



NAC Executive Insights

Know What You Are Trying to Accomplish: The Primacy of the Scope Baseline

Key Points

- Scope baseline has primacy among the baseline documents (scope, schedule, and budget).
- Lack of clarity of scope and goals is the number one project pitfall for contract management.
- Inadequate scope definition and management is the source of the Spearin Doctrine, which determines who bears the construction of design errors.
- Scope of work and basis of design must be tightly linked to the owner's project requirements.
- Principle elements of scope of work are scope of facilities and scope of services.
- All items of scope must be quantifiable and measurable.

In project management it is accepted that a project can be described and best controlled against three baselines—scope, schedule, and budget. Together they define the project's performance measurement baseline. This Executive Insight focuses on the scope baseline and suggests its primacy among the three baselines. An incomplete scope will, by definition, result in incomplete or inaccurate schedules and estimates.

What is Scope?

Scope is the detailed set of deliverables and/or features for a project derived from the project's requirements. **Scope** must clearly identify the work required to successfully deliver a given project. A more detailed description of the elements of scope is provided later in this insight.

Why is scope definition and management important?

Inadequate scope definition and management has been identified as a major source of degraded project performance. The International Association for Contract & Commercial Management (IACCM) has identified 10 common pitfalls for contract management. Number 1 among these is "lack of clarity on

scope and goals”¹. Others^{2,3,4,5} have identified that when scope is not clearly and accurately defined, overruns become systemic; scope creep is a consequence and the second highest rework indicator.

In addition to cost overruns arising from poor scope definition, delayed completion and disputes often occur as well.

Inadequate scope definition and management is also a source of owner’s risk, referred to as the Spearin’ Doctrine⁶ in the U.S., for which no effective transfer or warranty mechanisms currently exists.

What creates scope problems?

Among many potential contributors to scope challenges, business and/or project complexity and uncertainty are the principle sources of scope and goal issues. This inescapable challenge is exacerbated by⁷:

- Inadequate project definition and agreement during the pre-contract phase, reflecting:
 - Ambiguity
 - Incomplete definition
 - Lack of stakeholder engagement and agreement
- Failure to manage change and maintain and update scope post award, leading to scope creep.

Scope change in and of itself is not bad as long as it is driven by factors that necessitate it to meet strategic business objectives or reflect changing capabilities. Scope change is often driven by the natural refinement of the initial scope statement. Such changes best occur at the earliest stages of the project lifecycle⁸. Change must be proactively and aggressively managed.

Scope development process

The scope development process begins in the owner’s organization and must be directly linked to the Strategic Business Outcomes (SBOs) the organization wants to achieve (Why). From this, the earliest identification of the needs that the project must satisfy are developed (What). The Why and What allow the owner to articulate a set of specific goals and objectives often memorialized in the Owner’s Project Requirements (OPR).

¹ Excellence in Contract Management; Common pitfalls from a practitioner’s perspective; IACCM; CPA Global 2016

² Scope Creep; Stephanie Gurlen; University of Missouri–St. Louis; 2003

³ Investigation and Analysis of the Rework Leading Indicators in Construction Projects: State-of-the-Art Review; University of Texas at Arlington; Elnaz Safapour; Sharareh Kermanshachi; Piyush Taneja; 2019

⁴ Hollmann, John K. 2016. Project Risk Quantification: A Practitioner’s Guide to Realistic Cost and Schedule Risk Management (Probabilistic Publishing: Gainesville, FL, USA).

⁵ Guidance Note 1 Project Scope; Australian Government Department of Infrastructure and Regional Development; March 2017

⁶ United States v. Spearin (248 US 132)

⁷ Opinions about Project Scope Management; NYU; Henry Zhou; 2016

⁸ Scope Development to Support Estimating; National Academy of Construction Executive Insight; Stu Anderson; 2018

The project requirements⁹ should include:

- Business requirements
- Stakeholder requirements
- Solution requirements
- Project requirements
- Transition requirements (Brownfield projects)
- Assumptions, dependencies, and constraints¹⁰
-



The owner's project requirements are then translated into a definitive scope of work (SOW) and an accompanying basis of design (BOD). The SOW confirms the objectives and goals laid out in the OPR and ensure they are specific, clearly laying out what, why, and how they will be achieved. Challenges and constraints the project will face also are laid out and initial iteration between scope, schedule, and budget development occurs, ultimately leading to a comprehensive project baseline.

The SOW and associated BOD¹¹ clearly establish detailed project requirements that must be met and their linkage to the OPR. Table 1 highlights some of the major challenges faced in defining project goals and scope¹².

⁹ Requirements Documents: Do You Know What Should Be Included?; Master of Project Academy

¹⁰ These should be memorialized and tracked throughout the project.

¹¹ Addressing Project Capital Efficiency through a Business Basis of Design; PM World Journal; Vol. III, Issue IV – April 2014

¹² Adopted from Tackling the Weaknesses in Contract Management; Pitfall #1: Lack of clarity in scope and goals; IACCM; 2016

Table 1

Major Challenges in Defining Goals and Scope

- Business complexity
- Articulation of client's strategic business outcomes
- Weak client processes
- Stakeholder clarity
- Inadequate time allowed
- Weak provider staff and processes
- Rapid change affecting project
- Metrics drive wrong behaviors
- Inflexible contracting terms and processes

The Construction Industry Institute (CII) developed the Project Definition Rating Index (PDRI)¹³. The PDRI provides a scoring tool for measuring the adequacy of project scope definition and identifies areas requiring improvement.

Elements of Scope of Work (SOW)

The scope of work consists of two principle elements, a scope of facilities and a scope of services. These are usually accompanied by an executive summary that provides an overview of the project, ideally linking back to the why and what described in the owner's project requirements. The SOW should consider and include, as appropriate, information related to the project's cost estimate and schedule. In addition, commercial and risk aspects should be considered.

Development of the SOW is aided by development of a project work breakdown structure (WBS) and the two activities typically go hand in hand.

Other elements addressed in the SOW include:

- Project organization
- Project approvals
- Reporting requirements
- Project control policy
- Change management policy
- Intellectual property rights (including nondisclosure and confidential information)

¹³ CII 1994, Pre-Project Planning: Beginning a Project the Right Way; Construction Industry Institute; The University of Texas at Austin

Scope of Facilities

The purpose of the scope of facilities is to present the physical and functional description of the final constructed and delivered facility.

Design Basis

The design basis provides a general introduction and an overview of the project's scope of facilities. It addresses the following aspects of the project:

- Introduction (who, what, when, and where)
- Type of project (Engineer, Engineer Procure, Engineer Procure Construct, EPC Manage, others)
- Type of contract (cost plus, lump sum, or others)
- Brief overview of client
- Purpose and overview of project facilities
- Design basis overview (linked to the more detailed Basis of Design document)
- Project specification list
- Work Breakdown Structure
- Site location and battery limits

Items that describe the design approach, activities, and deliverables for the project should be discussed in the Scope of Services section.

Assumptions and Clarifications

This element focuses on the general project assumptions¹⁴, clarifications, and exclusions (for the providing firm, the client, or others) associated with the physical and functional description of the facilities that are applicable to the project. Exclusions should be clearly detailed and presented in a positive manner. Uncertainties and "soft" issues should be addressed, reviewed with the client, and documented for clarity and to minimize liabilities.

Assumptions, clarifications, and exclusions regarding design approaches, activities, and deliverables also should be addressed in the Scope of Services section.

Typical concerns include:

- Is future expansion of the facility to be considered in the design?
- Adequacy of existing plant utility (or other) systems to be used for the proposed project facilities.
- Presence of hazardous wastes, asbestos or volatile organic carbon materials in the work areas.

Scope of services

The Scope of Services should include:

- Project execution approach, activities, and deliverables.
- Activities and deliverables to be provided by the client, suppliers, subcontractors, and others

¹⁴ Assumptions should be documented and regularly tracked.

- Interfaces should be detailed and tracked.
- Activities and deliverables normally provided that will not be provided by anyone else.
 - These represent potential “white space risks”¹⁵. These are risks that fall in between well-defined organizational, policy, process, and scope elements and are not otherwise reflected in risk assessment and management activities.

Project Approach

The project approach provides a general introduction and an overview of the project's Scope of Services. The company execution plan and the methods, activities, and tools that will be provided and/or used for the project are addressed. Specific roles and responsibilities, activities, and tools of the client and other parties for the project also are presented.

The project approach covers the following aspects of the project (if applicable):

- Project type (E, EPC, EPCM, CM, etc.).
- Type of contract (cost plus, lump sum, etc.)
- Identification of engineering or construction companies if performing only partial services
- Project roles and responsibilities
 - Project services responsibility matrix may be prepared or included with a project execution plan
 - Roles and responsibilities of the company engineering, procurement, construction and project management team.
 - Roles and responsibilities of the client
 - Roles and responsibilities of other engineers, contractors and/or companies
- General description of how the project will be executed
- Detailed further in the project execution plan
- Equipment and area numbering systems
- Units in which the work will be measured (e.g., English, metric)
- Language the work will be delivered in
- Types of project reviews (P&IDs, safety, constructability, operability)
- Permit responsibilities (construction, building, environmental)
- Intellectual property; nondisclosure and/or secrecy agreements
 - Data ownership and usage rights
- Brief overview of BIM/CAD systems to be used
- General description of any special design aids to be used, including proprietary company tools
- General description of any planned artificial intelligence (AI) and validation/verification of use
- Brief overview of how company will add value to the project

General information about the physical and functional description of the facility should be discussed in the Scope of Facilities section.

References and Standards

¹⁵ PMR (2019). Program Management Is Anything but Simple: Interview with Robert Prieto; *Project Management Review*; republished in the *PM World Journal*, Vol. VIII, Issue VI, July 2019

The SOW should contain a list of all currently adopted codes and standards that are common to most engineering disciplines for the project. The codes and standards may be the company's, the client's, or applicable industry standards. Any standards related to acceptance of materials, components, systems, and equipment also should be explicitly stated and accepted by the client. Confirm consistency with proposal, cost, and pricing basis. It is important to note applicable revision dates to be used where possible and to avoid citing "latest applicable standards," which opens up a potential disparity between the version used in furnishing and installing and ultimate acceptance testing.

Codes and standards applicable to only one or two engineering disciplines should be listed in the individual discipline's References and Standards section of the Scope of Services. A general description of any special design aids to be used also should be discussed in this section.

Typical standards include:

- ANSI – American National Standards Institute
- ASME – American Society of Mechanical Engineers
- ASTM – American Society for Testing Material
- FM – Factory Mutual
- NEC – National Electrical Code
- NEMA – National Electrical Manufacturers Association
- NFPA – National Fire Protection Association
- OSHA – Occupational Safety and Health Administration
- UL – Underwriter's Laboratories Inc.
- State and local codes and regulations having jurisdiction
- Client standards
- Company standards
- Project specification list

Any approvals required by codes shall be obtained by the supplier, such as certification required by local inspecting authorities on foreign supplied equipment, and should be reflected in their respective statements of work.

Particular attention must be paid to new and emerging technologies where standards may not yet exist or are evolving rapidly.

Performance based standards should be noted, ensuring recognized acceptance tests exist.

Special attention is required when AI is incorporated in analysis or final system performance and control. AI is an emerging area warranting special attention.

Special Resources

Any special resources that are of a general nature that will be used to implement the project should be called out, addressing the specific tasks of the resources and the timing of their involvement. Special types of computer simulation and software also should be addressed, together with any planned use of AI.

Deliverables to Client and Construction

The general types of project documents to be provided to the client and construction during or at the end of the project should be described. A more definitive listing of engineering deliverables is typically included as part of the project execution plan. This list should include but should not be limited to:

- Deliverables to Client:
 - Scope of Work for project
 - Project estimates
 - Schedules
 - Monthly project report
 - Project procedure manual
 - Project distribution list
 - Final Building Information Modeling (BIM) model/CAD files (containing only contractually required info)
 - CAD file index
 - Drawing list
 - Specification list
 - Special reports
 - Close-out report
 - Professional Engineer (PE)-stamped documents (if specifically required by client)
- Deliverables to Construction:
 - Scope of work
 - Project estimates
 - Schedules
 - BIM Model/CAD files (as required)

Client Interface

A general overview of the review and approval of project documents and the level of client involvement in the project should be described, reflecting agreement with the client. All major client representatives involved in the interface should be identified along with their roles and responsibilities. Indicate the process and frequency for the various reviews for the project, ensuring consistency with any client approval matrix typically included in the project execution plan.

Inter-Discipline Coordination

How the project team will interface and coordinate work should be described, including methods and procedures to formally review engineering and supplier documents (drawings, specifications, and others). Reference the development of any project activity model as a means of documenting interface requirements.

Assumptions and Clarifications

The SOW should lay out the general assumptions, clarifications, and exclusions (for company, client, and others) associated with the general design approach, activities, and deliverables for the project. Exclusions should be presented in a positive manner. Uncertainties and "soft" issues should be documented in order to promote review and discussion with the client and to minimize liabilities.

This section should address:

- Location of engineering task force, including work in offshore engineering centers
- Estimated trips to job site, suppliers, and others by project management
- Reliability of client documentation
- As-built drawings
- Permits (construction, building, environmental, and others)
- State and local approval of construction documents
- Construction support
- Commissioning and startup support
- Training of plant personnel
- Operating manuals

Assumptions, clarifications, and exclusions regarding the physical and functional description of the facility should be addressed in the Scope of Facilities section.

Engineering and Construction Industry Challenge

An assessment made on the readiness of various industries to ensure project requirements are well defined and understood ranked the engineering and construction industry lowest of six industries¹⁶. Accountability for goal clarity and completeness of requirements begin with the owner, but engineering and construction require strong and regularly implemented scope processes that ensure these have been clearly and comprehensively defined. Requirements should be tracked throughout the project, cascading down into the various structures, systems, and components. A requirements traceability matrix is one tool that can be used.

Assurance that goals and requirements have been clearly and comprehensively defined must include consideration of both the internal and external stakeholder ecosystems. From personal experience, failing mega-projects have suffered from lack of articulation of strategic business objectives as well as agreement on them and continuous communication.

Measurement systems need to focus on project execution, closely managing the prime contract and its associated scope, not just cost and schedule performance. Weaknesses in scope definition and completeness are a predictor of overall negative project performance. Scope, or more appropriately *scope creep*, needs to be a key component of rigorous monthly project reviews¹⁷.

Scope documents must reflect the full range of risks that projects may face, avoiding artificially screening out low probability, high consequence risks. Uncertainty and complexity warrant special attention.

The cascading of project scope throughout a complex supply chain needs to better ensure that unseen “white space” risks are not being created.

¹⁶ Industries, in order of readiness included technology/software; telecommunications; aerospace/defense; services; oil/gas/minerals/utilities; engineering/construction. Tackling the weaknesses in Contract Management; Pitfall #1: Lack of clarity in scope and goals; IACCM; 2016

¹⁷ Effective Project Review Meetings; National Academy of Construction Executive Insight; Bob Prieto; June 5, 2019

Role of Work Breakdown Structure (WBS)

The WBS serves to further refine the project's scope as well as to break the work down into manageable, executable tasks. The lowest level in a WBS is the work package level¹⁸. Advanced Work Packaging (AWP) creates small, well-defined Engineering, Construction or Installation Work Packages (EWP, CWP, IWP) for the construction workforce. This paper is not focused on the WBS, however, several cautions are worth noting.

First, the process of refining and defining the project's scope must avoid tendencies to create scope growth through the addition of *wants* vs the project's *needs* defined in the scope document. These wants can include new requirements, nice-to-have features, or personal preferences of members of the WBS team. The developed WBS must be thoroughly reviewed against the SOW for both gaps as well as extraneous items.

Second, the theory behind WBS development rests on an initial premise of conventional project management theory that holds that projects are well bounded and decomposable into smaller tasks. In the world of large complex projects¹⁹, projects are not well bounded, being susceptible to a wide range of external factors that create *project flows* that modify task activities and more significantly the flows or work reflected in the connecting arrows in a WBS. For large complex projects, these arrows are no longer dimensionless and white space risks can be created as the result of project flows.

Scope Creep

Scope creep, or at least the tendency to grow the scope of work, is a reality of project execution. Scope change, effectively managed, is not necessarily bad. Scope creep, ineffectively managed, creates project problems and drives cost and schedule overruns. Table 2²⁰ identifies some indicators of potential scope creep risk.

¹⁸ What Is A Work Package?; The AWP Institute; April 23, 2018

¹⁹ Theory of Management of Large Complex Projects; Construction Management Association of America (2015); ISBN 580-0-111776-07-9

²⁰ Identifying Manageable Scope Creep Indicators and Selecting Best Practice Strategies for Construction Projects; Safapour, Kermanshachi; 2019

Table 2

Scope Creep Indicators

- Communication within owners
- Number of oversight entities
- Impact of project location
- Alignment of internal entities
- Number of owner organizations
- Number of funding phases
- Clarity of project goals
- Project population density
- Target project schedule
- Number of joint venture entities
- Number of active internal entities

Front end planning and alignment strategies are effective means of reducing the risk of scope creep. Strong change management practices complemented by effective dispute resolution practices also contribute to better scope management.

Key Performance Indicators (KPIs)

All items of scope must be quantifiable and measurable. These in turn must be linked to the baseline cost and schedule. Project deliverables need to be confirmed by all relevant stakeholders and the effort to create and maintain these deliverables needs to be considered.

Key performance indicators (KPIs) should be linked to acceptance criteria for each deliverable.

About the Author

Bob Prieto was elected to the National Academy of Construction in 2011. He is a senior executive who is effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering, and construction industries.

Although the author and NAC have made every effort to ensure accuracy and completeness of the advice or information presented within, NAC and the author assume no responsibility for any errors, inaccuracies, omissions or inconsistencies it may contain, or for any results obtained from the use of this information. The information is provided on an “as is” basis with no guarantees of completeness, accuracy, usefulness or timeliness, and without any warranties of any kind whatsoever, express or implied. Reliance on any information provided by NAC or the author is solely at your own risk.