

Effective Project Alignment for Construction Success



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Implementation Resource 310-2



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Effective Project Alignment for Construction Success

*Research Team 310, Improving Engineering and Procurement
Alignment in Coordination with Construction
Construction Industry Institute*

*Implementation Resource 310-2
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Introduction

CII chartered Research Team 310, Improving Engineering and Procurement Alignment in Coordination with Construction, to investigate alignment of engineering and procurement for construction success. The research team initially expected to find specific issues/mechanisms/processes that would advance current practice at the engineering-procurement to construction interface. Yet, it soon became clear that, because so much of what happens in the later project phases is set up (or should be set up) during front end planning (FEP), the research also had to address early alignment. **The data indicate that, from FEP through construction, the industry has difficulty accomplishing basic alignment with the common practices.** The team was surprised that its review of project processes uncovered significant issues with the consistent execution of alignment fundamentals. Early findings from the CII 10-10 benchmarking program support this broad and important research finding. Moreover, lack of alignment basics also impedes the adoption of leading practices such as Advanced Work Packaging (AWP) or modularization that improve construction outcomes.

To fulfill the original charter and address this widespread failure at implementing basic practices, the team focused on specific areas that will advance alignment for improved construction success. There are three specific areas as follows:

1. **The research indicated that the industry's neglect of specific FEP practices—particularly in project execution planning (PEP)—limits effective alignment and coordination in the later phases.** RT 310 provides a template for a standard PEP table of contents that broadly includes multiple provisions for alignment; the alignment focus of these recommendations will improve the quality and consistency of project execution planning documents. These include recommendations for PEP that adapt practices like AWP to familiar execution planning documents. In presenting a template for a PEP table of contents that is focused on alignment-related activities for construction success, the team has provided a foundation for successful alignment—from FEP through execution.
2. **The data also showed that project procedures in all phases, from FEP through construction, are lacking both in basic provisions for alignment and in the specifics related to execution processes that align engineering, procurement, and construction.** Because the poor performance of basic procedures blocks successful implementation of more detailed processes, RT 310 chose first to address this more general problem. The Alignment Procedures Checklist highlights the most readily deployable actions the industry can take to close the most typical and important gaps in practice.

3. **The research team also found that the industry lacks robust supplier engagement and that, because CII's previous work on procurement is largely conceptual, there was a need for more practical guidance.** After interviewing 25 suppliers, the team identified the opportunity for increased partnership with suppliers. The team also determined the need for improved clarity of scope and expectations of deliverables during the procurement process. The RT 310 Supplier Engagement Checklist provides a clear path forward for these improvements.

Implementation Resource Sections

RT 310 delivers its recommendations and tools for industry in five sections. These are combined in this document and separated into tabbed sections. This format makes the most pertinent information accessible to the person(s) best able to implement the recommendations. (The five tabbed sections are also available in separate PDF documents, for easier dissemination to project team specialists.) At the same time, the team wanted the documents to be seen as a set, since accomplishing effective alignment is challenging and multifaceted. While improvements in specific problem areas can provide immediate help, systematic review is fundamentally sound for the long term. The RT 310 tools and recommendations add considerations for improved construction outcomes to the existing CII toolkit for alignment.

The first three sections of this implementation resource treat each of the three areas identified by the team as central to advancing alignment for construction success: project execution planning; alignment procedures; and supplier engagement. Two additional sections—one on alignment behaviors and the other on automation—offer a deeper review of alignment. Figure I.1 depicts the five sections, their inter-relationships, and their applicability across the typical project life cycle. The figure shows the typical overlap of phases in modern, fast-tracked projects, with the sections arrayed below the project phases in which they are applicable.

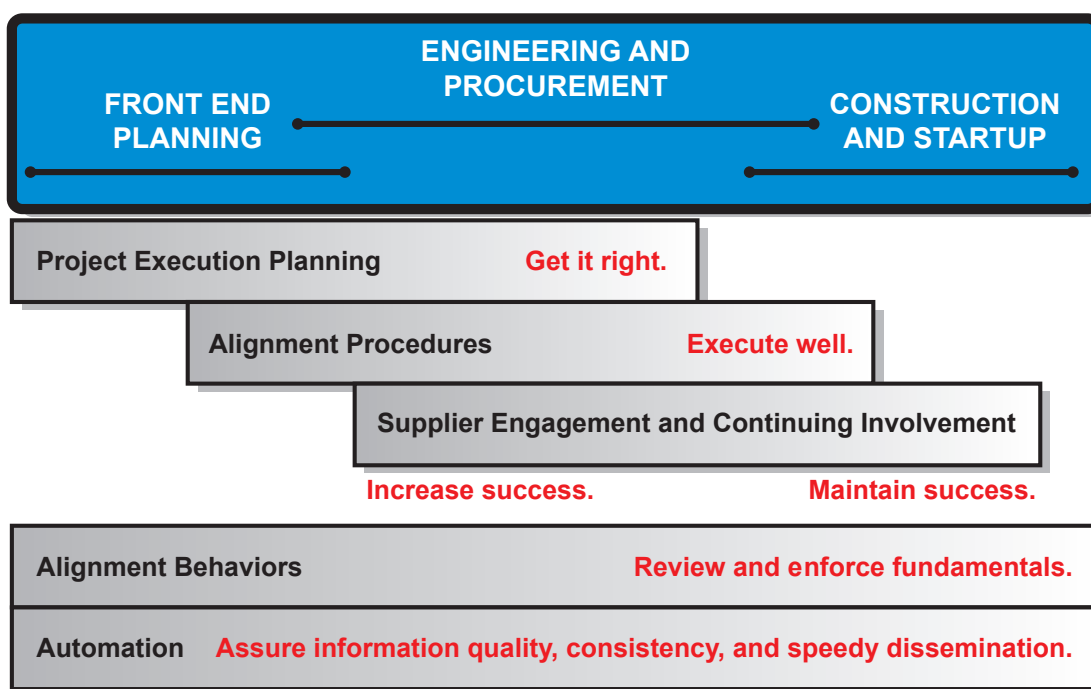


Figure I.1. IR 310-2 Sections with Respect to the Project Life Cycle

Following are brief descriptions of each of these sections:

1. **Project Execution Planning.** The project execution plan (PEP) should be a key document generated during front end planning to guide execution on all projects. The PEP should be a living document that is referenced and updated throughout execution. As such, it is the basis for alignment to guide execution for success in the field. RT 310 found that not only do PEPs lack consistency in their contents, but they also generally omit key provisions for alignment. To bridge this gap, Section 1 introduces the RT 310 Project Execution Planning Checklist for rapid review, as well as a longer PEP template. Among the team's key findings is that many elements supporting alignment are not competently included in PEPs on a regular basis. These alignment-promoting elements range from project scope (most frequently included, but still in need of improvement) to interface management (the most neglected element). This section discusses the PEP checklist and template in detail and provides specific recommendations.
2. **Alignment Procedures.** Many companies are procedure-driven, since procedures convey the corporate standard for execution. RT 310 conducted a detailed review of 20 companies (seven owners and 13 contractors) with respect to their provisions for alignment for construction success and found

a number of areas lacking. These areas include the following: provisions for alignment among personnel such as team building; on-boarding of new members; maintenance of continuity across phases; and more targeted provisions for such concerns as alignment of engineering deliverables. To address these shortcomings, this section introduces the RT 310 Alignment Procedures Checklist, along with a longer survey template for companies seeking a more rigorous review of their alignment procedures. This section also presents a detailed discussion of alignment procedures and offers recommendations.

3. **Supplier Engagement.** CII has long recommended the inclusion of suppliers in project planning and execution. RT 310 sees supplier engagement as an opportunity to improve the chances of construction success, since, on modern projects, suppliers may account for more than 50 percent of the total installed cost. Interviews with 25 suppliers of various sizes and materials (from bulks to fabricators to engineered equipment) indicated that project teams miss significant opportunities to engage earlier and more closely with suppliers, for better planning and scheduling. Suppliers also report that industry organizations could do a better job of making clear requests in their requests for quotation (RFQs) and POs. This section reviews the research findings and introduces the RT 310 Supplier Engagement Checklist, a tool with categories that include supplier identification and involvement, RFQs, and commercial terms.
4. **Alignment Behaviors.** Sections 1–3 above target specific high-impact improvements to project alignment for construction success. While these improvements should be mutually supportive (e.g., procedures should support effective implementation of PEPs), they are not comprehensive remedies. Provisions for alignment must necessarily be broad to address the complexity and number of parties involved in contemporary capital projects. RT 310 began its research with a thorough review of the literature related to alignment as it distilled the experience of the team members. From this effort, the team developed an approach to alignment extending across the project life cycle, with detailed recommendations for alignment behaviors associated with key actions and deliverables in each project phase. These recommendations address people, processes, and tools, and are provided as a resource for individuals, projects, and firms seeking a deeper and more thorough review of alignment for construction success.

5. **Automation.** This section extends the alignment behaviors of the section above to automation capabilities. Because it can assure quick, consistent, and high-quality information, automation is a key enabler of effective alignment. Just as the section on alignment behaviors does, this section offers projects and firms a deeper review of their provisions for alignment than those provided in the first three sections. It is targeted at professionals responsible for implementing automation tools, providing a comprehensive review of automation capabilities at different maturity levels to support recommended alignment behaviors across the project lifecycle. This review will help firms assess their automation capabilities and make reasonable plans for improvement. For example, many of the information behaviors supported by effective information dissemination are related to information maturity levels ranging from simple emails to workflow routing to integrated document management systems.

Collectively, these five sections of IR 310-2 provide tools that extend the CII toolkit for alignment across the project life cycle. These tools will help ensure effective execution, from FEP through engineering and procurement, and into construction and startup.

Project Execution Planning

Overview

A project execution plan (PEP) is a key document that guides alignment from front end planning (FEP) through design, procurement, construction, and startup. Thus, an effective PEP is central to assuring an aligned project with productive and predictable outcomes. The RT 310 research findings indicate that, in developing PEPs, project teams often omit many items crucial to alignment during engineering, procurement, and construction. Moreover, while companies use a variety of PEP formats and standard contents, the industry has no widely accepted standard for the contents of an effective PEP.

In light of the importance of PEPs and the gaps identified in practice, the research team developed the RT 310 Project Execution Planning Checklist and the Project Execution Plan Table of Contents (PEP TOC). The team formulated the checklist as an easy-to-use tool for auditing project execution planning contents. It also provides recommendations for practice. The PEP TOC presents a PEP standard for projects, with a focus on alignment for construction success.

Project Execution Planning Checklist and Summary Recommendations

RT 310 developed the Project Execution Planning Checklist from the 23 PEP elements it identified as critical to alignment but frequently not (competently) included in the plans. (Figure 1.1 presents a portion of the checklist, and Appendix 1.A provides the entire checklist.) Project teams should use the checklist as a quick and straightforward way to assess corporate execution planning templates or existing execution plans for possible gaps and remedial action.

Both the checklist and the PEP TOC include many considerations for improving project team alignment throughout execution. Results from surveys of 200 professionals indicate both the importance of these considerations and their generally infrequent inclusion in practice. Even the most commonly accomplished PEP consideration—scope definition—showed room for improvement. Others, especially those related to interface management, are accomplished less frequently and highlight areas for industry-wide improvement.

A PEP should be a front end planning deliverable and should function as a living document that guides project execution through startup and turnover. A PEP can serve as a basis for more detailed, phase/function-specific execution planning documents,

such as procurement and construction execution plans. As such, the PEP is a key document for ensuring effective alignment. Based on its findings, RT 310 makes the following recommendations:

- Review corporate project execution planning practices using the PEP Checklist as a starting point. As a default, all projects should include the elements highlighted on the checklist. Use the PEP TOC as a richer resource from which to review and enhance practices.
- Small- and medium-sized projects may have less detailed PEPs than larger projects, but all elements should be considered.
- The survey data indicated that many PEP elements related to alignment are not commonly included in existing plans; these data showed that interface management matrices are the least commonly included. Since many areas are also in need of improvement, organizations should review their existing projects for these elements and take any necessary corrective action.
- Ensure that execution plans are living documents and are used and updated throughout the project. RT 310 found that corporate procedures are lacking across the project life cycle. (See Section 2). Ensuring that corporate and project procedures have provisions for alignment will support effective use of the project execution plan.

Project Execution Planning Table of Contents

A project execution plan is a key document that establishes the basis of what is to be built and how the team will accomplish the project. To date, no CII research team has developed and provided a PEP TOC as a standard template of what should be included in a PEP. Thus, RT 310 makes the basic recommendation that all organizations should use its PEP TOC to audit and improve their execution planning practices. To fulfill its research charter to drive alignment for construction project success, the research team developed the PEP TOC to emphasize elements that drive alignment across the project life cycle. (See Appendix 1.A.) This section provides the context and background for the PEP, highlighting the TOC elements most critical to alignment.

The PEP TOC is supported by survey results from over 200 professionals in the capital projects industry. These professionals were surveyed at events sponsored by CII, the Construction Users' Roundtable (CURT), the Construction Industry Roundtable (CIRT), and the Construction Owners Association of Alberta (COAA), and represent a broad range of capital project expertise. The respondents were surveyed about the criticality and frequency of the 23 PEP TOC elements deemed most important by the research team. The survey findings show that the capital projects industry has significant room for improvement in its development and execution of project execution plans with respect to alignment-enhancing actions.

Context

CII research has conclusively shown that effective front end planning adds significant value to projects. An effective project execution plan (PEP) helps coordinate a project's front end planning with its overall execution methodology. While it is generally accepted practice for projects to develop execution plans, the research team's review of existing execution plans at team member companies found a great deal of inconsistency among them. The team also saw a frequent lack of provision for recommended project execution practices such as Advanced Work Packaging (IR 272-2) and Planning for Startup (RS 121-1).

The PEP should be used as an alignment tool to deliver agreed-upon project objectives to the various groups/departments and companies involved in the project. These agreed-upon project objectives should include the following: health, safety, and environmental goals; QA objectives; budget/cost objectives; schedule requirements; maintenance/operability objectives; and startup objectives.

A key function of the project organization must be the effective planning, scheduling, and sequencing of the work, as well as the efficient use of methods, techniques, tools, equipment, and a qualified workforce, all to perform the work as described in the PEP. The desired result is to manage a project successfully through detailed design, construction, and turnover. The intent of the PEP is to outline the practices that are critical to project success while aligning resources to deliver the project. ***A PEP should be a front end planning deliverable and should function as a living document to guide project execution through startup and turnover.*** A PEP can serve as the basis for more detailed, phase- and function-specific execution planning documents, such as procurement and construction execution plans.

Background

One of the first tasks the research team undertook was to review project processes and procedures within team member companies, to establish which (if any) were specifically related to aligning engineering and procurement with construction. The team used key-words such as "alignment," and "team building," to search for any such processes and procedures, and was surprised to find almost none. However, a project execution plan (PEP) was one key document that was common to almost every project. As team members searched through the many PEPs in the libraries of their respective organizations (representing multiple industries), they found no standard format and saw that each was unique to the organization/project using it. Since a PEP is a key project deliverable, the team collectively decided that the PEP could be the most suitable way of formally aligning the stakeholders. The reasoning was that engineering and procurement could not align and support construction unless everyone involved

in these activities clearly understood all aspects of the construction execution plan (and associated schedule) and, then, determined how, when, and in which format their deliverables would be required to support it.

Since sound project management demands that projects have a well-defined PEP, RT 310 developed a reference PEP Table of Contents (TOC) with 14 sections. (Appendix 1.A presents this PEP TOC in full detail.) The 14 sections are as follows:

- | | |
|---|------------------------------|
| 1. Project Summary | 8. Pre-Construction Planning |
| 2. Project Execution Strategy | 9. Project Controls |
| 3. Definitions | 10. Safety (HSE Plan) |
| 4. Project Management | 11. Quality Management Plan |
| 5. Interface Management | 12. Supply Chain Management |
| 6. Engineering | 13. Information Management |
| 7. Operations (Commissioning and Startup) | 14. Accounting and Finance. |

The team further compiled a list of items deemed most critical to alignment within the PEP TOC. Each of the 14 sections of the PEP TOC has elements that are important for a complete and thorough PEP; however the elements most important to alignment are highlighted in red text. Each of these highlighted elements is discussed in depth below, to help stakeholders who use the template better understand their project expectations and goals. More importantly, it will help them understand their roles in ensuring that engineering and procurement are aligned with construction, commencing early in the front end planning phase of a project. Figure 1.1 presents a section of the PEP TOC, showing a few of these highlighted alignment-related items.

Project Execution Plan (Recommended Table of Contents)	
Legend	Elements Critical to Alignment
I. Project Summary	
	A. Introduction and Overview
	B. Project Premises/Basis of Design
	C. Scope
	1. Illustration – Site Map
	2. Illustration – Plot Plan
	3. Milestone Schedule
	4. Cost Summary
II. Project Execution Strategy	
	A. Advanced Work Packaging (AWP)
	B. Work Face Planning (WFP) Strategy
	C. Prequalification Process
	D. Path of Construction
	E. Preassembly and Modularization
	F. Contract Strategy/Requirements

Figure 1.1. Section of PEP TOC

Interpreting the Project Execution Planning Table of Contents

Although it is difficult to produce guidance that will apply to all industries and all project sizes, RT 310 opted to develop a table of contents for a typical project execution plan (PEP) for two main reasons:

- CII has not previously researched/produced a PEP template for its members.
- RT 310 determined that the PEP was a key document for aligning front end planning, engineering, and procurement with construction and startup.

The research team felt that a complete PEP with a narrative for each section and subsection would be too extensive and that most owner/project standards and procedures would already contain much of the information. Instead the team chose to provide a fairly extensive TOC and only provide narrative on sections identified as key to aligning engineering and procurement with construction. The team produced the PEP TOC at a level of detail that is most suitable for larger projects, but included an explanation of how to use it on small- and medium-sized projects. This explanation of its use on smaller projects follows the narrative description of the recommended TOC.

Using the Project Execution Planning Table of Contents

The project manager should develop a preliminary PEP after the project concept is selected for execution. This initial PEP should be aimed at ensuring alignment consolidation of the project execution strategies, priorities, organization, interfaces, and sequencing. A definitive PEP should be completed prior to the end of project definition. The PEP should then be issued as “approved for use” prior to the commencement of any significant project activities.

The PEP should do the following:

- Summarize the project scope of work per the design basis, and according to any other design-, construction-, or logistics-related supporting requirements.
- Summarize the engineering, procurement, and construction execution plans.
- Summarize the path of construction (POC), from design through procurement and construction, and into commissioning and startup.
- Inform and align all stakeholders (internal and external); align all functions, project plans, and contractors.
- Inform stakeholders about and provide definition for cost estimates and schedules.
- Summarize the risk plan for use in identifying and mitigating risk.
- Provide a basis for development of the construction execution plan and, subsequently, for the contractor’s detailed construction plans.
- Provide early alignment for future project readiness reviews and other discipline reviews.

The PEP is a collaborative document and should define the scope, sequence, philosophy, drivers, priorities, and assumptions for the project’s design development, procurement strategy, construction execution, and commissioning and startup.

Because of the team’s research focus, the following sections discuss the alignment-related aspects of the RT 310 PEP TOC. So, while it includes all aspects of planning and execution, it does not provide a narrative for the ones unrelated to alignment. To provide context, the parts of the PEP TOC not related to alignment will be listed but not discussed. Appendix 1.A presents the complete PEP TOC. As in Appendix 1.A, the TOC headings related to alignment are highlighted in red.

I. Project Summary

C. Scope

The scope should include a brief description of the project scope of work and basis of design. Because the scope may change as a project develops through the FEL process, it may require updated information. Scope definition is adequately defined by the following items and may be commensurate with the extent of engineering performed:

- project objectives and priorities
- process technology and licensing
- design basis
- economic operating cost data
- site location and data or a site assessment, selection, and development plan.

II. Project Execution Strategy

A. Advanced Work Packaging

Advanced work packaging (AWP) is defined as the overall process flow of all the detailed work packages on a project (i.e., engineering work packages (EWPs), construction work packages (CWPs), and installation work packages (IWPs)). As such, if a project team follows the AWP structure, it not only reaches alignment on the physical boundaries of each of these packages, but, more importantly, stakeholders are aligned on the sequence of deliveries of each of the packages. Figure 1.2 provides a conceptual view of AWP.

AWP stresses the necessity of beginning with the end of the project in mind (i.e., the commissioning and startup). If these considerations are the foundation of the planning process, then the project team can plan construction to meet these requirements and can then plan the associated engineering and procurement process to meet the construction requirements.

The alignment that this creates is what sets AWP projects apart from traditional projects. Following are the hallmarks of AWP-based alignment:

- Construction understands the scope and the requirements of what will be required for the sequential release of the finished packages that are needed for commissioning and startup to proceed as planned.
- Engineering understands the scope and sequence of the packages that construction requires to meet this goal

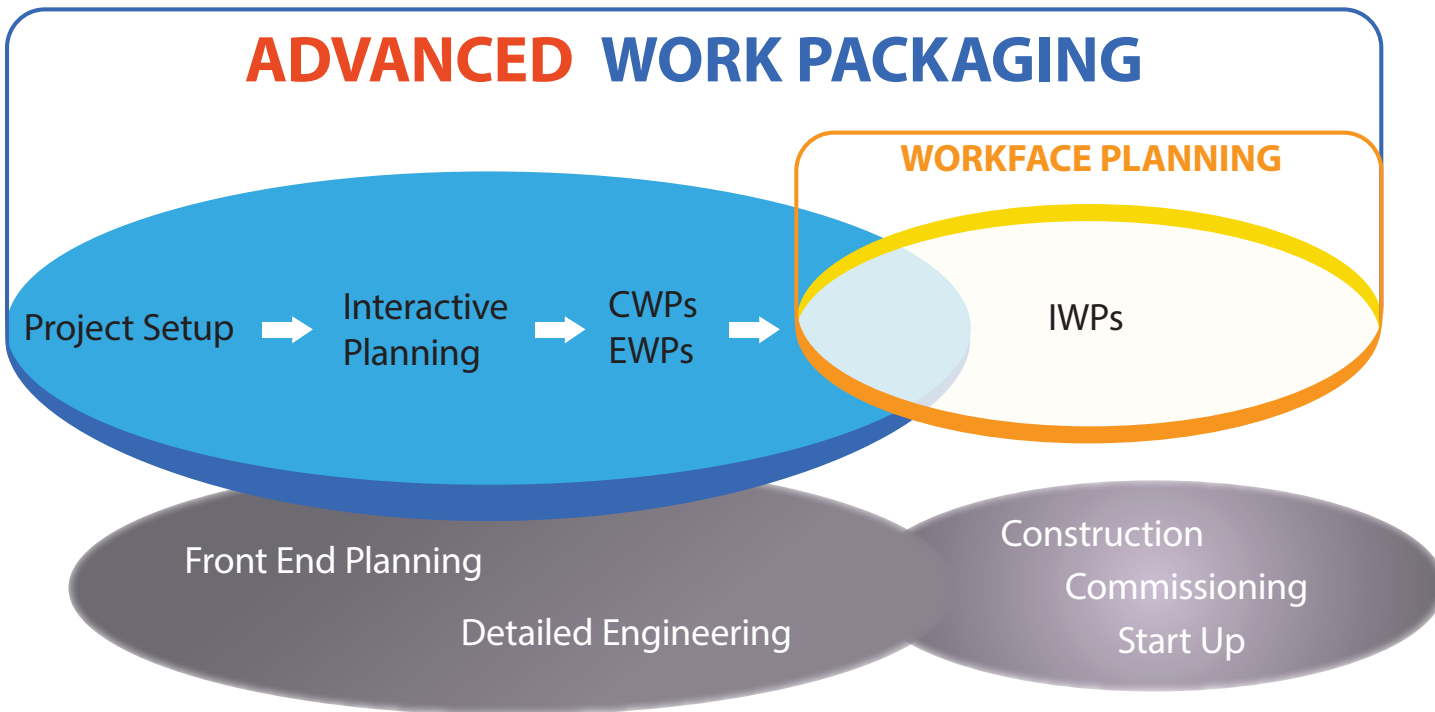


Figure 1.2. Advanced Work Packaging (Source: Implementation Resource 272-2)

- The supply chain (including procurement) understands the sequence and timing of all the vendor data (for equipment and materials) that are needed to meet the EWP during the planning stage. Suppliers also understand and meet the onsite dates for construction.

AWP strategy should be introduced very early on in the project, since it is very difficult to change the scope and sequencing of individual packages once the process has started without AWP.

B. Workface Planning Strategy

Workface planning (WFP) is the process of organizing and delivering all of the elements necessary for an IWP before the work is started. An IWP is simply a work package that clearly provides a basis for the scope of work that a single discipline crew (e.g., a foreman and piping crew) can successfully complete in a short work period. (A rule of thumb is that an IWP is about one week's worth of work or a single shift for a crew at a camp location.) A CWP is composed of multiple IWPs. A key rule followed in WFP is that an IWP should not be released to a crew until all constraints have been satisfied such as the following:

- All the materials are available and have been checked as correct and without defects, and are bagged, tagged (with an IWP number), and staged.
- The crew has clear access to the area in which the work is to be done (i.e., concerns such as surveying, the presence of scaffolding, any conflicting work activities (e.g., lifting), and work permits have been addressed).
- All the information to do the work (e.g., drawings and specifications) is available and issued as part of the IWP as required.
- All equipment and tools required to do the work (e.g., construction cranes or articulated platforms) are scheduled and available.
- Any precedent work is completed and signed off on (e.g., structural steel scope prior to starting pipe erection).

As Figure 1.2 shows, workface planning is the packaging of work performed during the construction phase of a project. Ideally, the planning of IWPs commences in the latter part of the front end (planning) phase. One of the key findings from projects using this strategy is that many of the requests for information (RFIs) that are normally generated in the field during construction can be addressed before the crews commence working on the packages. This availability prevents the stop-work delays that frequently occur on traditional projects. Indeed, projects using WFP attribute their much higher productivities to their crews not having to wait for information and materials.

D. Path of Construction

The path of construction (POC) is the documented articulation of the optimal building sequence of the physical components of the facility. Other projects may have other names for this process, but the purpose is to get stakeholder agreement on the schedules for going through a formal gating process, so that at each phase, a project can get board approval to continue. An important part of this process to ensure that the front end planning (engineering), procurement, and construction are completed in accordance with the project's commissioning and startup strategy.

The key to the POC process is to ensure that all the appropriate stakeholders are adequately represented and participate in the discussions. These stakeholders should include, but not be limited to, the following:

- owner (including commissioning and startup resources)
- project management
- construction management
- engineering
- the supply chain (including procurement and contracts)
- construction contractors (if applicable).

The POC is an iterative process that is used to articulate the construction sequence with clearly defined information. For example, a schedule developed early in the planning stage may not have the final contracting strategies developed, and the delivery schedules for the long lead procurement of capital equipment may also not be finalized. The inclusion of such new information into the schedule will ultimately require the construction sequence to be altered. POC is also a documented process that stakeholders sign off on formally. It is one of the key processes for ensuring that the stakeholders are aligned at each phase of the project.

The expected result of the POC process is to ensure that the stakeholders have agreement on the following concerns:

- The CWPs are defined and sequenced to meet the commissioning and startup strategy.
- The EWPs are “mapped” to the CWPs (scope and boundaries) and sequenced to meet the CWP release requirements.

The procurement packages are “mapped” to the EWPs and CWPs to ensure that engineering receives the vendor data on schedule. Timely vendor data ensure that engineering can meet the EWP release schedule and that the equipment and materials arrive on site to meet the CWP sequencing requirements.

E. Preassembly and Modularization

The use of modularization is a major execution strategy decision that must be made early in the conceptual phase of the project. Modularization historically has provided cost and schedule benefits over stick-built construction on projects sited in geographic regions with limited labor or weather constraints. Other factors may also dictate the need for modularization, such as permit or schedule constraints. Modularization requires a different approach to all areas of design and may even affect site selection and plot plan development. It is advisable to make the decision to modularize early to prevent the confusion and design rework created when a project transitions from stick-built to modularization.

Preassemblies, “dressed out” equipment, and skid-mounted equipment have been used extensively in construction, but large project modularization is less common. Project team members must understand the impacts of modularization to the design approach and schedule, and they must be aware of the potential of both cost savings and increases. Teams should take the following project considerations into account when deciding whether to proceed with preassemblies and modularization:

- **cost** – additional engineering costs and construction cost differences
- **safety** – improved safety resulting from fewer onsite personnel and lower work elevations
- **risk mitigation** – allocation of risk between contractors and fabricators
- **quality** – potential for improved quality through the use of an established and trained module fabrication workforce
- **schedule** – potential schedule improvement from parallel work on mechanical scope, site civil work, or permitting
- **weather** – decreased risk of weather delay in a fabrication yard environment
- **equipment** – potential need for early procurement in anticipation of variable module shop fabrication times/need-by dates and potential need for additional equipment (particularly for long lead equipment).

F. Contract Strategy/Requirements

It is difficult to get project stakeholders aligned if the contract strategy is unsettled. A key decision during the front end planning phase is to develop the CWP with the associated defined boundaries and sequencing. Without this type of information, it is difficult for engineering and procurement personnel to package their work properly. If CWP gets split up later in the planning process, the EWP has to be mapped accordingly, with any associated rework (i.e., additional hours) taken into account.

III. Definitions

C. Team Building and Alignment Program

Team building helps key project personnel, owner's representatives, and other stakeholders achieve alignment as they participate in project scope development, assignment of responsibilities, and project execution plan generation. Team building should start in the early project stages and should be reinforced throughout the project life cycle. A procedure should be developed to govern a formal team building program.

IV. Project Management

B. Champion(s)/Sponsor(s) for Strategies

The project team must acknowledge that the stakeholders will have a natural tendency to “push back” on new strategies, as a result of the barriers that will inevitably come up as the new approach is implemented. Their resistance can be the result of simply not understanding how the new strategy changes their individual roles. For the new process to work properly, each stakeholder group will have to accept its “top-down” implementation, and must be sure to assign a champion or sponsor with the appropriate level of authority and training to drive its adoption. The key champion/sponsor will be in the owner's organization (or in the project management organization, if that is also within the owner's organization). The amount of work that these champion(s)/sponsor(s) will undertake cannot be underestimated, especially if this is the first implementation of a strategy.

The champion/sponsor will be responsible for ensuring the following:

- Each stakeholder group understands its role in the implementation of the strategy(s).
- Each stakeholder provides a matrix of roles and responsibilities (including a training matrix) for its organization. (See item V.D below for further clarification of roles and responsibilities.)
- Individuals get the necessary support and training within their respective organizations to perform their new roles and responsibilities successfully, per the new strategy(s).
- Any barriers to implementing the strategy(s) are mitigated.

It is difficult to maintain alignment if any of the stakeholder organizations do not embrace their roles within the new strategy(s).

D. Project Roles and Responsibilities (Defined, Effective, Accountable)

To ensure alignment among and within all stakeholder groups, each stakeholder must do the following:

- Define the roles and responsibilities of each member of the organization and understand how each member fits into the overall project matrix.
- Define the training matrix for each individual and then support the training process.
- Ensure that the organization or group is sized appropriately to be effective.
- Hold each member of the organization accountable for his or her roles and responsibilities.

It is not unusual for project alignment to suffer if any of the above is not done properly. This is because alignment is virtually impossible if individuals do not understand their roles and responsibilities, are not supported or given the additional training that may be required, or are not held accountable.

E. Management of Path of Construction Process

The process of documenting the path of construction (POC) is “owned” by the project manager/project management team (PMT). (See item V.W for additional information on POC.) The actual POC process meetings are led by the construction management team (CMT), with the participation of appropriate stakeholders such as engineering, supply chain teams (e.g., procurement, source inspection, suppliers, transporters, and fabricators), and construction contractors (when available). (See Figure 1.3.). When the CMT has developed the POC as far as is possible (with the information available at the time), it is presented to the PMT for review, to ensure that it meets the owner’s stated intentions. As seen in Figure 1.3, each review should be held as an “integrated planning session,” to ensure that all stakeholders attend, participate, and agree to the plan moving forward. This is key to the alignment of all the stakeholders.

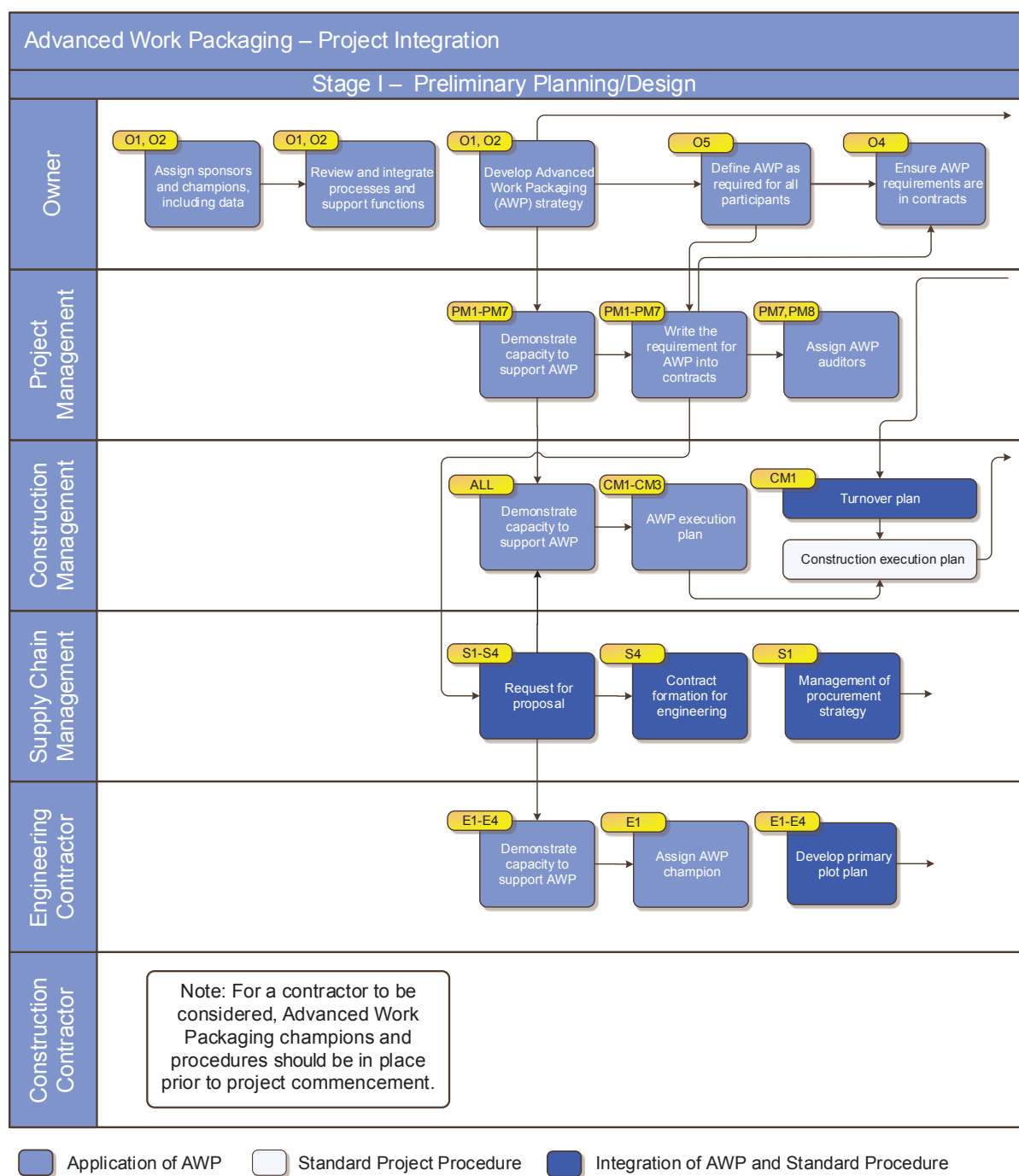


Figure 1.3. Advanced Work Packaging Planning Project Integration
(from CII IR 272-2, Volume II)

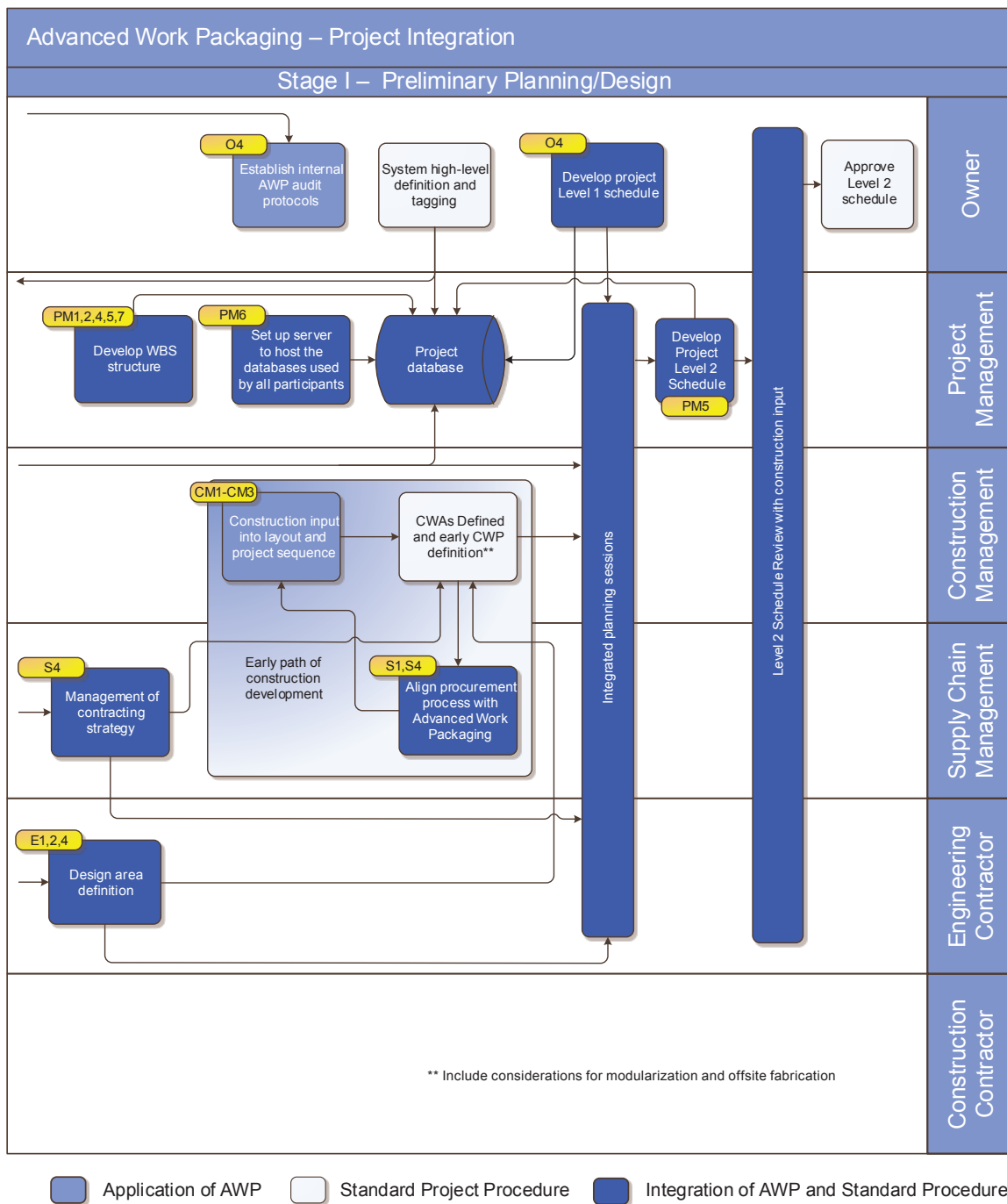


Figure 1.3. (cont'd.) Advanced Work Packaging Planning Project Integration
(from CII IR 272-2, Volume II)

F. Approval Authority Matrix

Project Delegation of Authority Matrix: Delegation of authority must be established in order to define the limits of authority of specified project positions of responsibility and determine the types and maximum financial limits of obligations that any individual may approve. Approvals of commitments and transactions must always be made by the parties that have been assigned responsibility for them. For procurement documents, the project delegation of authority matrix should designate who has the authority to sign documents on behalf of the company (i.e., signature authority), as well as who has authority to make individual expenditures for the project (i.e., expenditure authority). (See Table 1.1.) All signature and expenditure authority should be by company and should not be delegated to any client, agent, contractor, or subcontractor. This matrix serves as a template for organizations to use to create project-specific matrices with the names and positions of the individuals with authority. Such a project-specific chart will typically require the approval of a business unit president (or the equivalent) prior to being implemented.

Table 1.1. Project Delegation of Authority Matrix

Company Position	Commitment Type	Signature Authority			Expenditure Authorization Limits
		General Contractor	Agent for	Administrator	
Business Unit President (Insert Name)	Purchase orders/change orders	Yes	No	No	\$USD (for commitments above this limit refer to corporate DOA)
Business Unit Project Director (Insert Name)	Purchase orders/change orders	Yes	No	No	\$USD
Project Manager (Insert Name)	Purchase orders/change orders	Must sign for project commitment approval	Must sign for project commitment approval	No	(Per business unit DOA)
Client Representative	Purchase orders/change orders	No	Must sign as authority to make commitment	Must sign as authority to make commitment	None for general contractor; unlimited for agent for or administrator (refer to client DOA)
Project Procurement Manager (Insert Name)	Purchase orders/change orders	Must sign as reviewer	Must sign as reviewer	If required by client	None
Buyer	Purchase orders/change orders	Must sign as creator	Must sign as creator	If required by client	None

I. Participative Planning (Planning, Cost, and Schedule Meeting Process)

Participative planning, also referred to as interactive planning, is key to successful project planning and scheduling. This effort supports schedule development that utilizes a common software tool, such as Primavera. Participative planning applies primarily to the FEP phase and is a facilitated process involving owner and EPC contractor project teams. At a minimum, the team will have representatives from project management, engineering management, modularization, fabrication, supply chain, construction, commissioning and startup, HSE, and regulatory. The teams review the project scope, overall project strategies, key documents, standards, and procedures. One of the key goals of these sessions is achieve stakeholder alignment throughout the life cycle of the project.

J. Critical Success Factors – Reward and Recognition System

Research has shown that, when properly designed to support overall project objectives, reward and recognition systems help align stakeholders. (See IR 113-3, *Alignment During Pre-Project Planning: A Key to Project Success*, for a detailed discussion of this topic.) A key objective is to ensure that the reward and recognition structure is fair and uniform, since participants will quickly lose alignment if the structure favors certain individuals or groups. A key finding from IR 113-3 is that conflicting reward structures for different team members may cause decisions on project planning and objectives to be in direct opposition.

A reward and recognition program must address both short- and long-term objectives in order to maximize initial engagement of the workforce and maintain longer-term focus. Recognition programs must reward both non-manual and manual labor in a structured and fair manner. Salary-based completion bonuses, with performance-based multiplication factors (e.g., safety, schedule, and/or cost) should be considered.

L. Risk Plan

The risk management team should develop the project risk plan. To do this, team members should have a working knowledge of project risk management and understand the risk management process. A risk is an uncertain event or condition that, if it occurs, can have a positive or negative effect on the project objectives. Risk events can be understood as either threats or opportunities. The risk management team should develop a project risk register, using a standardized template to record all identified risks and prioritize them according to the severity of their potential effect(s) on the project. Every risk identified should have a mitigation plan for managing, reducing, or eliminating it. The risk management process starts at the earliest stage of a project and is maintained throughout the execution phases.

The entire project team must be aligned with the process of identifying and logging the risks on the risk register. It must also understand and consistently implement the plan to manage these risks. Projects can easily fail if any particular stakeholder misses the integrated planning discussion and, thus, does not follow the agreed-upon mitigation process.

M. Value Improvement Practices

Value improvement practices (VIPs) sometimes overlap with best management practices, but their successful implementation involves alignment within the complete project team, not action by a single party. VIPs are formal practices or processes used in a project's front end planning phase to yield improved project outcomes. Successful VIP implementation involves a formal, disciplined, and documented approach, with measurable results. Success requires participation of the full team (i.e., owner, operations, engineering, contractor, and suppliers), meeting with facilitators and participating in open discussion on the merits and/or risks of the project. VIPs challenge alignment and promote better understanding of impacts to other project team members. The following are VIP examples that are critical to project team alignment:

- technology review and selection
- process simplification
- design to capacity
- design for maintenance and operability
- value engineering
- energy optimization
- constructability reviews
- risk analysis
- Project Definition Rating Index
- lessons learned.

Every VIP is not applicable to each project, so project leaders should prepare a value improvement plan to identify the right VIPs for the project. This plan should address how each will VIP will be facilitated, and it should identify the stakeholders who will be involved in each process.

O. Audit Plan

An audit plan provides the framework for feedback to project team members, helping them discover areas for improvement. It not only reviews financial status, but also supports assessments of risk, efficiency, and quality. When the audit plan framework is known upfront, all team members are apprised of the measurements and benchmarking to take

place on the project. This allows for more effective management decisions. The audit offers a way of ensuring that achievements meet objectives. Clearly communicating the audit plan improves the alignment of team expectations, which improves project results.

P. Regulatory and Permitting Plan

Since on-time project delivery often depends on timely permit releases, a comprehensive regulatory and permitting plan is critical. The plan should at a minimum do the following:

- Identify all required permits (with the appropriate level of detail) to support the physical build, startup, and operations of the project facility.
- Include the agreed-upon division of responsibility (e.g., owner, engineering authority, construction contractor, and others), as applicable.
- Identify the individual permit requirements and the applicable authority.
- Track and monitor permit application preparations, submission target dates, and actual submission dates.
- Track, monitor, and report compliance.
- Identify any licenses requiring transfer to owner.

Organizational support should be identified through a suitable organizational chart, to manage and maintain compliance with the permit requirements, such as the following:

- development approvals
- construction approvals
- works approvals and licenses from governmental agencies or departments
- dangerous goods licenses (for bulk fuel storage)
- approvals matrix
 - to list permits
 - to record division of responsibilities of permits
 - to track progress for permits
- external contact log
 - to record contacts per communications protocol
- project schedule
 - to track “high” priority and “other” significant permits
- development applications review cycles
- other permits under development.

V. Interface Management

A. Interface Management Matrix

External: Early identification and management of external interfaces is critical in order to avoid potential project impacts. Developing an interface matrix facilitates the visibility of each interface, identifies any associated actions and deliverables, and assigns responsibility and a date for completion of the interface activity. The matrix prioritizes actions and covers project development from design through startup and operation (as required by contract).

Projects should ensure that all relevant parties participate in the development and screening of the interface management matrix; to do this, they should consider conducting an interface workshop. At a minimum, the interface management matrix should include the following information for each interface:

- interface title
- identification of the external party and contact details
- interface descriptions
- required deliverables
- name of the person accountable for managing the interface
- timeline for completion of actions.

Projects utilizing an interface workshop should employ a competent and independent screening facilitator to help prepare for and facilitate the workshop.

Internal: An interface management plan should be developed for project management, engineering, procurement, and construction. This plan will address functional interfaces between two or more projects, or across different project areas. The plan will also address different functional interfaces, including the following: project management and construction; construction interfaces, e.g., heavy lift schedules; and logistics and contractor interfaces between two or more contractors.

There are two ways to identify interface integration problems: predictive and reactive. Predictive identification spots interface issues that will affect the project before they happen. It is the preferred method, and any issues predicted should be recorded on the project interface and integration log. Reactive identification catches issues that are not identified in advance but are discovered as they arise. These also should be recorded in the log.

To ensure that all stakeholders understand their respective scope—and, thus, to maintain alignment—the matrix of roles and responsibilities within the interface management plan should be well-planned and effectively communicated.

B. Communications Plan

External: An external communications plan gives project leadership guidance on engaging and informing external individual and group stakeholders. The plan should identify the project personnel authorized to disclose information, and should detail the appropriate nature and content of approved communications, including the following:

- All communications activities should be aligned within a framework that has been approved and reviewed by the owner and contractor (senior management and legal).
- Key stakeholder(s) must be clearly identified.
- All communications should be kept simple, timely, and relevant, and should provide full context in addition to content.
- Communications should be leader-led and coordinated according to the integrated communications plan.
- Message objectives and strategy should be clear and approved prior to release.
- Communications should be open, honest, supportive, and two-way.
- Communication and engagement calendars and channels should be identified (e.g., town hall events, community meetings, press releases, project web sites (external), and regulatory offices, among others).
- Avoid promotional “trinkets,” and seek instead to develop a common project brand that is aligned with the owner philosophy.

Internal: The intent of the communications management plan is to ensure clear, accurate, and timely communications through the proper channels to the correct stakeholders. Good communications are critical to project success, since miscommunication can increase project risk. The objective of the plan is to ensure a smooth uninterrupted execution of the project, from the DBM phase through project completion (including commissioning and startup). The structured plan will provide detailed project reporting requirements, direct lines of communication, and a communications structure—all of which allow for timely project-wide response in the event of an incident or emergency. The communications plan should also define roles and responsibilities, and should establish meeting schedules.

VI. Engineering

A. Engineering Plan

1. Automation Tools

Early agreement among principal stakeholders on automation processes and formats is critical to project success. A single Internet portal giving engineering, construction, owners, partners, and vendors access to engineering and construction data will enable a creative and collaborative environment in which project execution can be more productive. Competing and succeeding in the current market demands electronic capabilities such as automated response, online validation, shared model access, electronic change management, and real-time information exchange.

B. EWP/CWP Plan

Developing an EWP/CWP plan is key to aligning project stakeholders. This alignment (or “mapping”) of a project’s EWPs to its CWPs must be accomplished in conjunction with the path of construction and the procurement plan. The procurement plan may be focused on long lead deliveries of key major equipment that meet the objectives of the CWP sequencing and schedule. However, project teams often overlook planning the timely delivery of vendor data that allows the EWPs to be completed as sequenced and scheduled. The scheduled delivery of complete vendor data must be specified and must form part of the terms of payment. It is so important that projects should consider some means of ensuring it happens. Many projects get out of alignment because, lacking this information, their engineers cannot complete the EWPs. This information gap causes EWPs to be split, late, or released out of sequence, which causes significant alignment problems with the construction contractor(s) involved.

C. Preassembly and Modularization Plan

Because modularization can have a significant impact on detailed engineering, it should be considered during FEL design development. This early consideration prevents errors and rework that would delay the design freeze. In addition, the relationship between layout, piping, and steelwork design has to be closely coordinated. The preassembly and modularization plan must offer guidance on preparing a work strategy and a standard engineering package for the design, manufacture, and erection of the modules. This plan should ensure the following:

- The engineering packages produced for each design area are in a similar format and convey the same information for module manufacture and construction.
- The packages received by each module manufacturer are in a similar format and contain the same level of detail for each unit.

- Module interconnects will be coordinated from area to area.
- Supports will be similar and coordinated from area to area.
- Tolerances will be consistently controlled.
- The field installation process will be similar for similar modules in each area.

The preassembly and modularization plan must also address key activities for the team:

- developing the module-specific design criteria
- determining a standard deliverables package
- developing a standard set of drawings for each discipline
- determining the design and electronic tools required for project execution
- developing a module design team training plan
- preparing a plan and schedule for monitoring adherence to the module design plan
- integrating the design process with the material control plan.

1. Logistics

The maximum size of a module that can be shipped is determined by several factors:

- access clearances on site, en route, and at fabricator facilities
- available access to the site
 - water access by barge or ship
 - truck access and limitations
 - railroad access and limitations
 - road weight limit
- restrictions by country, customs, and regulations
- manufacturers' limitations and capability.

The final module sizes will be determined according to site access, method of transport, setting considerations, and cost analysis.

The immediate need is to determine the dynamic load factors for various shipping methods (e.g., barge, ship, or truck). Factors that will influence dynamic load factors for barge shipping include the shipping route, sea state, and barge size. The project team should hire a marine engineer to perform an analysis and prepare a report defining the dynamic shipping loads, based on shipping method and route, and the preliminary module sizes.

These dimensions are the out-to-out dimensions of the module and are defined by any item projecting from the module frame on each side. The final maximum module size can vary due to shipping limitations and interconnections. Other factors that can affect the module size include the size of available cranes and barges.

VII. Operations (Commissioning and Startup)

A. System Identification

The project must be broken down into systems for turnover to the owner on the basis of system definitions established by operations. To ensure a smooth startup schedule with the least impact to existing operations, these systems should be prioritized for turnover according to operations requirements and required construction interfaces. While the contractor typically breaks down the turnover systems into appropriate hydro-test systems or subsystems, these subsystems must be consolidated for the purposes of turnover. (See Figure 1.4 for a diagram of a system handover management process.)

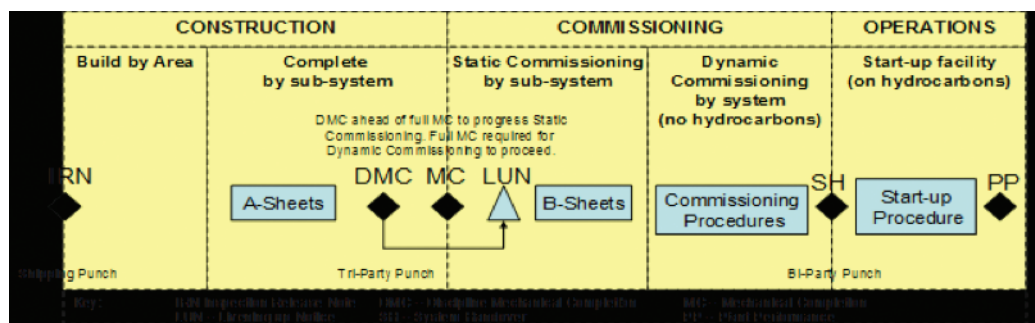


Figure 1.4. System Handover Management Process

At a minimum, the following information must be provided in order to define a system adequately:

- a marked-up set of P&IDs defining the system boundaries, as applicable
- for systems turned over by geographical area, a marked-up plot plan defining system boundaries
- an overall index including a turnover system numbering system approved by operations
- a system turnover priority provided by operations that reflects operational needs during commissioning and startup.
- engineering scheduling to support the system turnover schedule and to ensure that design supports the required system boundaries.

B. Mechanical Completion Plan/C. Commissioning and Startup Plan

Mechanical completion requires that all construction and installation activities that are related to (but not limited to) equipment, piping, electrical services, instrumentation/controls, and utilities are physically complete and that designated inspections, tests, and checks documented.

During FEED, the following construction activities should be completed:

- early and continual alignment with commissioning requirements
- construction input to system and subsystem definitions
- development of hook-up and completion plans for offshore projects
- identification of and emphasis on possible reductions in MC scope
- development of MC plan
- development of initial MC organization.

Construction management, in its assurance role, should (as applicable) ensure that the responsible construction contractor safely completes all activities associated with bringing the facilities up to the prescribed state of mechanical completion—safely and in alignment with the approved integrated schedule. The contractor should use a “systems completion database” for monitoring and recording systems completion progress. With such a system in place, construction must be supportive of the system handover process and schedule.

By early execution, construction should develop a detailed mechanical completion plan in coordination with commissioning, making sure that it supports the activities associated with systems mechanical completion. The project construction manager (PCM) and commissioning manager should agree upon and co-approve the inspection and test report portfolio (i.e., the inspection check sheets). During execution, the PCM should assign a dedicated mechanical completions manager.

D. Simultaneous Operations Plan (SIMOPS)

The commissioning manager and the project HSE manager should lead the development of the safety transition plan, which should document the project’s safe transition from the point of handover from construction to commissioning, and from commissioning to operations. The safety transition plan resides within the project HSE plan as a separate, detailed plan that allows for updates to be easily managed and communicated. The safety transition plan should not duplicate any sections of the project HSE plans, but rather should focus on transition requirements and any considerations around simultaneous operations (SIMOPS).

The scope of the SIMOPS/safety transition plan should define the requirements for transitioning safely from construction into commissioning and through operations, while recognizing and addressing any simultaneous operations. The plan defines both the facility and procedural requirements for this transition, with clear milestones that match controls with potential risks as the systems are commissioned and made live. The end state for the SIMOPS/safety transition plan should be the management requirements as defined by operations. To develop this plan, operations personnel must rationalize the hydrocarbon requirements to a commissioning environment. This allows the project and operations team to develop bridging plans for the control of work (CoW). To address the increase in HSE risk as the project approaches handover to operations, the CoW plan defines where and when the contractor's CoW procedure takes primacy, and where and when the operating facility's CoW procedure takes primacy.

The safety transition plan should be written at a high level before the detailed design phase, with support from HSE, construction, operations, and project management. The high-level safety transition plan should provide the overarching concepts for the project and should define greenfield and brownfield areas. The SIMOPS/safety transition plan should be approved by the project manager, HSE manager, project construction manager, area operations manager, and commissioning manager prior to the construction phase.

During the construction phase, the commissioning, HSE, operations, and construction managers should determine any need for individual plans for localized issues. Before the construction phase is completed, the commissioning manager and project HSSE manager should determine whether to prepare individual plans for an area/location or an update to the project commissioning safety transition plan. Such an update should convey the completion of major milestones and discuss the remaining scope of work. The goal is to have documented plans that can be communicated to the workforce to support safe commissioning. If this is achieved by updating only one document, then it meets the requirements of this practice.

As discussed, the SIMOPS/safety transition plan should be developed before the construction phase is completed, and should be approved by the project leaders listed above, with the project representative from the primary contractor and the primary contractor's HSE manager demonstrating agreement.

Suggested table of contents of the SIMOPS/safety transition plan:

- leadership
- roles and responsibilities
- inspection and audits
- communications

- changes to the HSE transition plan
- SIMOPS
- CoW for specific work areas:
 - access to work area
 - CoW
 - communications
 - emergency response management
 - local rules
- incident management
- environmental costs
- area/unit-specific requirements
- references/forms/change log.

SIMOPS/Safety Transition Plan Training

The HSE, operations, construction, and commissioning teams should develop a training module supporting the project's SIMOPS/safety transition plan, to maximize consistency between rotations and minimize risks associated with change. This module should be included in the site orientation when appropriate. The purpose of this training is to foster HSE awareness as the site transitions from a non-energized state to an energized state, while considering ongoing simultaneous facility operations. This information should be delivered through site training and reinforced at tool box talks. The key elements of the plan should be published in a working handbook for all workers.

E. Brownfield Design and Planning Considerations

Brownfield projects historically have had significant cost and schedule overruns due to complex planning and execution restrictions related to the following considerations:

- the presence of hydrocarbons
- minimization of production downtime
- need for in-depth site verification for project scope definition (mostly limited to visual and external inspections)
- changes during execution due to actual conditions
- SIMOPS interfaces
- ongoing production maintenance requirements
- work permitting requirements

- hot work restrictions—both open flame and spark potential
- lifting restrictions due to concerns about dropped object and crane availability
- access and egress to the jobsite, including availability of temporary facilities and utilities to execute the work
- more confined and congested construction jobsite, due to multiple crafts working within the facility and reporting to different groups
- availability of experienced brownfield contractors
- coordination among existing support contractors and brownfield contractors.

In order to prevent such occurrences and to achieve the same technical and execution certainty that inform the decision-making process, brownfield planning activities should be performed one stage earlier than greenfield activities. This rigorous front end definition and planning will make for a safer build with less discovery work, ultimately resulting in less cost and schedule growth. Advanced work packaging is a key tool to help deliver brownfield projects.

F. System Handover Plan

Operations should collaborate with construction to develop and maintain a system turnover schedule and an overall testing plan for the assigned scope of work. This turnover schedule should be used to advise operations of upcoming punch-out activities, testing activities, system turnover progress, and other handover concerns. In general, the implementation of the system turnover schedule occurs at around 60-percent overall mechanical completion progress. This schedule is based on system priorities provided by operations and should be coordinated with the operations commissioning and startup plan.

VIII. Pre-construction Planning

A. Construction Interface and Integration Management Procedure

See PEP TOC Section V. A., Interface Management Matrix.

B. Constructability Plan

A constructability plan should be developed for the project to ensure that construction knowledge and expertise is integrated into project planning, design, engineering, and project execution. A well-defined plan will minimize field work, optimize the use of offsite fabrication and modularization, minimize impacts due to weather and site conditions, maximize field productivity, and increase safety performance.

C. Subcontracting Strategy

One of the first steps is to establish the “prime contractor” status on the project. At a minimum, the contractor subcontracting plan should have the following contents:

- a pre-qualification process that aligns with the project goals and objectives
- contract terms and conditions that align with the proposed strategies of the project
- a subcontracting plan addressing strategy and construction subcontractors (e.g., module yards, fabrication shops, and assembly areas, among others)
- a subcontracting schedule providing a detailed construction schedule for each work area/place
- estimated work quantities by discipline and construction work areas (CWAs)
- area site plan with CWAs defined.
- a division of responsibility matrix establishing the provision of common services.

D. Preassembly and Modularization Plan – Construction Execution

See VI. C. Preassembly and Modularization Plan

E. Construction Execution Plan

The site construction effort represents a large part of the project cost, and the way the effort is executed has a significant influence on the project’s ultimate cost and completion date. A key function of the construction organization must be the effective planning, scheduling, and sequencing of the work, as well as the efficient use of methods, techniques, tools, equipment, and qualified workforce to perform the work as described in the construction execution plan (CEP.) The CEP should be used as an alignment tool to deliver agreed-upon objectives. These agreed-upon project objectives should include HSE goals, QA objectives, budget/cost objectives, schedule requirements, maintenance/operability objectives, and startup objectives.

F. System Turnover Identification/Packaging

After turnover systems have been defined and communicated, the contractor is responsible for preparing test packages and defining any subsystems within each system. Depending on the size and complexity of the given system, construction may establish many test packages. Immediately after system evaluation, construction should communicate the index of test packages to operations for the applicable scope of work. The contractor should obtain input and approval from operations on a test package numbering system.

G. EWP/CWP Identification/Planning Aligned with Procurement Plan

See VI. B. EWP/CWP Release Plan

IX. Project Controls

B. Project Schedule

2. Detailed Schedule by EWP/CWP

One of the key deliverables from the POC process is the agreed-upon sequence and scheduling of each CWP and EWP. In the process, each EWP is mapped or linked to a corresponding CWP, both in sequence and schedule. Each EWP should correspond to an item on the project's Level 3 engineering schedule. Unless this criterion is satisfied, a project cannot be considered aligned. IWPs should be scheduled on 90-day and four-week rolling schedules (with three-week lookaheads at Level 5).

C. Cost Control

2. Rules of Credit

Rules of credit can simply be defined as the maximum allowable percentage complete for each project milestone, from start to completion of each deliverable. To align the stakeholders from the start, the project should specify at the outset what the rules of credit will be for each EWP, CWP, and IWP. Thus, the project should specify what percentage complete will be allowed for various milestones for each deliverable. The milestones should also show important key metrics that the project team feels are necessary to keep the stakeholders focused on the goals.

The following are shown only for the purpose of items that might be considered:

CWP (e.g., one expected to have 40 IWPs)

Scope and physical boundary set	____%
CWP mapped to EWP	____%
Construction started on schedule	____%
IWPs released to construction	____%
IWPs completed	____%
Deficiencies on each IWP completed	____%

EWP

Scope and physical boundary set	____%
EWP mapped to CWP	____%
EWP started on schedule	____%
Vendor data received	____%
EWP released IFC with no holds	____%
Construction accepted EWP	____%

IWP

IWP produced electronically	____%
IWP released to crew (no constraints)	____%
IWP completed	____%
IWP QC completed, with no deficiencies	____%.

The key is to make the metrics fit the project and to ensure that each CWP, EWP, or IWP is not progressed beyond reason. An example would be “an EWP should not be allowed to be progressed beyond ____ percent, if the vendor data has not been received.” Setting up such rules of credit is a significant component of ensuring alignment. Construction rules of credit are generally back-end loaded to drive completion of physical work. This is the opposite of engineering metrics that are often quantity-driven (e.g., cubic yards/metric tons of concrete or tons of steel, or other metrics measured by standard S-curves), rather than completion-driven by EWPs and CWPs.

XII. Supply Chain Management***B. Identify Long Lead Equipment***

Early in design, long lead equipment items should be identified, along with their impact on the proposed project schedule. This information is critical to all parties and affects both design and construction scheduling. It is also critical to owner cash flow and project funding decisions. Orders for critical equipment must be placed early in design, to support project planning. Other early actions for successful planning include the following:

- Ensure timely arrival of vendor data to support engineering and design.
- Support field need dates for equipment deliveries.
- Support early modular fabrication schedules.
- Provide necessary data on owner cash flow, to support early vendor engineering and cash commitments.
- Ensure shop space commitments from vendors to support project needs.
- Allow adequate time for heavy haul and heavy lift planning.

F. Vendor Alignment (Vendor Data, Finance, Schedule, and Quality)

Since a major focus of this PEP TOC is to provide guidance on the criticality of vendor data and delivery of equipment and materials, project teams must determine which vendors may need additional “coaching” or negotiating to ensure their understanding of their effects on project outcomes. This may mean including these vendors in POC

meetings so that they clearly understand their position. Alternatively, their contracts or purchase orders could entitle them to participate in the project reward/recognition program. Rewarding vendors might not necessarily entail additional costs, since rewards could be as simple as larger up-front payments within the structure of purchase orders for the release of vendor data. If such a payment is released, it could be tied to a corresponding “penalty” if the vendor data are changed at a later date and/or an equipment shipping date is missed. This practice aligns the vendor with the project’s need to receive the complete and proper data at the scheduled time; it also provides other stakeholders with confidence that vendors are likely to meet their deliverables.

This vendor alignment could be most important for long lead delivery items that can adversely affect the release of CWPs (and their associated IWPs), or it could also adversely affect the completion of the EWP’s. Any movement or delays could greatly affect the alignment of the participants. Owners and larger contractors are moving toward having fewer but deeper supplier relations, and this change should be highlighted, since managing supplier relationships at the senior management and executive level can provide significant positive returns.

1. Expediting/Material Delivery

With respect to the material management process, two of the key alignment issues are ensuring that the proper materials arrive on time and that the entire process of receiving, warehousing, care/control/custody of materials and equipment, bag-and-tag, and delivery is carefully planned and executed. As the schedule for commencing specific CWPs approaches, it is important to confirm that the final deliveries of all equipment and materials will be met, so that the final planning and release of the associated IWPs meet the project schedule. Thus, the project team must not only supply EWPs with accurate bills of material, but it must also provide them in a timely manner so that bulk materials can be “mapped” to specific CWPs. If the project is implementing advanced work packaging, the construction contractor depends on the materials being bagged and tagged by individual IWPs (recommended as a best practice of an AWP implementation strategy). Thus, early in the planning process, the material delivery strategy has to be a key alignment metric.