

Value of CII Best Practices Report



Construction Industry Institute

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Introduction and Background

Motivation

Since its establishment in 1983, CII has supported research on capital project delivery, conducted by teams composed of its academic and industry members, working together to support CII's mission:

[T]o inspire owners, contractors/suppliers, and academia to collaborate through research to produce best practices and implementation resources, creating innovative solutions that tangibly improve safety and capital efficiency.¹

CII then validates the results of its research, identifying some of the published topics as best practices, which it defines as processes or methods that, “when executed effectively, [lead] to enhanced project performance.”² This report supports CII's mission by assessing and promoting the dissemination of these CII Best Practices. It is important to note that this report aims to reinforce the evidence that supports the dissemination of best practices, complementing and updating evidence already available in CII publications.

Best Practice Data

Since the previous edition of this report, CII has launched the 10-10 Program, a Performance Assessment effort designed to assess, in each project phase, the organizational issues that affect project performance, as well as the outcomes of each project phase. The data submitted to the 10-10 Program serve as the basis for the analyses included in this report and allow the assessment of 10 of the current 17 CII Best Practices, as shown in Figure 1.

¹ Construction Industry Institute (2015). *2015 Strategic Plan*. STR-2015.

² Construction Industry Institute (2016). “CII Best Practices” (Website).

CII Best Practice	Front End Planning	Engineering	Procurement	Construction	Startup
Front End Planning	✓				
Constructability	✓	✓			
Project Risk Assessment	✓		✓		
Planning for Startup	✓	✓	✓	✓	
Alignment	✓	✓	✓	✓	✓
Team Building	✓	✓	✓	✓	✓
Change Management		✓	✓	✓	
Quality Management		✓	✓	✓	
Materials Management		✓	✓	✓	
Zero Accidents Techniques				✓	✓

Figure 1. CII Best Practices by 10-10 Phase

CII determined which practices fell within the scope of this report by considering both the availability of questions that address the practices in the 10-10 questionnaires, and the relevance of these practices to each project phase (e.g., the implementation of Constructability will be critical during the planning and design phases, but less so during actual construction). Figure 2 shows the definitions of the start and end points of the five phases included in the 10-10 Program.

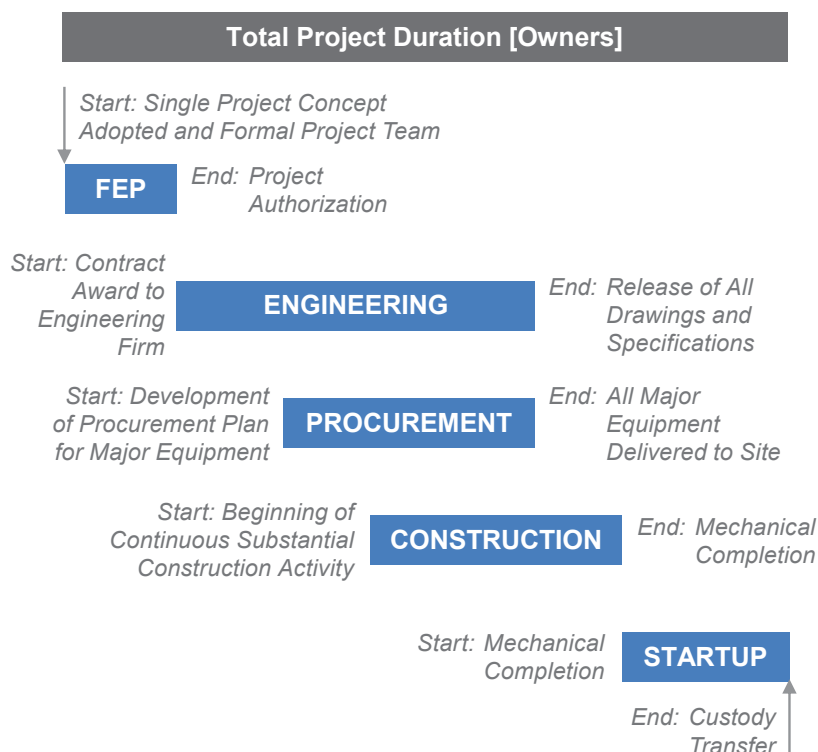


Figure 2. Definitions for the Start and End Points of the Five 10-10 Phases

Using the 10-10 data to assess the implementation and impacts of CII Best Practices provides the following benefits:

- the assessment of impacts by project phase, possibly providing insights into the optimal timing of practice implementation and each practice's specific benefits in different phases
- the creation of a contemporary dataset that can be updated systematically, allowing continual updates to this report
- the assessment of practices based on feedback from multiple team members.

As of November 2015, the 10-10 database included 742 project-phases submitted by 81 CII member organizations. Figure 3 shows how these projects were distributed across three industry sectors and five phases. Figure 4 shows the distribution of projects by phase and organization type (i.e., owner or contractor). Of these projects, 597 (79%) were located in the U.S. or Canada.

The 742 project-phases provided data for about 443 unique projects, and 31% of these projects submitted two or more phases, but only 36 (4.8%) of the projects reported all five phases. The assessment of each practice's impacts across project phases and on overall project outcomes is limited, owing to the relatively small number of projects that submitted multiple phases.

Figure 5 shows the average cost and duration of the projects submitted to each phase. In accordance with CII's definitions, the FEP and Startup phases do not overlap, while the Engineering, Procurement, and Construction data may overlap.

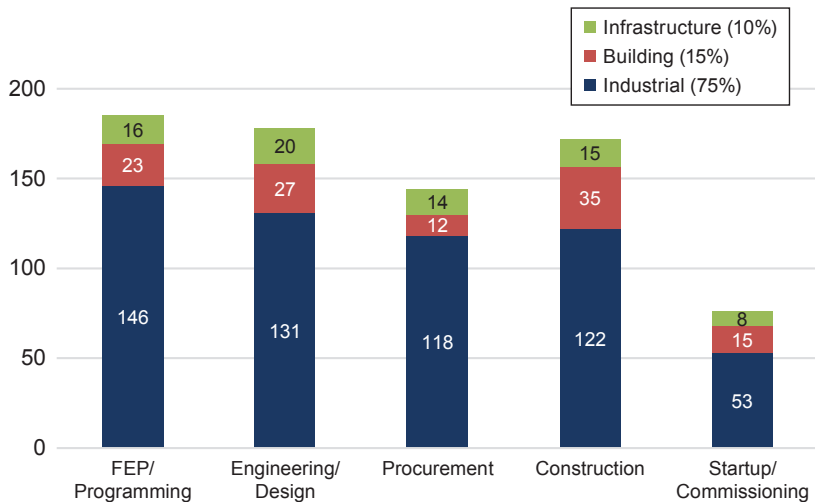


Figure 3. Count of 10-10 Project-phases by Phase and Sector

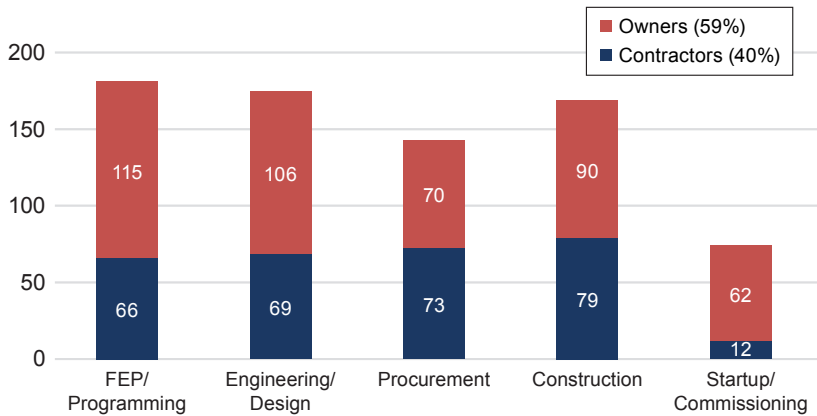


Figure 4. Count of 10-10 Project-phases by Respondent Type and Phase

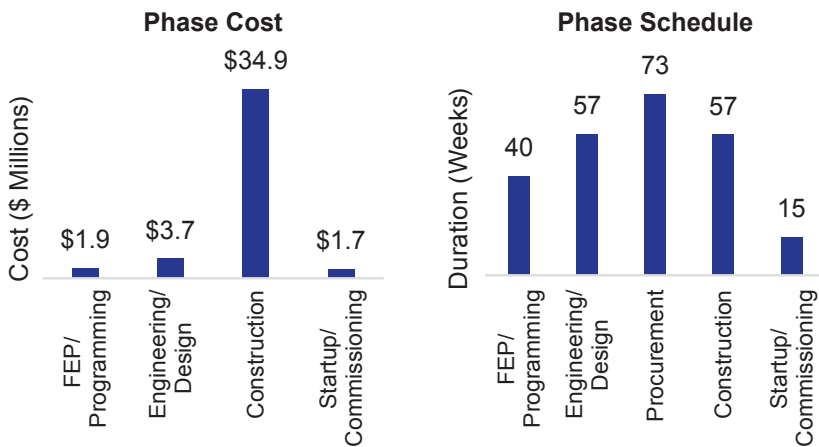


Figure 5. Average Phase Cost and Duration of 10-10 Project-phases

The 10-10 data are collected through 15 questionnaires, one for each sector and phase. Each questionnaire consists of three sections. The project coordinator is the person in charge of managing the project in CII's 10-10 system, by completing both the General Information and Output sections. The General Information section collects project information, including location, type, nature, and currency. The Output section collects project output data that may include phase cost and schedule, estimated/actual project cost and duration, project safety outcomes, and the production capacity of the plant being built.

The Output section's data allow the calculation of relative and absolute metrics. CII has collected relative metrics (e.g., phase cost growth) since the beginning of the CII Benchmarking Program. Absolute metrics have been added during the 10-10 Program, to generate metrics that are more sector- and project type-specific, and that can add value to business units' decision-making. The 10-10 absolute metrics are mainly based on cost per unit of production capacity (e.g., Dollars per MW for energy/generating projects). While relative metrics can be compared across projects of different types, absolute metrics only allow the comparison of projects with the same output type and similar scope. This creates the need for a large number of projects to be submitted for each project type and of the same capacity as a precondition to the evaluation of benchmarks based on absolute metrics.

Figure 6 shows the number of project-phases by project type for each of the three sectors included in the 10-10 Program. For each sector, metrics with fewer than eight projects were aggregated into an "other" category. Note that this count includes multiple phases.

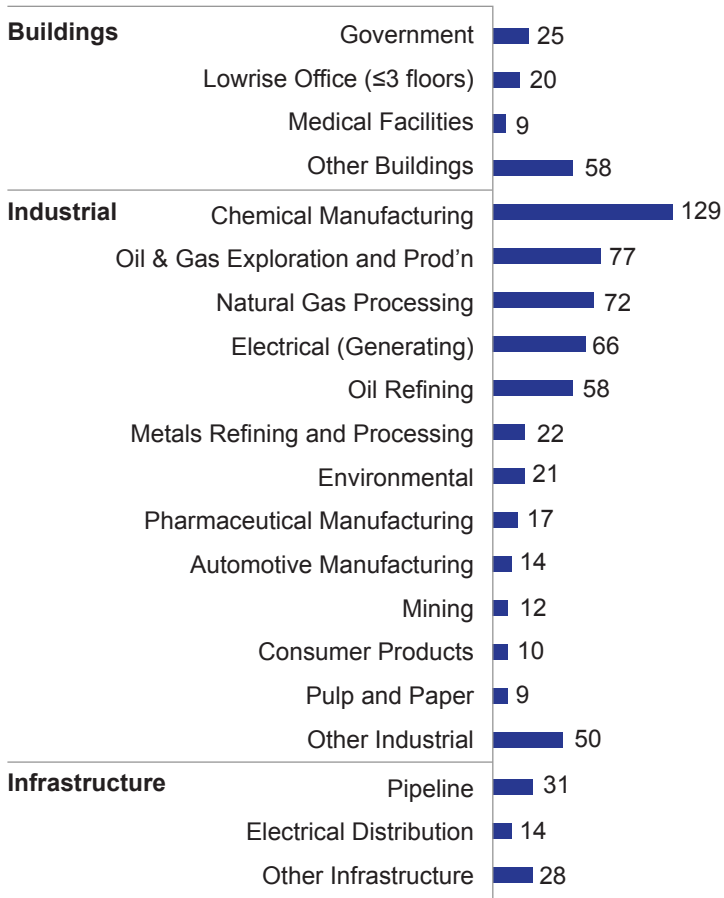


Figure 6. Count of 10-10 Projects by Project Sector and Type

The remaining 10-10 section, called the Input section, captures the performance of the project organization mainly through statement-based questions. The section's questionnaire was sent to all members of the project management team. Each member received a link to a separate survey, which was submitted anonymously to CII. By capturing feedback from multiple project team members, the Input section captured conflicting and complementary perspectives. As of November 2015, there were an average of 1.8 responses per project-phase. However, 73% of the projects had only one response, and CII's Performance Assessment Committee emphasized the importance of capturing multiple responses, in order to increase the system's capability to more accurately assess the project organization.

Using 10-10 Questions to Assess Practices

Most 10-10 questions in the Input section relate to the use of CII practices. The responses to these questions provide an assessment of the implementation of practices according to the team member's viewpoint. Therefore, the responses to questions in the Input section were used to calculate the Best Practice score, a proxy for the level of implementation of practices. For example, the Zero Accidents Techniques practice is measured by responses to the following questions included in the construction phase questionnaire:

- Overall how many workers per safety professional were typically (i.e., in terms of the average workforce) on site?
- This project used the following methods: substance abuse testing (multiple-choice question).
- Were accidents including near misses formally investigated? (Yes/No)
- Was safety performance a criterion for contractor and subcontractor selection? (Yes/No)
- Project safety procedures were well defined and strictly followed (five-level Likert scale).
- Were safety toolbox meetings held daily? (Yes/No)

- Formal (classroom) safety training was attended (five-level Likert scale).
- Was there a written, Startup-specific safety plan for this project? (Yes/No)
- The project employed regular safety audits or observations (five-level Likert scale).

The average of all questions associated with a given practice is designated the practice score. (See Appendix A for a list of the questions associated with each practice.) When interpreting the score of a practice, the reader should consider that it reflects the perceptions of team members, as captured through a number of questions related to that practice. This assessment becomes more robust as more team members report and more questions are thus available to address a given practice.

Report Goals

The goals of this report were to assess the use of CII Best Practices as shown by the practices' scores and to measure the impacts of these practices on phase outcomes. When assessing the scores of CII Best Practices among CII members, the analyses aimed to identify which practices were well or poorly implemented in each phase. This approach helped to identify which practices CII members, as a whole, were prioritizing across the five project phases, and how the focus on each practice varied across the project phases.

The analyses of practices' impacts on phase outcomes aimed to find which practices had statistically significant associations with phase outcomes. By identifying such impacts, the report allowed the identification of which practices were likely to provide benefits in terms of phase outcomes and which practices provided positive benefits but had, on average, relatively low scores across CII membership. Improving implementation of the low-scoring practices could generate benefits for the CII membership as a whole.

Limitations

When reading the analyses reported in the following sections, the reader should consider the following:

- Not all CII practices are included in this report, owing to the fact that the 10-10 Program includes a limited number of questions and, therefore, can only assess a limited number of practices.
- The analyses are **based on project phase outcomes**. This results from the limited number of projects that include multiple phases. The main consequence of this limitation is the inability to measure the impacts of each practice on subsequent phases or at the project level.
- Only the Industrial sector is addressed, since it is the only sector with sufficient data to allow more robust analyses.
- The impact of practices on absolute output metrics was not assessed, due to the limited amount of data for projects sharing the same type and capacity unit.
- Not all aspects of a given practice may have been assessed, due to the limited number of questions available to evaluate practices.
- Results reflect the performance of the projects submitted by CII members, and do not reflect the entire construction industry.
- Results are not comparable to the previous editions of this report, since both the data sources and the adopted methodologies are different.

Report Organization

This report is composed of this introduction and three other chapters. Chapter 2 describes the overall methodology of the analyses. Chapter 3 describes the results and findings, both in terms of overall results and specifically for each phase. Chapter 4 summarizes the findings and conclusions of the report, including the future work that would be required to extend the present analyses.

2

Approach

Figure 7 shows the overall procedure adopted for the analyses reported in the next section. Each of the four main steps is discussed in the following paragraphs.



Figure 7. Data Analysis Approach

Data Collection

The 10-10 data have been collected since 2014, mainly through two data collection campaigns. During these campaigns, each company represented in the CII Board of Advisors was asked to submit 10 project-phases. The first campaign jump-started the 10-10 database with nearly 550 project-phases submitted via an off-the-shelf survey system. Since CII launched a custom 10-10 system in August 2014, a second data submission campaign further expanded the dataset. (Looking beyond these campaigns, projects can be created and submitted at any time.)

The submission process involves the participation of a project coordinator, who works on the member side. The project coordinator enters project data and coordinates the distribution of surveys to the project management team via the 10-10 system. Once projects have been completely captured, they are submitted to CII, where a CII account manager validates the data and works with the submitting project coordinator to make any necessary corrections.

Data Preparation

The second step in Figure 7 consists of the calculation of scores for individual CII Best Practices by phase. This step starts by identifying which questions are associated with each practice. (These questions are included in the 10-10 Input section, which is distributed to all project team members. See Appendix A for a complete list of the questions assigned to each CII Best Practice.) For every project, a score is calculated for each practice by averaging the scores for the questions associated with that practice. Any outliers in practice scores are identified and removed from the dataset.

Assessing Practice Scores

In step three, the practices' scores are plotted, in order to assess their relative placement within a phase. Additionally, owner and contractor scores are compared, to identify any significant differences in their scores during any given phase. One practice's scores across different phases can be compared side by side to assess that practice's relative performance across multiple phases. The reader should keep in mind that each practice is scored between 0 and 5, based on the responses that project management teams provided in the 10-10 survey. Each practice score reflects an average of all questions associated with that practice. To return to the explanation of 10-10 scoring provided near the end of Chapter 1, a 0 score for Zero Accidents Techniques (ZAT) would indicate that all team members in all projects submitted to 10-10 provided the most negative response to all questions associated with ZAT, while a score of 5 would mean that all team members of all projects submitted to the database provided the most positive response to all questions associated with ZAT.