Front End Planning of Railway Projects

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ABSTRACT

Infrastructure capital projects are at the center of efforts to invest in the recovery of the economy, both domestically and internationally, and are seen as a primary growth engine of the construction industry today. Sadly, many of these projects are unsuccessful due to poor early project planning. Front End Planning (FEP) is a critical process for uncovering project unknowns, while developing adequate scope definition and a structured approach for the project execution process. FEP assists in identifying and mitigating issues such as right-of-way concerns, utility adjustments, environmental hazards, logistic problems, permitting requirements and so on. This paper will outline research funded by the Construction Industry Institute (CII) focused on front end planning of infrastructure projects. This investigation, which includes input from domestic and foreign planning experts from over 30 organizations using as reference over 60 capital projects, provides an understanding of the critical issues that must be addressed during FEP of infrastructure projects, particularly as applied to rail projects. A new risk management tool for FEP, called the Project Definition Rating Index (PDRI) for Infrastructure Projects, will be shown. Critical success factors for FEP of railway and infrastructure projects will be shared, including key planning process steps, along with guidance to practitioners involved in planning these types of projects.

INTRODUCTION

In recent years, a high percentage of the annual construction-related capital spent by public and private owner organizations is on infrastructure work in both foreign and domestic markets. Estimates by Engineering News Record for 2008 were at $225 billion for new construction and repair/renovation of aging infrastructure. This represented a 10 percent increase over 2006 expenditures (ENR 2007). Although this 2008 forecast probably did not occur because of the economic downturn, it does show the extent of expenditures in this sector.

Recent failures in infrastructure projects, such as the bridge collapse in Minnesota, steam line failure in New York City, levee failures, and the public outcry to invest in traditional and alternative energy infrastructures to reduce the price of energy have highlighted the precarious condition of the nation's infrastructure. Studies have shown a poor success rate on many large infrastructure projects including several railway systems (Flyvbjerg et al. 2003; NRC 2003). As the economy has slowed, government economic stimulus efforts, both foreign and domestic, are focusing on infrastructure investments to revitalize economic conditions. Consequently, a large and growing volume of construction work is focused on infrastructure projects. The increased demand for more sustainable infrastructure, calls for greater control in the front end planning (FEP) process. In order to provide the construction industry with an adequate tool to solve the current conditions, the Construction Industry Institute (CII) formed a research team with the purpose of creating a front end planning tool specifically designed to address the unique circumstances that surround infrastructure projects.

While addressing FEP of industrial and building projects, previous CII-research efforts have not focused on infrastructure work directly, and little research has been performed in the area of FEP for infrastructure projects. The research project outlined in this paper is a continuation of the research/development thread conducted by CII over the past 18 years, extending to this important industry sector. The objective of this paper is to portray the importance of developing a tool for front end planning of infrastructure projects, and to describe the process the CII research team is using to develop the FEP tool, including initial findings.

Research focused on FEP for infrastructure projects began in October 2008. CII brought together a team of 20 industry professionals representing hundreds of combined years of experience in infrastructure projects, pre-planning, estimating and related fields. This team was comprised of highly experienced members from 20 different owner organizations, contractors, and suppliers along with the academic team.

IMPORTANCE OF FRONT END PLANNING

Front end planning is defined as “the process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chance for a successful project” (CII 1994). Figure 1 shows the CII phase gated front end planning process. Front end planning generally occurs up until phase gate 3 on the model, just prior to design and construction of the project. Front end planning is arguably the single most important process in a capital facility project life cycle. It is focused on creating a strong, early link between the business or mission need, project strategy, scope, cost, and schedule and maintaining that link unbroken throughout the project life (CII 2008a). Anecdotally, many organizations concede that effective front end planning is rare, but it is desired for every project and essential for optimal and consistent project execution.

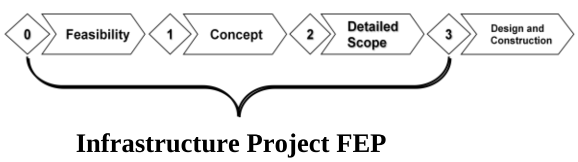

Figure 1. Front End Planning Process

CII research indicates that well performed FEP has helped reduce total design and construction cost by as much as 20 percent, reduce total design and construction schedule by up to 39 percent, improve cost and schedule predictability and increase the chance of meeting the project's environmental and social goals (CII 1994).

PROJECT FLOW PER FTA

The Federal Transit Administration (FTA) has provided the industry standard for project management of major transit infrastructure projects through its Program Management Oversight (PMO) Program. The original PMO rule was issued in September of 1989 and defined the tenets of major capital programs. It set out the requirements for the Project Management Plan (PMP) and the PMO Program that would be required of all major capital programs (FTA 2003).

The FTA process is semantically different than shown in Figure 1, but corresponds in content and result. Figure 2 shows the FTA process with the front-end planning stretching from alternatives analysis to the end of preliminary engineering and the “okay” for final design.

Over time the PMO Program has evolved to include major risk assessments as well as other specific procedures such as value engineering (FTA 2007). The PDRI tool as described in this paper is more than a risk assessment process. It provides a way to poll all of the major participants in the project as to their assessment of the completeness of the process to-date. The evaluation and subsequent workshops will often identify and focus on risk, but they also provide a consensus from the group of people most knowledgeable about the project (the Project Team) as to the quality of its plan. In contrast, the FTA risk assessment process requires an evaluation by persons (often independent of the Project Team) concerning what the major risks to the program are and how significantly they will impact the schedule and budget. Granted, those evaluations are based on workshops and interviews with the project team to provide input and feedback on the findings by the risk assessment team. Used in conjunction with this process, the PDRI would help the project team address the quality of the planning to date, identifying gaps strengthening the overall risk management process.

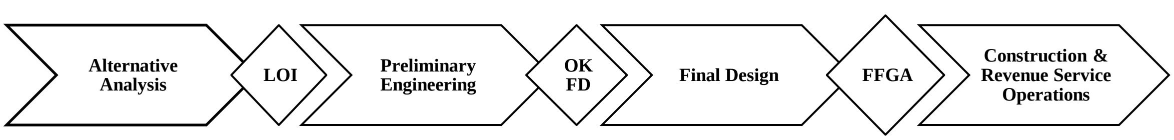

Figure 2. FTA Process Map

WHAT IS AN INFRASTRUCTURE PROJECT?

One of the first tasks undertaken in this research effort was to develop an agreed-upon definition of an infrastructure project. Many definitions were reviewed and the team spent several meetings refining the definition that is given below: (Bingham et al. 2010)

> "A capital project that provides transportation, transmission, distribution, collection or other capabilities supporting commerce or interaction of goods, service, or people. Infrastructure projects generally impact multiple jurisdictions, stakeholder groups and/or a wide area. They are characterized as projects with a primary purpose that is integral to the effective operation of a system. These collective capabilities provide a service and are made up of nodes and vectors into a grid or system (e.g., pipelines (vectors) connected with a water treatment plant (node))."
>
> Vector examples:
> - Railway systems
> - Electrical distribution systems:
> - Pipelines
> - Highways
> - Canals
> - Tunnels
> - Telecommunication lines
> - Wide Area Networks
>
> Nodes/Centralized facilities examples:
> - Rail, marine, or air terminals
> - Dams
> - Power generation facilities
> - Steam or chilled water production
> - Water/waste water/ solid waste processing

In the context of systems, an infrastructure in this definition provides the needed services and connections (vectors) that enable industrial facilities and buildings to function effectively. If any of these vectors are disrupted, the entire system will fail to function effectively unless redundancy is provided. A diagram illustrating this concept is given in Figure 3.

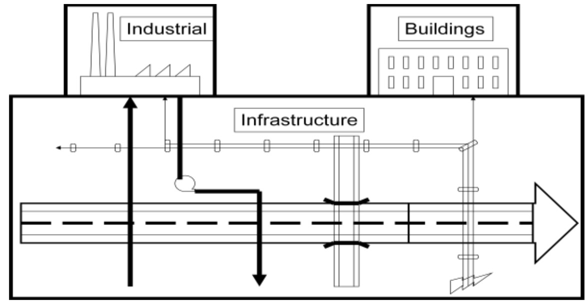

Figure 3. Infrastructure Interrelationship Diagram

WHAT IS THE PDRI?

Beginning in 1994, the Construction Industry Institute (CII) began to develop a tool used in the front end planning process. This tool is known as the Project Definition Rating Index or PDRI. The first PDRI was intended for use on industrial projects. After successful research and testing, the PDRI for industrial projects went through three revisions to give us the current edition. It became evident to the developers, that there was a need for a similar tool for building projects. In 1999, the Project Definition Rating Index for building projects was developed (Dumont and Gibson 1996; Cho et al. 1999).

The PDRI is a tool designed to measure the degree of scope definition in a project. This tool is composed of a comprehensive checklist of scope definition elements to be evaluated based on level of completeness by project representatives before detailed design and construction. After all elements have been assessed, an index is calculated that gives the relative level of definition for the project. A lower score indicates a more complete scope definition (CII 2008a; CII 2008b).

Initially developed in 1996, the PDRI for industrial projects has been extensively used by Amgen, 3M, US Steel, Anheuser-Busch, Cargill, Shell, Exxon Mobil, Phillips Conoco, Air Products, Elf Atochem, WorleyParsons, Jacobs, S&B Engineers, OPG, KBR, Norsk Hydro, PDVSA, URS and others. The PDRI for building projects was developed in 1999 and is widely used by major organizations such as 3M, Hensel Phelps, NASA, GM, Department of State, General Services Administration (GSA), Department of Health and Human Services, Smithsonian Institution, and others. The system has been so successful that third editions of both versions were published in the summer of 2008.

The development of the infrastructure PDRI has included workshops with infrastructure industry leaders, and peer group assessments in order to provide appropriate weighting for the various elements in the PDRI process. The overriding hypothesis of this development effort is that there are FEP process steps and data that can be defined that will add value to a capital project, in this case an infrastructure type project. This process and associated variables will positively influence success of a project and a project team (and an organization) must perform this process effectively in order to have a more successful project venture. The development methodology to test this hypothesis has been used successfully in past efforts of this type (Dumont and Gibson 1996; Cho et al. 1999; Gibson and Whittington 2008).

The CII research team met multiple times over the course of nine months to draft the PDRI for infrastructure. The original basis of the tool was provided by a front end planning risk tool entitled the Advance Planning Risk Analysis (APRA) tool developed for Texas Department of Transportation (Caldas et al. 2006). The draft PDRI consists of 3 sections broken down to 13 categories and further into 68 elements focused on scope definitions for infrastructure projects. These 68 elements are organized in checklists, an excerpt of which can be seen in Figure 4 which shows the elements that make up the category entitled Project Strategy. Each element is further detailed with a description as shown in Figure 5, in this example for public involvement (element A.4).

SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
A. PROJECT STRATEGY							
A.1 Need & Purpose Documentation							
A.2 Investment Studies & Alternatives Assessments							
A.3 Key Team Member Coordination							
A.4 Public Involvement							
CATEGORY A TOTAL							

Definition Levels

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

Figure 4. Excerpt from PDRI Project Score Sheet

A.4 Public Involvement

Public involvement is an integral part of project development and should be planned and managed. Most infrastructure projects have to afford some level of public involvement to inform the public of project scope issues and to measure public attitudes regarding the development process. The level of public involvement is dependent upon a number of social, economic, and environmental factors, along with the type and complexity of the project. Community involvement efforts may include meetings with key stakeholders, including affected property owners, public meetings, and public hearings. Issues to consider include:

- ❑ Policy determinations regarding public involvement
- ❑ Notification procedures and responsibilities
- ❑ Identification of key stakeholders
- ❑ Identification of utility providers
- ❑ Types of public involvement:
- ❑ Press releases and notices
- ❑ Public meetings/hearings
- ❑ Individual or group meetings with affected property owners
- ❑ Local support and/or opposition
- ❑ Public involvement strategies after project approval
- ❑ Available website content
- ❑ Input of public involvement information into any typical deliverables such as a “Environmental Impact Statements”, “Public Hearing Notices,” or other
- ❑ Other user defined

Figure 5. Example Element, A.4 Public Involvement

Appendix 1 gives a listing of the 68 elements that were identified and defined as part of this development effort. Each of these elements is grouped topologically under categories, with the categories grouped within the three sections.

Using structured focus groups (also known as research charrettes) a purposive, expert sample of workshop participants was solicited by the research team to provide input into this tool. These workshops were held in London, Houston, New York, Washington DC, and Los Angeles in which 64 industry professionals representing 37 organizations, 15 owners and 21 contractors, with over 1400 years of individual experience in infrastructure projects have participated. Table 1 provides a listing of workshops, while Table 2 provides a list of organizations that participated in the workshops. Individuals in these workshops represented the viewpoints of 37 contractors/consultants and 27 owner organizations. An attempt was made to ensure that representatives had experience in one of three categories of infrastructure projects: projects that conduct energy such as transmission lines, people and freight projects such as highways or railroads, or fluids projects, such as pipelines or channels.

Location	Date	Number of Participants
Washington, DC	July 16, 2009	16
Sunbury, UK	August 11, 2009	8
London, UK	August 13, 2009	7
Houston, TX	September 16, 2009	13
New York, NY	October 14, 2009	12
Los Angeles, CA	October 20, 2009	8

Table 1. Workshops and Participants

The research team realized that the 68 elements that make up the PDRI for Infrastructure were not weighted equally. That is to say that there are individual elements among the 68 total elements that will have a greater effect on the overall level of preparedness for a project, and in turn the success of a project. With this in mind, the project team relied on participants in these research charrettes to develop relative weights to each of the 68 elements within the PDRI. Charrettes began with an explanation of the PDRI tool, purposes and goals of the research, its background, and desired end product. Participants provided background information that included their contact information, company, position, as well as the participant's total years of project management, planning or estimating experience, types of projects, and the percentage of work experience involving infrastructure projects.

Owners	Contractors
Architect of the Capital	AECOM
British Petroleum	Booz Allen Hamilton
Chevron	CH2M HILL
Conoco Phillips	CSA Group
European Investment Bank	D' Orange Ltd
Exxon Mobil	Fluor Enterprises
Natl. Inst of Stnds. and Tech.	European Construction Institute
Port of Long Beach	Jacobs Engineering
Salt River Project	KBR
Sempra Global	KPFF
Smithsonian Institution	Mustang Engineering
UK Highways Agency	P2S engineering
UK Network Rail	Parsons
U.S. Army Corp of Engineers	Pathfinder LLC
U.S. Department of Energy	Phoenix Constructors
	Project Resource Company
	PSEG
	S & B Infrastructure Group
	Syngenta Engineering
	The RBA Group
	Worley Parsons

Table 2. Workshop Participating Organizations

Participants were asked to give feedback to the score sheets, descriptions, and efficacy of the draft PDRI as the charrette progressed. These data were used to update and modify the structure to better represent industry terminology and risk profile for these types of projects.

The workshops proceeded with each participant using an infrastructure project that they had recently been involved in as a reference for providing relative importance values. This project would be used as a reference throughout the charrette to assign values to the defined elements. The workshop facilitator then reviewed each element within the 13 categories giving a detailed definition and description of the element while answering questions. Assuming that scope development for the project had been completed, the workshop participants were instructed to apply what they felt to be an appropriate cost contingency to each element, given two circumstances: 1) the element was undefined or 2) it was completely defined. The weighting was based on their opinions as to the relative impact that each element has on the overall accuracy of the project's total installed cost (TIC) estimate.

The data collected from the workshops was used to develop the final working version of the PDRI score sheet. By normalizing the responses from the workshop participants, the research team will create a scoring system from zero to 1000 points. The detailed description of this process is beyond the scope of this paper, but follows the model developed by Cho et al. (1999) and outlined in Bingham et al (2010). The end product is a comprehensive score sheet that can be used to evaluate the level of completeness or definition for individual project scopes and is in final production.

This tool has been used on two in-process infrastructure project planning sessions and used to assess the planning efficacy "after the fact" on 11 additional projects. These 13 total projects represent approximately $4.5 billion. This testing phase will continue for another few months and results will be outlined in Bingham et al. (2010). To date, the results are encouraging in terms of providing a mechanism for addressing risks during front end planning.

The developed tool provides a way to poll the project participants on their assessment of the condition of a number of project characteristics at different states in development process. These ratings are incorporated into a weighted model that then provides a measure of the quality of the planning at that point in time. While the assessments by the individuals are qualitative, their aggregation indicates the team's view of project scope definition. Not only does this indicate areas where the current planning is weak, it also provides insight to all participating individuals in the assessment session, thus facilitating alignment of the team.

The process includes team workshops to assess the project, where risks are identified. It goes beyond risk assessments as it allows the group to focus on scope gaps and gain a better understanding of the status of the project.

INITIAL RESULTS

An analysis of the data collected through the various workshops supported the theory that some elements were of relatively higher importance than other elements. The following are assessments from the initial data when normalized. Based on input from the workshop participants, the top ten elements (of 68) in order of importance for infrastructure projects are:

1. Need & Purpose Documentation: Project need may be identified in many ways, including suggestions from operations and maintenance personnel, engineers, planners, local elected officials, developers, and the public. Documentation should result from the assessment, including factual evidence of current and future conditions, as well as why the project is being pursued.

2. Investment Studies & Alternatives Assessments: Various studies address possible alternatives including location, technology, funding sources, contracting strategy and so forth. These findings will avoid unnecessary expenditures on preliminary engineering and related costs. They will also confirm the viability of proceeding with the selected option and typically take the form of feasibility/route studies or major investment studies.

3. Contingencies: The contingency management process should effectively communicate the contingency magnitude and confidence level to all appropriate stakeholders. Contingencies are forecasted and adjusted throughout the planning process based on the level of confidence in the current estimate accuracy.

4. Design & Construction Cost Estimates: The project cost estimates should address all costs (excluding right-of-way acquisition and utility adjustment costs) necessary for completion of the project.

5. Preliminary Project Schedule: A preliminary project schedule should be developed, analyzed, and agreed upon by the major project participants. It should include milestones, unusual schedule considerations and appropriate master schedule contingency time (float), procurement plan (long-lead or critical pacing equipment/material and contracting), and required submissions and approvals.

6. Funding & Programming: Initial cost estimates are prepared, assessing funding provided for planning, design, construction, right-of-way acquisition, utility adjustment, maintenance, and other project expenses. Measures must be in place for determining the sources, levels, forms and timing of funding available to the project, as it competes against others for limited funds, whether public or private.

7. Existing Environmental Conditions: An understanding of existing environmental conditions must be obtained from a variety of sources, including previous surveys, geographic information systems, and resource agency databases. Identifying problematic issues at an early stage in the project development process enables better decision making as well as adequate time to address and mitigate these concerns.

8. Design Philosophy: A list of general design principles should be developed to achieve a successful project that fulfills the functional requirements and assimilates into the existing infrastructure system.

9. Capacity Study: Capacity studies are required for scope definition of most infrastructure projects. These studies provide a description of the related process flows and interactions allowing the planning team to ensure adequate facility capacity, while guarding against over- or under-design.

10. Evaluation of Compliance Requirements: An understanding of adherence requirements to various local, regional, and national plans is required. Compliance should be assessed with existing plans, codes, and standards, national, regional or local requirements and utilization of design standards.

A study of the element rankings when compared to the rankings given in the PDRI for buildings and industrial projects, highlighted elements of equally high importance as well as confirmed the uniqueness of infrastructure projects. Some issues that were found in all three top ten lists include: the importance of marketing and business planning, evaluation of site conditions, and identification of all needs and uses of the facility. Unique characteristics of infrastructure projects included in this top ten list: contingencies, design philosophy and funding.

PUBLIC TRANSIT AND PDRI

The PDRI is applicable to rail and public transit including: light rail, commuter rail, subways, high speed rail and passenger services. PDRI use in Rail planning, design, construction, finance, supply, and operation will assist the project team in risk analysis and management. This tool is especially applicable as an assessment mechanism during the project development, initiation, and planning stages of the development as outlined in FTA's project process. A perusal of the FTA's Project and Construction management guidelines shows that the PDRI fits very well within this structure (FTA 2007).

Three of the 68 elements making up the infrastructure PDRI specifically call out issues unique to rail projects. Many more elements in the PDRI address issues unique to moving people and freight, whether highway, rail, or air.

KEY FINDINGS RELATED TO RAIL

Of the 64 professionals who participated in the workshops, five represented rail projects. An analysis was performed to identify differences between rail projects and other infrastructure projects (if any) with the focus on the top ten elements. Table 3 shows the relative weights of the top ten (of 68 elements) for rail versus infrastructure in general. While the number of rail respondents was small, the results appear to be consistent with the authors' experiences.

Element Number	Rail Element	Railroad Element Weight.	All Projects Weight
C.1	Funding & Programming	43	*
A.1	Need and Purpose Documentation	37	44
C.3	Contingencies	35	27
C.2	Preliminary Project Schedule	31	22
A.2	Investment Studies & Alternatives Assessment	28	28
B.1	Design Philosophy	26	22
L.2	Design & Construction Cost Estimates	25	25
A.4	Public Involvement	22	*
D.4	Existing Environmental Conditions	22	22

* Note: Not among the top ten for all projects; Investment Studies and Alternatives Assessment and Capacity not in top ten for rail projects

Table 3. Comparison of Rail to All Infrastructure Projects

Funding and programming became the most important element in rail infrastructure work probably because most of these projects are discretionary (do not have to be done for the system to function or are establishing a new system) and are often greatly shaped by the funding available and not purely by a needs assessment.

The preliminary project schedule shows a higher rating in the rail projects then within the infrastructure projects in general. This is possibly due to the high level of third parties' involvement in rail projects and their ability to influence both the scope and timetable. When risk assessments are done for these projects, many times the most significant cost risk is related to delay. This is due in part to escalation overshadowing all the other cost impacts. Many of the risks translate to larger escalation cost than other cost increases because of the delays intrinsic in the risks. A valid preliminary project schedule increases in importance for any public rail project because of the tendency of political pressure to accelerate the project beyond reasonable levels. It is not uncommon for project milestones to be established before any real analysis has been carried out and a reasonable timetable established. The PDRI can prove to be an effective tool for reality checking the full project team on the reasonableness of the project schedule.

The high level of third parties' involvement within rail projects perhaps explains why the Public Involvement PDRI element appears as a top issue for rail projects and is absent from the top 10 list for all infrastructure projects. Most rail projects require close coordination with public entities and the general public to ensure that the project will not be delayed for public concerns. (see Figure 5 for more detail)

Capacity is anticipated to be not as critical for rail projects because capacity often is a step function in rail systems in general and passenger rail systems in particular. Most passenger rail projects are designed as 2-track systems at minimum even if the complete second track is built out over time not as an initial investment. This minimum is required for operational reliability if not for capacity. The addition of tracks beyond this minimum significantly increases the cost of projects and is often not required for the capacity demands of new rail systems. This is less true in the case of the station capacities for handling pedestrian loads. Many elements of stations are more scalable such as vertical circulation and excess capacity. Because of this, we suggest that station capacity be recognized as a separate element from line capacity.

CONCLUSIONS

Railway projects share many of the same tenets with other infrastructure projects. First, these projects typically involve a larger number of key stakeholders than building or industrial projects. These stakeholder interfaces must be managed. Second, these projects are typically horizontal in nature and cross multiple jurisdictions. This fact means that non-homogeneous jurisdictional and technical conditions exist that must be addressed, such as compliance requirements, disparate funding sources, and right of way procurement difficulties. Managing these issues during the front end planning process requires a disciplined and diligent approach. The PDRI as outlined in this article can provide a mechanism to help with this process.

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Appendix 1. List of Sections, Categories and Elements of PDRI, Infrastructure Projects

SECTION I. BASIS OF PROJECT DECISION
A. Project strategy
A1. Need & purpose documentation
A2. Investment studies & alternatives assessment
A3. Key team member coordination
A4. Public involvement

B. Owner/operator philosophies
B1. Design philosophy
B2. Operating philosophy
B3. Maintenance philosophy
B4. Future expansion & alteration considerations

C. Project funding and timing
C1. Funding & programming
C2. Preliminary project schedule
C3. Contingencies

D. Project requirements
D1. Project objectives statement
D2. Functional classification & use
D3. Evaluation of compliance requirements
D4. Existing environmental conditions
D5. Site characteristics available vs. required
D6. Dismantling & demolition requirements
D7. Determination of utility impacts
D8. Lead/discipline scope of work

E. Value analysis
E1. Value engineering procedures
E2. Design simplification
E3. Material alternatives considered
E4. Constructability procedures

SECTION II. BASIS OF DESIGN
F. Site Information
F1. Geotechnical characteristics
F2. Hydrological characteristics
F3. Surveys & mapping
F4. Permitting requirements
F5. Environmental documentation
F.6 Environmental commitments & mitigation
F7. Property descriptions
F8. Right-of-way mapping & site issues

G. Location and geometry
G1. Schematic layouts
G2. Horizontal and vertical alignment
G3. Cross-sectional elements
G4. Control of access

H. Associated structures & equipment
H1. Support structures
H2. Hydraulic structures
H3. Miscellaneous elements
H4. Equipment list
H5. Equipment utility requirements

I. Project design parameters
I1. Capacity
I2. Safety & hazards
I3. Civil/structural
I4. Mechanical/equipment
I5. Electrical/controls
I6. Operations/maintenance

SECTION III. EXECUTION APPROACH
J. Land acquisition strategy
J1. Local public agencies contracts & agreements
J2. Long-lead parcel & utility adjustment identification & acquisition
J3. Utility agreement & joint-use contracts
J4. Land appraisal requirements
J5. Advance land acquisition requirements

K. Procurement Strategy
K1. Project delivery method & contracting strategies
K2. Long-lead/critical equipment & materials identification
K3. Procurement procedures & plans
K4. Procurement responsibility matrix

L. Project control
L1. Right-of-way & utilities cost estimates
L2. Design & construction cost estimates
L3. Project cost control
L4. Project schedule control
L5. Project quality assurance & control

M. Project execution plan
M1. Safety procedures
M2. Owner approval requirements
M3. Documentation/deliverables
M4. Computing & CADD/model requirements
M5. Design/construction plan & approach
M6. Intercompany & interagency coordination & agreements
M7. Work zone and transportation plan
M8. Project completion requirements