet these projects annually comprise more than half of all completed projects by number in most organizations’ portfolios.

In addition to producing this publication, the team created a macro-enabled spreadsheet to help project teams assess their projects. The next page gives directions for downloading this accompanying software from the CII website.



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What Is the PDRI?

The PDRI is a powerful, easy-to-use tool for measuring the degree of scope development.

The Project Definition Rating Index (PDRI) is a powerful, easy-to-use tool that identifies and precisely describes each critical element in a scope definition package. It also enables project teams to identify quickly the project risk factors related to desired outcomes for cost, schedule, and operating performance. By using the PDRI method, teams can capture mitigation action items and evaluate the completeness of scope definition at any point prior to detailed design and construction. While three of the four previously developed versions of the PDRI apply to large and complex projects for building, industrial, and infrastructure projects (IR155-2, IR113-2, and IR268-2, respectively), a fourth version (IR314-2) was specifically developed for small industrial projects. This fifth PDRI addresses small infrastructure projects.

Table 1.1 lists practical applications for each version of the PDRI, so users can decide which versions apply best to their particular projects. For further clarification, Table 1.2 summarizes the main characteristics of infrastructure, building, and industrial projects. Together, these tables can guide the selection of the most appropriate PDRI for any project under consideration.

Table 1.1. Applicable Project Types for Each PDRI

Building Projects (IR155-2)		
• Airport terminals • Apartments • Banks • Churches • Dormitories • Government facilities • Hotels and motels • Industrial control buildings	• Institutional buildings • Light assembly and manufacturing • Medical facilities • Nursing homes • Offices • Parking structures • Public assembly and performance halls	• Recreational and athletic facilities • Research and laboratory facilities • Schools (classrooms) • Stores and shopping centers • Toll booths • Warehouses
Industrial Projects (IR113-2, IR314-2)		
• Chemical plants • Food processing plants • Manufacturing facilities • Oil and gas production facilities • Paper mills	• Pharmaceutical plants • Plant upgrade/retrofit • Power plants • Refineries • Steam heat/chilled water plants	• Steel and aluminum mills • Textile mills • Water/wastewater treatment
Infrastructure Projects (IR268-2, IR314a-2)		
• Access ramps • Airport runways • Aqueducts • Canals • Electrical substations and switch gears • Electricity transmission and distribution • Fiber optic networks	• Highways • Levees • Locks and weirs • Meters and regulator stations • Pig launchers and receivers • Pipelines	• Pumping and compressor stations • Railroads • Reservoirs • Security fencing • Towers • Tunnels • Water control structures • Wide area networks

Table 1.2. Project Sector Characteristics that Inform Selection of a PDRI Tool

Project Sector Characteristics			
Characteristics	Building	Industrial	Infrastructure
<i>Primary Designer</i>	Architect	Chemical, mechanical, or industrial engineer	Civil engineer
<i>Project Orientation</i>	Vertical	Vertical	Horizontal
<i>System</i>	Node	Node	Vector
<i>Utilization</i>	Functional use	Transformation	Conveyance
<i>Operational</i>	Nodal terminations	Consumptions and production	Flow dynamics, networked into a grid
<i>Interface with Public</i>	Moderate	Minimal	Extensive
<i>Environmental Impact</i>	Moderate	Extensive	Extensive
<i>Primary Cost</i>	Building, building system	Piping, mechanical, equipment	Earthwork, materials, associated structures
<i>Installed Equipment Cost</i>	Moderate	Extensive	Minimal
<i>Land Cost</i>	Low to high	Low to moderate	Moderate to high
<i>Jurisdictional Interface</i>	Moderate	Moderate	Extensive

The PDRI is intended for use during front end planning (FEP), the project phase that encompasses activities such as feasibility, concept, and detailed scope definition. (See Figure 1.1.) Note that “front end planning” has many other equivalent and associated terms, including “front end loading,” “advance planning,” “pre-project planning,” “programming,” “schematic design,” “design development,” and “sanctioning.” Although the term “front end planning” is used in this document, it should be considered synonymous with the analogous term that is more familiar within the user’s business process. (More detailed information on timing and process is provided below.) Although the original PDRI was envisioned as a decision-support metric for funding detailed design and project execution at Phase Gate 3, experience has shown that, depending on project size and complexity, PDRI should be used more than once prior to arriving at this gate.

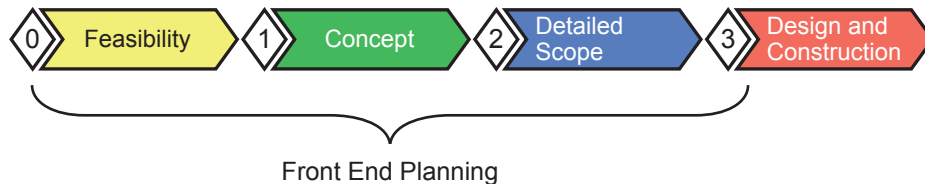


Figure 1.1. Diagram of Project Phases

Every version of the PDRI includes specific risk factors relating to new construction (greenfield) projects and renovation and revamp (R&R) projects. An R&R project is defined as one that is focused on existing infrastructure facilities but does not involve routine maintenance activities. It includes the act, process, or work of replacing, restoring, repairing, or improving the infrastructure with capital funds or non-capital funds. It also may include the construction of additional structures and systems to achieve a more functional, serviceable, or desirable condition. These modifications address such considerations as profitability, reliability, efficiency, safety, security, environmental performance, or compliance with regulatory requirements. An R&R project may be known by numerous other names, such as repair, upgrade, modernization, or restoration, among others. (More details on how to adapt the PDRI to R&R projects are presented below. For more information on how to manage the FEP of R&R projects, see IR242-2, *Front End Planning of Renovation and Revamp Projects*.)

How Is this PDRI Different?

Infrastructure projects with substantial scope, complexity, schedule duration, and cost are typically considered “large,” while projects with lower costs and smaller scope are categorized as “small.” Organizations expend considerable effort to ensure success on large projects, since the level of expenditure makes them high profile. Organizations often view small projects as having low risk and, thus, as not warranting a structured planning approach, so the organizations may place minimal emphasis on detailed FEP. Moreover, organizations often use small projects as training grounds for younger or inexperienced project managers and engineers, to prepare them for future work on larger projects. In reality, it is shortsighted to assume that a small project inherently carries lower risk or is less critical to an organization. Indeed, because small projects constitute over half of all projects completed in the infrastructure sector every year, poorly planned small projects can have a major cumulative impact on an organization’s bottom line. In response to this overlooked potential improvement, CII chartered Research Team 314a (RT-314a) to develop the PDRI–Small Infrastructure Projects to address this highly important and prevalent project type.

RT-314a defined small projects as those generally with less than \$20 million (in U.S. dollars) in expenditures, six to 12 months in construction duration, and less overall complexity than large projects based on several indicators; these projects annually comprise approximately 50 percent of all completed projects by number in most organizations’ portfolios. In some cases, the speed and concurrent phasing of small projects make it more difficult to provide guidance on the best time to conduct a PDRI review. On some small projects, the entire project may be charged against a funding budget; hence, users will want to perform an initial assessment to “get on track.” In other situations, funding may be awarded after the initial decision to proceed with development, and the optimal time to use the tool may be just prior to that second funding decision.

Figure 1.2 shows that small projects may be phased so that feasibility, concept, detailed scope, design, procurement, and construction all overlap, but in the infrastructure sector, many small projects follow the more traditional phase-gate approach shown in Figure 1.1. Unplanned concurrent activity is typically not the optimal way to proceed with a project, but it may reflect the reality of some small infrastructure projects.

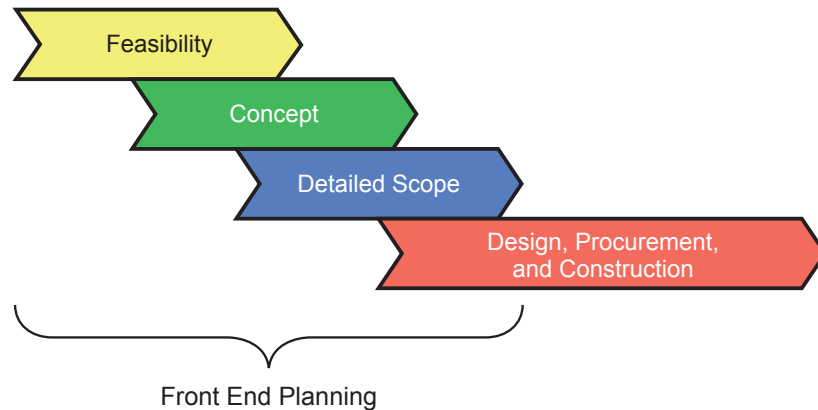


Figure 1.2. Concurrent Small Infrastructure Project Delivery

RT-314a designed the PDRI–Small Infrastructure Projects so that it could be used multiple times throughout the FEP process or as a single-use tool. By utilizing the tool multiple times, a project team can benefit from iterative reviews within the narrower time frame consistent with a shorter project schedule. However, even when it is used only once in the FEP process, the PDRI tool may prove comparably effective if the project team deploys it properly. For one-time use, the tool will work best with proper review-team development, effective capture of and follow-up on action items, and open and honest discussion aimed at revealing project scope concerns. Also, if a project is assessed only once, the earlier in the project this occurs, the better. (See Chapter 3 for further details regarding timing of use.)

The PDRI–Small Infrastructure Projects assesses specific risk factors related to repetitive programs, which consist of many similar projects executed throughout an organization’s portfolio, typically using organization-wide standards. Typical drivers of repetitive programs include the following:

replacements and upgrades to meet new regulations; equipment failures (end of life); new control systems; safety; additional capacity; repurposing; and security concerns. Ideally, all projects in these programs should be developed and executed consistently with the overall program standards. These program requirements are likely to be developed at a higher programmatic level, and should flow down into a given project being evaluated by this tool.

Note that this tool and these descriptions have been developed to address a variety of types of small infrastructure projects that are “horizontal” in nature and connect nodes in different types of infrastructure systems. Three basic varieties of projects are addressed in this tool:

1. **projects that convey people and freight**, such as runway resurfacing and intersection rebuilds
2. **projects that convey fluids**, such as reconditioning or relocating pipelines
3. **projects that convey energy**, such as transmission lines or electrical duct bank insulation.

More examples of the three basic project types and typical nodes are listed in Table 1.3.

Table 1.3. Small Horizontal Infrastructure Project Types

1. People and Freight	• Access ramp • Adding railroad track to existing roadbeds • Highway resurfacing	• Highway or road of shorter length • Intersection rebuild • Runway resurfacing • Security bollards
2. Fluids	• Fire-protection water line relocation • Meters and regulator stations • New pipeline of shorter length	• Pipeline asbestos abatement and re-insulation • Pipeline recoating
3. Energy	• Electrical duct bank insulation • Fiber optic line and conduit	• Natural gas pipeline service feeder • Transmission line

PDRI Structure

The PDRI–Small Infrastructure Projects offers a comprehensive checklist of 40 scope definition elements in an easy-to-use score sheet format. (Note that IR268-2, *PDRI–Infrastructure Projects*, has a total of 68 elements.) Each element is weighted on the basis of its importance relative to the other elements. Since the PDRI score relates to risk, users can easily isolate areas in need of further work, and then identify and document mitigation actions. (See Chapter 4 for a detailed description of the weighting system.) To develop the PDRI–Small Infrastructure Projects, RT-314a collected input and feedback from 38 industry professionals representing owner organizations, and 33 representing contractors and engineers. Altogether representing 41 organizations, these 71 industry veterans had an average of more than 17 years of individual experience in managing small infrastructure projects.

The PDRI consists of three main sections, which break down into a series of categories. Figure 1.3 shows how these categories are divided into elements in one part of the PDRI hierarchy. Table 1.4 provides a complete list of the PDRI's three sections, eight categories, and 40 elements.

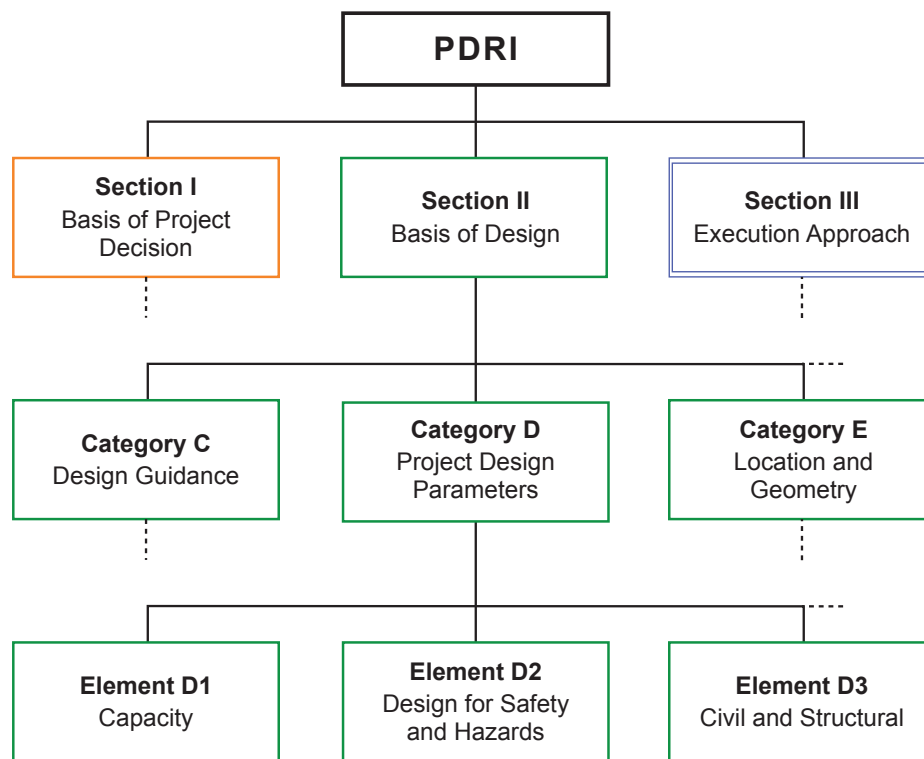


Figure 1.3. Partial PDRI Hierarchy

Table 1.4. PDRI Sections, Categories, and Elements

I. BASIS OF PROJECT DECISION	
A. Project Alignment	B. Project Requirements
A1. Need and Purpose Statement	B1. Functional Classification and Use
A2. Key Project Participants	B2. Physical Site
A3. Public Involvement	B3. Dismantling and Demolition Requirements
A4. Project Philosophies	
A5. Project Funding	
A6. Preliminary Project Schedule	
II. BASIS OF DESIGN	
C. Design Guidance	D. Project Design Parameters
C1. Lead/Discipline Scope of Work	D1. Capacity
C2. Project Codes and Standards	D2. Design for Safety and Hazards
C3. Topographical Surveys and Mapping	D3. Civil and Structural
C4. Project Site Assessment	D4. Mechanical and Equipment
C5. Environmental and Regulatory Consideration	D5. Electrical and Controls
C6. Value Analysis	D6. Operations and Maintenance
C7. Construction Input	
E. Location and Geometry	F. Associated Structures and Equipment
E1. Schematic Layouts	F1. Support Structures
E2. Alignment and Cross-section	F2. Hydraulic Structures
E3. Control of Access	F3. Miscellaneous Elements
	F4. Equipment List
III. EXECUTION APPROACH	
G. Execution Requirements	H. Engineering/Construction Plan and Approach
G1. Land Acquisition Strategy	H1. Design/Construction Plan and Approach
G2. Utility Adjustment Strategy	H2. Project Cost Estimate and Cost Control
G3. Procurement Strategy	H3. Project Schedule and Schedule Control
G4. Owner Approval Requirements	H4. Project Quality Assurance and Control
G5. Intercompany and Interagency Coordination	H5. Safety, Work Zone, and Transportation Plan
	H6. Project Commissioning/Closeout

The PDRI should be used in conjunction with IR113-3, *Alignment During Pre-Project Planning: A Key to Project Success*, to ensure that critical risk issues are addressed and that stakeholder interests are represented effectively in the FEP process. In addition, users should determine whether the project is a renovation or revamp project. If it is either of these, they should use the additional descriptions provided in the tool (in the “Renovation and Revamp” sub-section) to address critical R&R issues during FEP. Figure 1.4 provides a decision diagram to help users determine the most effective use of the PDRI–Small Infrastructure Projects tool. (Note that, if the project includes a shutdown/turnaround/outage scenario, the project planning team should also use the Shutdown/Turnaround Alignment Readiness (STAR) tool provided in IR242-2, *Front End Planning of Renovation and Revamp Projects*, to address the unique issues associated with these types of events.)

Choosing the Appropriate Infrastructure PDRI

Simply put, a small infrastructure project is not a large infrastructure project. While this statement may seem flippant, it reflects the fact that, over time, project professionals have had considerable debate over the distinction between small and large projects. Indeed, past CII research explored this topic and concluded that a clear, consistent definition of a small project does not exist. However, what is clear is that a project that is viewed as small by one organization may not necessarily be viewed as small by another.

Small projects should not be differentiated from large projects solely on the basis of static project cost levels within an organization or across the industry at large. Complexity is the true differentiator between “small” and “large” projects. Complexity was defined by RT-305 as the degree of interrelatedness between project attributes and interfaces, and their consequential impact on predictability and functionality. This definition attempts to capture how project attributes, project scope, team organization, project location, policies and legal regulations, new technologies, and workforce skill sets interact both within a project and with the business and environmental context of the project. With selected management strategies in place to control diverse project attributes and interfaces, the probability that projects can be successful and predictable is increased due to awareness and application of specific management techniques identified to track, control, and manage project complexity attributes.

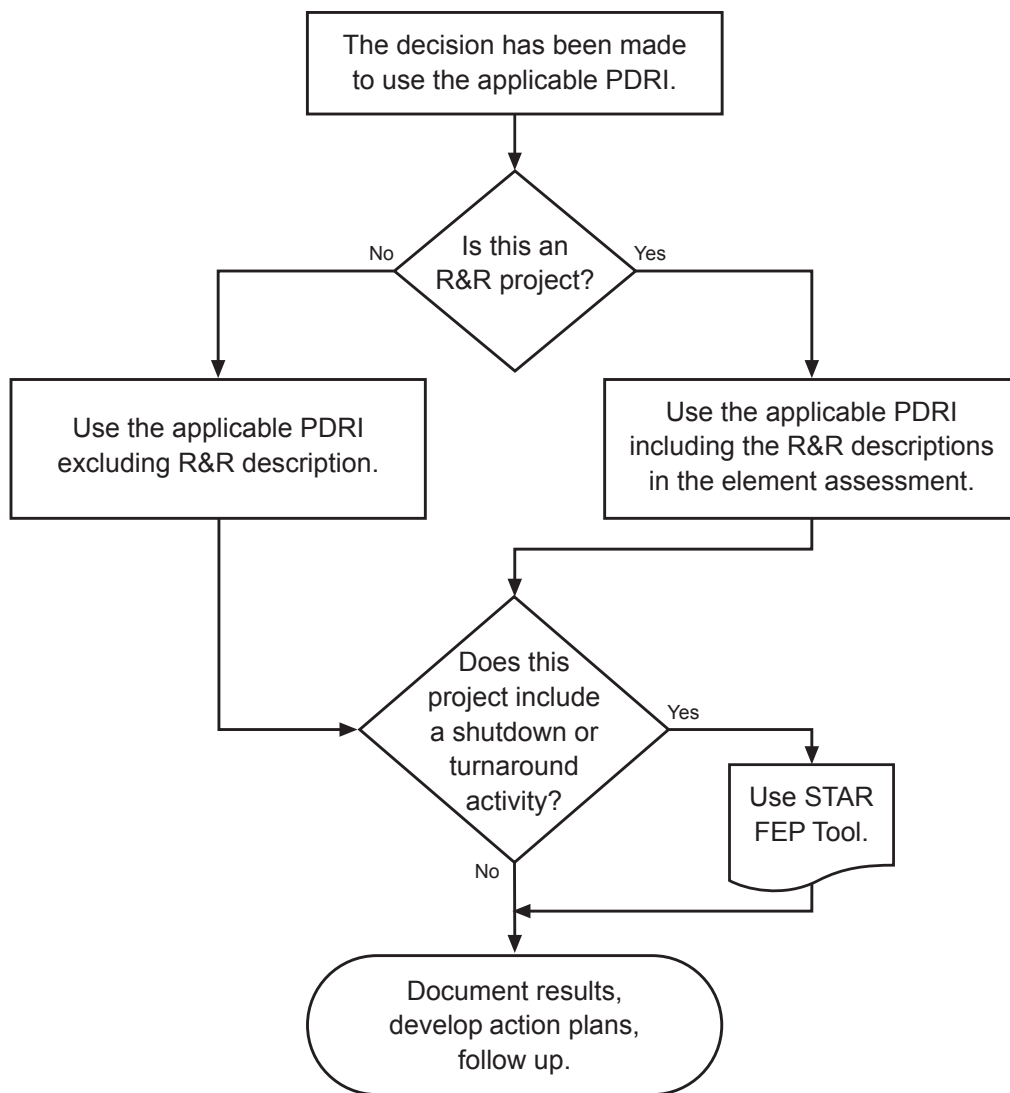


Figure 1.4. Using Additional Tools to Supplement PDRI

Infrastructure construction projects can fall anywhere along a spectrum of complexity, from projects with little to no complexity (e.g., simple maintenance projects, such as re-surfacing or pipe replacement) to highly complex projects (e.g., a subway project or major river crossing). The rigor of planning efforts expended on a project should match its level of complexity. The PDRI–Small Infrastructure Projects focuses on less complex projects.

Table 1.5 provides a matrix for selecting the appropriate PDRI tool for use on an infrastructure project, but should not be used as a strict guideline. Note that the complexity factors appear according to the order of importance reported by survey respondents; that is, total installed cost is the most important factor for differentiating small projects from large, while the number of right of way (ROW) parcels required is the least important differentiator. While Table 1.5 provides guidance as to factors to consider, the values that serve as delineators between small and large projects will vary from one organization to another. For instance, in some organizations, projects with total installed costs of \$20 million may be considered very small, while in other organizations, projects of this caliber would be considered very large. In choosing a suitable tool for a specific project, users are urged to consider such factors and let common sense prevail. If project team members feel that a certain project should be considered small based on their experiences in their organization, then it probably should be. The same can be said about large projects.

Users should keep in mind that RT-314a developed the PDRI–Small Infrastructure Projects only for assessing small projects. The tool is *not* intended as a shortcut to use in lieu of assessing a project with PDRI–Infrastructure Projects. Some organizations may wish to base selection criteria on the characteristics of their typical projects; however, RT-314a’s research validated the results presented in this document for projects meeting the criteria presented in Table 1.5.

Table 1.5. PDRI Infrastructure Selection Guide

Complexity Factor	Small Project	Large Project
<i>Total Installed Cost*</i>	<\$20 million	>\$20.1 million
<i>Engineering Effort*</i>	<5,000 hours	>5,000 hours
<i>Construction Duration**</i>	6–12 months	>18 months
<i>Number of Core Team Members**</i>	<10 individuals	>10 individuals
<i>Availability of Core Team Members**</i>	Part-time availability	Combination of part-time and full-time to completely full-time
<i>Project Visibility External to Organization (Public)</i>	Moderate	Significant
<i>Extent of Permitting</i>	None to moderate permitting	Significant permitting
<i>Number of Jurisdictions Involved</i>	1–3 jurisdictions	>5 jurisdictions
<i>Existing Utility Provider Interface and Coordination</i>	Minimal to moderate	Significant
<i>Sources of Funding</i>	Singular	Multiple
<i>Types of Permits</i>	None to local/state permits	Local/state to national permits
<i>Number of Trade Contractors</i>	3–4 separate trade contractors	7–8 separate trade contractors
<i>Extent of Public Outreach Effort</i>	Minimal to moderate	Significant
<i>Management of Public Outreach Effort</i>	Project team	Corporate executives
<i>Right of Way (ROW) Procurement Effort</i>	Minimal to moderate	Significant
<i>Right of Way (ROW) Parcels Required</i>	1–2 parcels	>5 parcels

* More than 50% of respondents reported this factor as a differentiator between small and large projects.

** More than 48% of respondents reported this factor as a differentiator between small and large projects.

2

Benefits of the PDRI

Effective front end planning improves project performance in terms of both cost and schedule, since it reinforces the positive impacts of early scope definition on project success. The PDRI allows a project team to assess, quantify, and rate the level of scope definition and readiness for project execution, prior to detailed design and construction. Moreover, it is a means by which project enablers can be identified early and acted upon. Its ability to provide these early measures and indicators makes the PDRI a remarkably powerful tool for proactive project management.

A significant feature of the PDRI—Small Infrastructure Projects is that one can quickly go through an assessment and evaluate scope definition on all types of infrastructure projects, including people and freight, energy, and fluids. Elements that are not applicable to a specific project can be zeroed out, thus eliminating them from the final scoring calculation.

Following is a list of the ways the PDRI—Small Infrastructure Projects functions:

- as a **checklist** that a project team can use to determine the necessary steps for defining project scope, for both greenfield and R&R projects
- as a listing of **standardized scope definition terminology** for small infrastructure projects
- as an industry standard for rating the completeness of the project scope definition package to facilitate **risk assessment** and prediction of escalation potential for disputes
- as a means of **monitoring progress**—when used successively—at various stages of the FEP effort
- as a partial forensic assessment tool for **evaluating design and construction readiness**
- as a tool that promotes **communication and alignment** among owners, designers/engineers, and construction contractors by highlighting poorly defined areas in a scope definition package
- as a means by which project team participants can **reconcile** differences, when used as a common basis for project evaluation

- as a means by which members of the project team can **identify gap-list tasks and act upon them** before the project cost, schedule, or quality are negatively affected
- as a **training tool** for organizations and individuals (particularly those with less experience) to understand the requirements of scope definition of small infrastructure projects throughout the industry
- as a **benchmarking tool** for comparing completion of scope definition on current projects against performance on past projects, both within organizations and externally, in order to predict the probability of success on future projects.

Who Should Use the PDRI?

Any organization wishing to improve overall performance of its small infrastructure projects should use the PDRI.

The PDRI can benefit owners, designers, and contractors. Owners can use it as an assessment tool to establish a comfort level that, when reached, prompts them to move forward with projects. Designers and contractors can use it to identify poorly defined project scope elements. As an objective tool that provides a common basis for project scope evaluation, the PDRI offers a means for all project participants to communicate and reconcile any differences they may have.

Owners should use the tool as a formal checklist of items to be defined and communicated to ensure that the design team fully understands the project business objectives and drivers. It also provides an opportunity for the owner and stakeholders—including operations and maintenance—to gain an understanding of the project, including compliance with mandates. Communication is essential to ensuring that the design team is proceeding to meet the expectations and requirements of the owner stakeholders. Engineers and contractors may become involved in projects at various points of the FEP process and should use the PDRI to organize their work. They should use it as an alignment tool to understand and participate in the development of the owner's business objectives and drivers, facilitating the design team's understanding of the elements defined in Section I – Basis of Project Decision. The project team should use this alignment check to

make decisions concerning cost, quality, and schedule as the project progresses from the scope definition stage into project execution. As FEP progresses, the PDRI helps project participants clarify requirements, and it ensures the right input from key owner stakeholders representing areas such as operations and maintenance, process engineering, research and development, manufacturing, and business, among others. The PDRI also supports coordination and execution planning with the owner organization.

Contractors are often given a request for proposal (RFP) on a project that has had all or a portion of the project scope defined by the owner, or the owner has utilized a third-party engineering firm to develop the scope definition package. In such instances, the contractor could use a PDRI assessment as a risk analysis to determine the degree of definition and identify any potential weaknesses or areas of concern before responding to the RFP. The contractor should make every attempt to include the most possible project stakeholders in this PDRI assessment session, and ensure that the team is making the correct evaluation based on the most reasonable assumptions, before proceeding to the next stage.

Contractors may also use the PDRI to determine whether the work within their control is ready to move to the next step. Many contractors spend a portion of the project development effort performing design, procurement, and constructability reviews prior to starting work in the field. For instance, the PDRI can be used to determine whether, prior to the start of the underground work or selection of a subcontractor to perform the work, there is sufficient definition to minimize schedule and/or cost impacts that could trigger mitigating strategies. Such assessments of definition can also be done prior to starting other major activities at the construction site.

In some cases, small projects are performed repetitively across many sites, and the PDRI–Small Infrastructure Projects assessment can be conducted for each one. In such cases, the assessments should be coordinated to ensure that critical issues are addressed and lessons are learned. Also, many organizations perform small projects rapidly, with much concurrency among planning, design, and construction activities. By highlighting gaps and risks, the PDRI–Small Infrastructure Projects can help project participants quickly assess scope definition and keep these overlapping efforts on track.

3

Instructions for Assessing a Project

**Assessing a project is
as easy as 1-2-3.**

Individuals involved in front end planning should use the project score sheets shown in Appendices A and B when assessing a project. Appendix A provides a simple unweighted checklist, while the checklist in Appendix B contains the weighted values and allows an FEP team to quantify the level of scope definition at any stage of a project on a 1,000-point scale. The unweighted version should be used in a team scoring process, to prevent bias in choosing the level of definition or in “targeting” a specific score. The team leader or facilitator can easily score the project as the weighting session is being held. If the project includes renovation work or is part of a repetitive program, the team should consider the supplemental issues that are provided in selected element descriptions.

When to Use the PDRI

The PDRI is a powerful tool that may be used at discrete times throughout a project’s FEP effort to ensure continued alignment, conformance to organizational procedures, and a continual focus on project priorities. Many organizations find value in utilizing a PDRI tool multiple times in the FEP process.

Project size, complexity, and duration will help determine the optimal time to use the PDRI tool. To aid in the expanded use of this tool, Figure 3.1 illustrates suggested application points for the PDRI—Small Infrastructure Projects. As shown in Figure 1.2, there may be significant overlap in the three stages of FEP. This overlap is a characteristic of some small projects, and is less typical of larger, more complex projects, where these stages are completed sequentially.

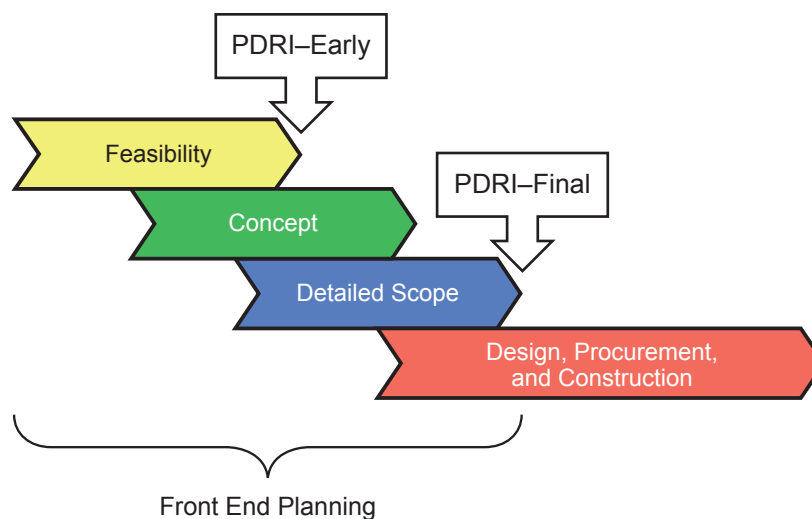


Figure 3.1. Employing the PDRI—Application Points

The purpose of completing a PDRI assessment is to help stakeholders ensure that they are doing the right project at the right time in the right place, that they have considered all design parameters and put the appropriate processes in place to handle a variety of circumstances, and that they will execute and close out the project according to plan. In order for the PDRI to help with these assurances, though, project teams must conduct the review before the related project activities begin. If the PDRI review is performed only once, and it is completed during or at the end of the Feasibility stage, it may help with the business case development; however, it may be necessary to complete a second review at a later point in the project. If the review is done later—say, at the end of the Detailed Scope stage—the team may discover misalignment on key project objectives within the project team, causing rework, delay, and additional cost. For many public infrastructure projects, a more traditional phase-gate approach might be required (e.g., Figure 1.1). For those types of projects, users may find it helpful to refer to IR268-2, *PDRI—Infrastructure Projects*, which describes the PDRI reviews for projects following a planning process akin to the one shown in Figure 1.1.

Regardless of the timing of the PDRI assessment, its participants should all use the same checklists and descriptions, and should all follow the guidelines outlined below. The following sections discuss the objectives and overall scores of PDRI assessments.

The **PDRI–Early review** is a high-level assessment of the project following the Feasibility stage. It is one of the decision criteria for continuing development of the detailed scope. PDRI Section I – Basis of Project Decision, should be well defined (with a low relative PDRI score) at this point. This assessment is typically held for projects at the initial project kickoff meeting, when an engineering firm is brought on board. The PDRI–Early review should focus on the following outcomes:

- aligning the team with project objectives
- ensuring good communication between business/sponsor and project/contractor team
- highlighting stakeholder expectations to facilitate reasonable engineering estimates
- identifying high-priority project deliverables
- helping to eliminate late project surprises; providing opportunities to prevent costly rework, changes, and schedule delays, later in the project life cycle.

Typical PDRI scores at this assessment will fall in the range of 400 to 600.

The **PDRI–Final review** is typically the final assessment of the project, and it comes at the end of front end project planning (at the end of Detailed Scope). The PDRI–Final review should be completed for all projects. At this stage, the project team has identified risk issues and is developing or has put in place mitigation plans. Typical scores for this review are 150 to 400, with a target of 300 or below.

In addition to these two PDRI reviews, the tool can be used at other points. For instance, it can be used early in the Feasibility stage as a checklist to help organize work effort. It can also be conducted during the Design, Procurement, and Construction stage, to verify the design before moving into construction.

Assessing a PDRI Element

To assess an element, first refer to the score sheet in Appendix A or B, and then read its corresponding description in Appendix C. Some elements contain lists of items to be considered as their definition levels are evaluated. These lists may be used as checklists. Additional issues may be applicable for renovations, shutdowns, and turnaround projects, or for projects that are part of repetitive programs. All elements have six pre-assigned scores, one for each of the six possible definition levels.

As noted earlier, the PDRI consists of three main sections that break down into eight categories, and these categories further break down into 40 elements. The elements are individually described in Appendix C: Element Descriptions. Elements should be rated numerically from 0 to 5. The scores range from 0 – Not Applicable, to 1 – Complete Definition, to 5 – Incomplete or Poor Definition, as indicated in the legend at the bottom of each score sheet. Elements that have been defined as well as possible should receive a 1, 2, 3, 4, or 5 rating, depending on the team's assessment of each. Those elements deemed not applicable for the project under consideration should receive a 0, so as not to affect the final score.

Users should choose only one definition level (0, 1, 2, 3, 4, or 5) for an element, based on their perception of how well it has been addressed. The suggested method for making this determination is through open discussion among the project team members. In considering the completeness of the PDRI elements, the project team should consider the desired outcome alongside the optimal cost and schedule performance. The team must have an adequate understanding of the element issues and the work required to achieve complete definition. On certain issues, it is important to defer to the most knowledgeable team members (for example, piping issues should be deferred to the process engineer), while at the same time respecting the concerns of other team members. As the discussion unfolds, it is critical to capture action items or “gaps.” Appendix G provides an example of an action item (gap) list.

Figure 3.2 outlines a method of assessing an element's level of definition at a given point in time. For elements that are completely defined, no further work is needed during FEP. For elements with minor deficiencies, no further work is needed during the FEP phase, and the issue will not affect cost and schedule

performance; however, the project team will need to track and address the minor issues identified as the project proceeds into the design phase. For elements that are assessed as having some problems or major deficiencies, or that are incomplete, the team will have to perform further mitigation during FEP before the end of the detailed scope phase.

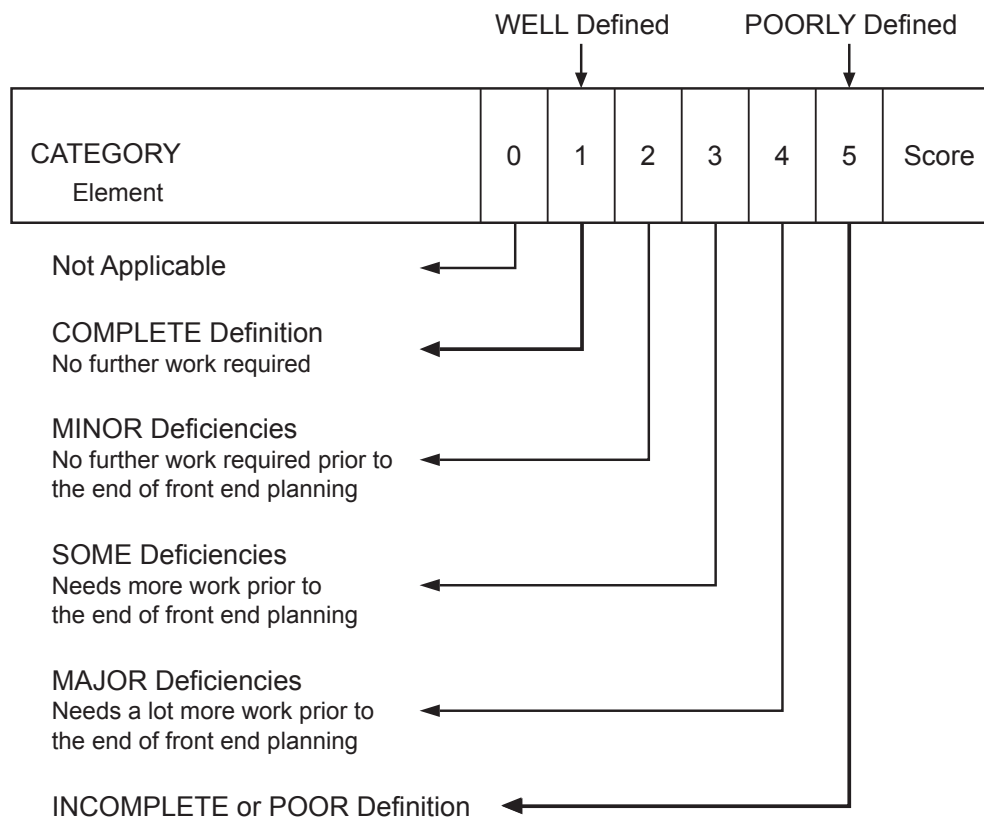


Figure 3.2. PDRI Definition Levels versus Further Work Required during Front End Planning

All element scores within a category should be added together to produce a total score for that category. Then, the scores for all categories within a section should be summed to arrive at a section score. Finally, the three section scores should be combined to determine the total PDRI score. The PDRI–Small Infrastructure Projects spreadsheet performs these calculations automatically. (Note that RT-314a established the levels of definition with a focus on developing the overall project scope of work, so that a project has a higher probability of achieving an acceptable cost or schedule outcome.)

The relative level of definition of a PDRI element is also tied to its importance to the project at hand. The flexibility of PDRI allows the project team some leeway in assessing individual element definitions. For instance, if the issues missing from the scope documentation of a particular PDRI element are integral to project success (and reduction of risk), the team might rate the issues at a definition level 3, 4, or even 5. On a different project, the absence of definition of these same issues within a PDRI element might not be of concern, and the team could decide to rate it at level 2. Maximizing the tool's flexibility and, thus, its consistent effectiveness, requires users to be alert to the unique priorities of each project.

Following is an example of how a member of a FEP team that is responsible for developing the scope definition package for a small infrastructure project would proceed through the steps of a PDRI assessment. The project that will be used is a city water pipe replacement project for an aging and outdated water distribution service that feeds businesses, residents, and an industrial plant within an urban setting. Since the project scope entails five blocks of linear piping and includes both Renovation & Revamp, it is the perfect candidate for the PDRI–Small Infrastructure Projects tool.

The FEP team's responsibility is to evaluate how well project alignment has been defined to date. This information is covered in Category E of the PDRI, as shown below, and consists of three elements:

CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
E. LOCATION AND GEOMETRY							
E1. Schematic Layouts							
E2. Alignment and Cross-section							
E3. Control of Access							

Definition Levels

0 = Not Applicable

2 = Minor Deficiencies

4 = Major Deficiencies

1 = Complete Definition

3 = Some Deficiencies

5 = Incomplete or Poor Definition

To fill out Category E, Location and Geometry, follow the steps below:

Step 1: Read the description for each element in Appendix C. Some elements contain lists of items that should be considered when their levels of definition are evaluated. These lists may be used as checklists.

Step 2: Collect all data that you may need to properly evaluate and select the definition level for each element in this category. This may require input from other individuals involved in the scope development effort.

Step 3: Select the definition level for each element as described and shown below:

Element E1: For the city water pipe replacement project, the team prepared a schematic to use for the public hearing. While the team was successful in producing the locations of the water main and branch lines, profiles and plan views, and verifying their rights-of-way, the team realized that it had missed some important features related to the customers. Not all of the existing backflow preventers along the service branch lines had been located, so water pressure might be insufficient to service fire sprinklers to the facilities. The team concluded that more coordination was called for, and hydraulic computations needed to be confirmed.

Definition Level = 4.

Element E2: For this element, the team analyzed pipeline alignment and cross-sections. The design documents only showed “standard details” for pipe trenching and placement, which might not have been sufficient at intersections where other systems, especially new communications ducts, could have been crossing. Therefore, being prompted by the “Crossover grades and profiles” bullet, the team determined that it needed to reach out to the municipality for more city water and wastewater drawings; to the district power company for steam heat, electrical, and other utility drawings; and to the IT providers to locate their communications duct banks. Since this was a pressure pipe project, the grade adjustments to work around these potential challenges would not have affected the overall design. Therefore, the team deemed that these could be overcome with more coordination and construction details.

Definition Level = 3.

Element E3: Prompted by the “Growth capacity” bullet, the team recognized that taps and blind flanges at the vacant lots along the water main’s path were not designed in. Knowing that these lots could be developed someday, the team identified a great opportunity to save money and reduce redundant effort by installing those accessories during the present project. Also, the team noted that operations and maintenance vehicles would continually have to close traffic lanes to service the water mains for the tie-ins after work was complete; therefore, it moved the mains out of the traffic lanes, so they could be serviced more easily. However, in moving the mains to the side, the team also created a challenge for maintenance vehicles to access those areas, which are commonly pedestrian ways. Therefore, in solving one design deficiency, the team created another design challenge. However, since the project was at its early stages, all solutions could be considered and all problems resolved.

Definition Level = 2.

CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
E. LOCATION AND GEOMETRY							
E1. Schematic Layouts					X		
E2. Alignment and Cross-section				X			
E3. Control of Access			X				

Definition Levels

0 = Not Applicable

2 = Minor Deficiencies

4 = Major Deficiencies

1 = Complete Definition

3 = Some Deficiencies

5 = Incomplete or Poor Definition

Action items and comments should be captured as discussion progresses, for later reference (in Step 6). This list is referred to as a “gap” list, since it identifies the issues that need to be addressed to move the project forward, and identifies gaps in the planning activities.

Step 4: For each element, enter the score that corresponds to its level of definition in the “Score” column. If the team feels that any or all of the elements in a category **are not applicable to this project, they should be given a definition level of “0” and zeroed out.** The weighted score sheet is given below, with elements circled for the chosen definition levels in this example.

Step 5: Sum the element scores to obtain a category score. Repeat this process for each element in the PDRI. In this example, the category has a total score of 41. Add up category scores to obtain section scores.

CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
E. LOCATION AND GEOMETRY							
E1. Schematic Layouts		1	8	15	22	29	22
E2. Alignment and Cross-section		2	8	14	20	26	14
E3. Control of Access		1	5	9	13	17	5
CATEGORY E TOTAL							41

Definition Levels

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

Add up all the section scores to obtain a total PDRI score. Completed PDRI score sheets for process-related and non-process-related Infrastructure projects are included in Appendix D for reference.

Step 6: Take Action. In this example, Category E has a total score of 41 (out of a maximum total of 72 points) and needs more work, particularly for elements E1 and E2. Use the gap list to identify issues that need additional attention. The gap list provided below is an excerpt from the PDRI–Small Infrastructure Projects spreadsheet.

PDRI E – Low Definition Items							
Section	Element	Element Description	Level	Comments	Additional Comments	Assigned to	Target Date
II	E1	Schematic Layouts	4	The team concludes that more coordination and hydraulic computations need to be confirmed.		Vicki Lee	5/2/20XX
II	E2	Alignment and Cross-section	3	More construction and coordination details required.		Judy Simchek	4/9/20XX

The project team leader should evaluate the gap list and then direct action towards those elements that are of a critical nature, as indicated by element scores and levels of definition.

In the PDRI–Small Infrastructure Projects spreadsheet, the default setting for the matrix is to output any elements with a definition level greater than 3 (i.e., 4 or 5). Depending on how mature the project is, the project team may elect to adjust the focal area. If the project has just started, many elements may be less defined. If this is the case, narrowing the focus to elements that were rated greater than 4 (i.e., only level 5 definitions) may help concentrate efforts for the greatest impact in the shortest time. A key issue with this approach is that some elements with lower ratings (i.e., with higher definitions) may still benefit from earlier review for two reasons:

1. More-defined elements that are difficult to reconcile take more time; later action on them may come too late.
2. Since each element's weighting corresponds to its relative importance in project planning and execution, one more-defined element may have a larger impact on the overall project rating than any of the least-defined elements.

For examples of such important weighted elements, see Elements A1. Need and Purpose Statement and C6. Value Analysis in Appendix B.

Philosophy of Use

Ideally, the project team will conduct a PDRI evaluation at two points in the project. Experience has shown that the scoring process works best in a team environment, with a neutral facilitator who understands the PDRI process. On a small project, the assessment team may be composed of only a few key stakeholders brought together. The facilitator manages the process, provides objective feedback to the team, and controls the pace of the assessment. (See Appendix F for details on facilitation.) If this team-facilitator arrangement is not possible, an alternative approach is to have key individuals evaluate the project separately, then evaluate it together, and ultimately agree on a final evaluation. Even individual use of the PDRI provides an effective method for project evaluation. For example, civil engineers may utilize applicable portions of the PDRI to look at horizontal and vertical alignment issues alone, to stimulate discussion on areas of interest and/or to evaluate potential risk areas. These types of assessments may be useful to help determine areas involving long-lead items or extended time frames.