



Construction Industry Institute®

Assessment of Effective Front End Planning Processes

Construction Industry Institute

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Assessment of Effective Front End Planning Processes

**Prepared by
Construction Industry Institute
Research Team 268, Integration of CII Front End Planning Products**

**Research Summary 268-1a
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Executive Summary

Since its founding in 1983, CII has been a driving force for process improvement in the construction industry. By 1991, CII had begun funding a significant research thread focused on front end planning (FEP). Since then, this ongoing effort has described and modeled the process in detail, has led to the development of a number of tools that project teams can use to improve their FEP practice, and has proven that FEP is critical to project success.

FEP is the process of developing strategic information to identify risks and determine the resources needed to mitigate those risks. The purpose of the FEP process is to create an environment very early in the project life cycle in which project teams can effectively analyze and address potential projects' risks. The desired result is to be able to successfully manage a project through detailed design and construction. With effective FEP, risks can be mitigated through the development of detailed scope definition and the subsequent efficient use of project resources.

This research summary describes the FEP research thread pursued by CII over the past two decades. Specifically, it details the FEP tools developed for early project planning, and the data gathered to analyze the tools used within the CII community. The CII FEP research effort can be summarized as follows:

- Since 1991, nine CII teams have addressed front end planning issues and developed effective management tools focused on the process.
- CII front end planning research teams have used a variety of research methods over the years to engage more than 800 industry professionals from 279 organizations, and studied 1,081 projects worth \$96.5 billion. This remarkable outreach illustrates the rigor and breadth of the effort.

- CII research has shown conclusively that effective front end planning leads to added project value. Assessments of projects with effective front end planning have shown cost differences of six to 25 percent, and schedule differences of six to 39 percent.

This research summary also presents data from a 2011 survey focused on the current state of FEP tool usage and implementation within CII. These data show the FEP tools that are commonly used, how they are used, and the common barriers that inhibit successful FEP implementation. In total, 59 completed surveys were received, with over 75 percent of respondents reporting the use of at least one CII tool in their front end planning processes.

The findings from twelve in-depth case studies are also shared in this summary. The research team used the case study interviews to gather detailed responses from organizations on the implementation of their FEP processes. The data show that CII organizations continue to find value in CII FEP tools, due to increased usage of them. The interviews also indicate that organizations must have strong management commitment, measured succession planning, and a standardized planning process to increase the likelihood of successful FEP strategies.

Introduction

In 1991, the Construction Industry Institute (CII) began a research thread focused on front end planning (FEP). The nine studies making up this effort in the intervening years have yielded tremendous insights into the process and a deep understanding of its profound impacts on project success. This new knowledge has generated a number of FEP tools that can enhance an organization's effectiveness.

FEP is the process of developing strategic information to identify risks and determine the resources needed to mitigate those risks (CII 1994). The FEP process has a number of aliases, such as pre-project planning, front end loading, advance planning, programming, and schematic design, among others. The purpose of the FEP process is to create an environment very early in the project life cycle in which project teams can effectively analyze and address potential project risks, while documenting the scope in a manner that leads to design and construction efficiency. With effective FEP, risks can be mitigated through detailed scope definition and subsequent efficient project resource use.

Typical activities and products of front end planning may include the following:

- options analysis
- scope definition and boundary identification
- life cycle cost analysis
- cost and schedule estimates
- site investigation
- environmental analysis
- process design basis
- initial equipment design
- space planning, including room data sheets and stacking diagrams

- site layout
- project execution approach, including project control plan
- procurement plan
- architectural renderings
- appropriation submittal package.

Figure 1 illustrates the three sub-phases of front end planning in the context of the typical life cycle of a project. The diamonds represent key decision points, or “phase gates,” that must be addressed prior to moving on to subsequent phases.

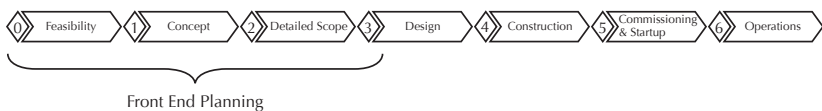


Figure 1. Front End Planning and Project Life Cycle Diagram

Past FEP research has helped construction industry organizations identify risks associated with projects. The research has led to the development of various tools that are used by numerous organizations, both domestically and internationally. These FEP tools include the following:

1. Front End Planning Toolkit (CII 2013a)
2. Project Definition Rating Index (PDRI):
 - Industrial (CII 1996a; CII 1996b; CII 2013b)
 - Building (CII 1999a; CII 1999b; CII 2013c)
 - Infrastructure (CII 2010; CII 2011; CII 2013d)
3. Alignment Thermometer (CII 1996b; CII 1997; CII 2013e)
4. Shutdown/Turnaround Alignment Review (STAR) (CII 2008a; CII 2008b; CII 2009a; CII 2013f)
5. Project Condition Investigation (PCI) cards (CII 2008a; CII 2008b; CII 2009a; CII 2013f)

6. International Project Risk Assessment (IPRA) tool (CII 2003a; CII 2004; CII 2013g)
7. Construction Input Assessment Tool (CIAT) (CII 2008c; CII 2009b, CII 2013h).

These resources have proven to help organizations in the various stages of front end planning, and they are particularly useful for implementing strong front end planning processes. These tools help project teams develop a clear scope definition and proper team alignment, as well as promote project risk identification and mitigation.

At the beginning of 2011, CII supported the second phase of Research Team (RT) 268, titled “Integration of Front End Planning Products.” (RT 268 had worked from 2008 until 2010 to develop the PDRI for Infrastructure.) The scope of this second-phase effort was to update the *Front End Planning Toolkit* (Implementation Resource (IR) 213-2, Version 4.0) and develop an overarching front end planning publication, titled *Adding Value Through Front End Planning* (Special Publication (SP) 268-3). The purpose of SP 268-3 was to inventory and summarize the benefits of all of the FEP research and tools that CII has developed since 1991. As part of the effort to develop and update these documents, CII reconstituted RT 268 and commissioned the team to perform a course of research that is outlined in this document.

The major tasks of this phase of the research investigation were to summarize all previous CII FEP research efforts and set the stage for more extensive adoption of FEP management practices by CII member organizations and the construction industry.

The first research objective of this second phase of RT 268 was to perform a thorough literature review to succinctly summarize the last 21 years of CII front end planning research. The second objective was to gather additional data about the CII FEP tool usage and compare the data to those collected in a mirror study conducted in 2004. The last objective

involved conducting in-depth interviews with organizations identified in the initial survey. The research team used these structured interviews to gain more detailed knowledge of each organization's implementation process; it specifically sought to know how the tools are implemented into the overall FEP strategy for CII members and the challenges users face during the process.

Chapter 2 of this document provides an overview of all past research concerning front end planning conducted by CII since its inception. Chapter 3 presents findings from the survey focused on CII members' use of CII FEP tools. Chapter 4 gives results from detailed interviews concerning key implementation issues for front end planning. Chapter 5 summarizes the findings of more than twenty years of work in this area.

Overview of Past CII FEP Research

Front end planning is a CII Best Practice. A CII Best Practice is a process or method that, when executed effectively, leads to enhanced project performance (CII 2011). The many years of research on the topic of front end planning are testament to its perceived importance to the construction industry and the CII membership.

Prior to 1991, three CII task forces (TFs) addressed front end planning issues as secondary components of their research charters. The three teams were the Cost/Schedule Controls Task Force (TF 6), Project Organization Task Force (TF 12) and the Constructability Task Force (TF 3). Important findings of the associated FEP research were that well-defined project scopes, continuous project risk management, clear project objective-setting, and effective teams increased the likelihood of project success. None of these efforts was specifically focused on the front end planning process, but each studied various parts of the process as part of its deliberations. These studies are outlined in various CII publications (CII 1986a; CII 1986b; CII 1988; CII 1991; CII 2003b).

Prior to 1991, three CII research task forces addressed front end planning issues as secondary components of their research efforts.

Systematic front end planning research at CII began in 1991, with the work of TF 39; the second phase of the RT 268 study was the Institute's last FEP research effort, having closed out in 2012. Over this 21-year period, CII front end planning research has involved nine teams and investigated the process in three major sectors of the construction industry: industrial, building, and infrastructure. (Note that the work of Project Team (PT) 181, International Project Risk Research Team, is included, since much of its investigation was focused on front end planning.) More than 180 team members from various construction,

owner, and academic organizations have taken part in this effort. Table 1 lists the front end planning research investigations since 1991, along with the number of research team participants and the number of identified industry organizations that participated in these investigations. (CII 1994; CII 1996b; CII 1999a; CII 2003b; CII 2006a; CII 2007; CII 2008c; CII 2011; CII 2013f)

Table 1. CII Front End Planning Research since 1991

Research Team	Number of Team Participants	Number of Participating Organizations
TF 39, Pre-Project Planning Task Force	18	22
RT 113, Front End Planning Research Team	18	63
RT 155, PDRI for Building Projects Project Team	18	41
PT 181, International Project Risk Research Team	12	63
RT 213, Support for Pre-Project Planning Research Team	24	67
RT 221, Information Flow During Front End Planning	15	Not available
RT 241, Construction Input During Front End Planning	15	27
RT 242, Renovation and Revamp During Front End Planning Research Team	24	77
RT 268, Project Definition Rating Index for Infrastructure Research Team	20	91
Total	182	Organizations overlap; therefore, no total.

Since 1991, nine CII teams have addressed front end planning issues and developed effective management tools focused on the process.

Organizational Participants

At least 279 organizations participated in the research processes of these nine research efforts, through project data submission, surveys, interviews, workshops, or some combination of these activities. The data were collected from CII members and non-CII organizations alike. Appendix A provides a list of these participating organizations; they include most of the current CII member organizations and a large number of other organizations. Taken together, these participants make up an impressive body of industry leaders that reflects the breadth of the investigations.

Projects Studied

The number of projects evaluated during the research on front end planning is substantial. Table 2 lists the number of projects studied, along with their dollar value. The analysis has focused on a total of 1,081 projects from countries on six continents. The total value of the projects analyzed is approximately \$96.5 billion.

Table 2. Projects Studied and Dollar Value

Team Number	Number of Projects Studied	Value of Projects Studied
TF 39	62	\$3.4 Billion
RT 113	43	\$3.6 Billion
RT 155	45	\$1.3 Billion
PT 181	66	\$27.1 Billion
RT 213	692	\$36.5 Billion
RT 221	51	\$2.9 Billion
RT 241	13	\$5.2 Billion
RT 242	83	\$8.3 Billion
RT 268	26	\$8.2 Billion
Totals	1,081	\$96.5 Billion

In the course of these studies, the teams conducted 247 structured interviews and 265 surveys. Note that each of these interviews or surveys involved interaction with at least one industry professional. In addition, the FEP researchers used charrettes in their investigations, to help with data collection. A research charrette is an organized workshop that uses various data collection methods. This approach has the advantage of bringing experts together for quick data gathering. CII front end planning researchers have conducted 27 successful charrettes since the Project Definition Rating Index for Industrial Projects research investigation; all told, 365 industry experts have participated in CII FEP research charrettes. (For more information on the research methods and data collection effort, see CII Research Report 268-12, *Data Analysis on the Implementation of Successful Front End Planning Processes*.)

CII FEP research projects have engaged over 800 industry professionals from 279 organizations, with a variety of research methods. This significant outreach illustrates the rigor and breadth of the effort.

FEP Research Project Performance

The result of the CII FEP research thread is an understanding of the relationship of good front end planning practices with cost and schedule outcomes, and with change orders. Table 3 summarizes the findings of five different research investigations on the performance of sample projects. The table makes a simple comparison of projects based on the level of project scope definition (i.e., “More Defined” or “Less Defined”) and provides the three performance metrics of cost, schedule, and absolute value of change orders. The cost and schedule columns reflect any differences between actual performance and the estimated performance.

Table 3. Front End Planning Project Performance

Research Team	Sample Size	Average Cost Under (–) or Over {+} Budget		Average Schedule Ahead (–) or Behind (+) Schedule		Change Orders (% of Total Cost)	
		More Defined	Less Defined	More Defined	Less Defined	More Defined	Less Defined
TF 39	53	–4%	+16%	–13%	+26%		
RT 113	128	–4%	+4%	+4%	+10%	7%	8%
RT 155	108	+3%	+9%	+5%	+21%	8%	11%
RT 213	609	–0.9%	+9.2%	+7.5%	+14.7%	7.3%	12.5%
RT 268	22	–2%	+23%	+5%	+29%	3%	10%

For instance, TF 39 studied 53 industrial projects in detail (CII 1994). Projects that were more defined were under budget by four percent and ahead of original schedule by 13 percent. In comparison, projects lacking definition were 16 percent over budget and were behind original schedule by 26 percent. In another example, of the 609 projects studied by RT 213, well-defined projects were 0.9 percent under budget, and within 7.5 percent of the originally planned schedule; they also had change orders equating to 7.3 percent of total costs. Inadequately defined projects were 9.2 percent over budget, 14.7 percent behind schedule, and they had change orders that were 12.5 percent of the total costs (CII 2006b). Much more information is provided in the various research reports cited in the reference section of this summary.

Table 3 makes it evident that projects with well-defined scopes outperform projects without a clear scope definition. Each of these samples focused on different types of projects from different industry sectors. Well-defined projects can perform as well as four percent under budget on average, compared to poorly defined projects that can perform as high as 23 percent over budget. Well-defined projects can realize time-savings of 13 percent, while poorly defined projects can run behind schedule by as much as 29 percent on average. Finally, well-defined projects can have project changes amounting to as little as three percent of project cost, compared to 12.5 percent for poorly defined projects.