

Best Productivity Practices Implementation Index for Infrastructure Projects



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Best Productivity Practices Implementation Index for Infrastructure Projects

Research Team 252, Construction Productivity Research Program

Construction Industry Institute

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Chapter 1:

Introduction

The Best Productivity Practices Implementation Index for Infrastructure Projects (BPPII–Infrastructure) is a tool designed to help project managers or superintendents plan productivity enhancing jobsite activities. The philosophy of the BPPII is that one can only improve what is measured. The BPPII–Infrastructure measures the planning and implementation levels of practices that have the potential to improve construction productivity on infrastructure projects. These practices differ from the Construction Industry Institute (CII) Best Practices since the focus of BPPII is on practices that promote productivity improvement. The BPPII enables managers to identify practices with low implementation levels on their projects. And it helps them carry out practices that, as noted above, positively affect productivity.

The BPPII should be used at the beginning of the execution phase, to help project managers identify the productivity-improving practices to be implemented at the construction site. However, it can also be used at the end of the detailed scope phase to help prepare the project execution plan.

Benefits of the BPPII

The BPPII can be utilized to fit the needs of almost any individual infrastructure project and provides the following:

- a list of the essential practices that need to be planned and implemented on a project
- a checklist that determines the level of planning and implementation of these best productivity practices
- a list of strategies to achieve higher levels of implementation of best productivity practices.

Relationships with Other CII Indices

CII provides other valuable indices for project assessment, such as the Project Definition Rating Index (PDRI) and the Project Health Indicator (PHI). Figure 1 illustrates the application of these indexes in the project life cycle. ***The PDRI measures the level of project scope definition during front end planning (FEP). The PHI assesses leading indicators of project performance during the execution phase. The BPPII supplements these indexes. It evaluates practice implementation levels with a focus on construction productivity. The BPPII should be used at the end of the FEP phase and at the beginning of the execution phase to support the preparation of the project execution plan (PEP).*** It can also be used during the execution phase for continuous assessment and improvement.

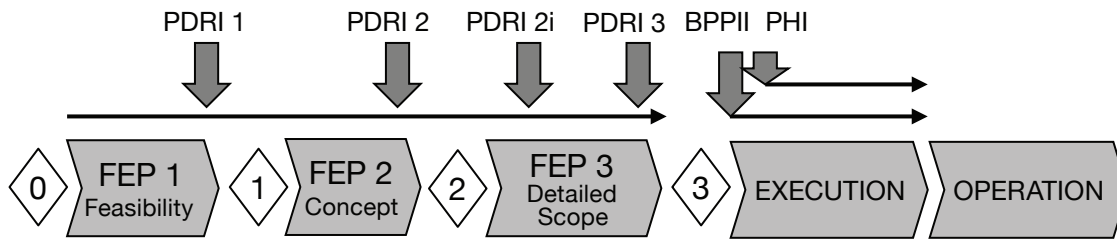


Figure 1. Application Stages of CII Indices

BPPII Tool

RT 252 designed the macro-enabled spreadsheet-based BPPII tool to help project teams assess individual projects. Developed in a Microsoft Excel 2010 environment it has five main interface components: 1) Introduction; 2) User Guide; 3) Background–BPPII Descriptions; 4) Input–BPPII Rating; and 5) Output–BPPII Reporting. (See Figure 2.) Readers may skip the remaining sections of this implementation resource and go directly to there is no need for any background or details on the tool.

Important parts of this tool are the Input–BPPII Rating and Output–BPPII Reporting sheets. They are the major input and output of this tool. More details and user instructions are provided within the Excel-based tool.

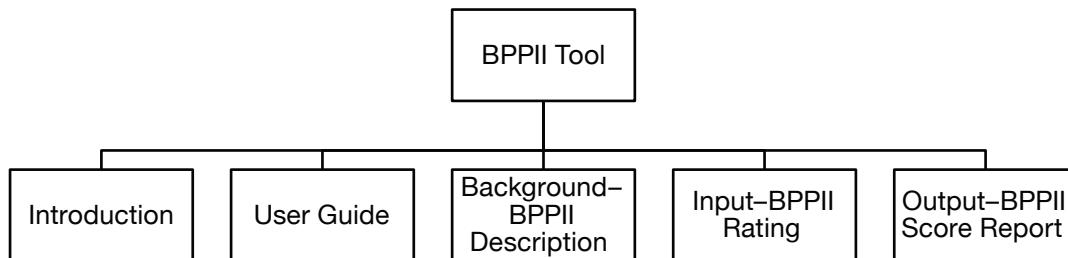


Figure 2. Structure of BPPII Tool

Although the BPPII Tool offers a more convenient method for the assessment of individual projects, this implementation resource also provides two manual-entry BPPII score sheets. (See Appendix A and B.) The first is the BPPII score sheet in Appendix A, which is based on the same weights used in the BPPII tool. A user can rate each element and sum the weights of the elements to calculate an overall BPPII score. The second score sheet in Appendix B does not include the weights of elements.

Chapter 2:

Development of BPPII–Infrastructure

Practices Identification

RT 252 based the BPPII on the knowledge and experience of productivity experts from owner and contractor organizations, and on its in-depth investigation of productivity-enhancing construction practices. To develop the tool, the research team first performed an extensive background review to identify factors affecting construction productivity and the practices that improve it. The team then analyzed the findings of this review and, at the end, was able to identify 61 best productivity practices, which it then organized into elements, sections, and categories. The result was the BPPII structure, which consists of 61 elements, 20 sections, and six categories. Publications were used extensively to accurately describe all BPPII elements, as well as their respective implementation levels. These descriptions will help project management teams objectively evaluate their own levels of implementation of each element.

Weighting

All of the 61 elements described in the previous section are not equally weighted in the BPPII. Each element was weighted on the basis of its relative importance in influencing construction productivity on infrastructure projects. In addition, the weighting of each section was relative to the other sections, just as the weighting of each category was weighted relative to the other categories.

Since, one of the best ways to develop reliable and accurate weights for tools like the BPPII is to rely on a broad spectrum of experienced and knowledgeable members of the construction industry, the research team conducted a survey of experts to determine the BPPII weights (Cho, 2000). Survey participants were asked to rank the importance of each element, and the team averaged their assessments to determine the weighted value of each element. These results are the basis of the BPPII weighted score sheet.

Validation

The research confirmed the relationship between the BPPII score and construction productivity. To validate this relationship, the team used a construction productivity metric called the Productivity Factor (PF). The PF is defined as the estimated productivity divided by the actual productivity. (See Equation 1.)

$$\text{Productivity Factor} = \frac{\text{Estimated Productivity (work hours/qty)}}{\text{Actual Productivity (work hours/qty)}} \quad \text{Equation 1}$$

The PF was a useful for validation because it is a relative metric. It can countervail any negative effects stemming from differences in projects (e.g., industry group, contract type, nature, size, location, complexity, and so on). By its definition, a PF greater than 1 means a productivity performance higher than estimated.

For this validation, the research team collected data from various infrastructure projects and divided the responses into two groups—projects with high and low BPPII scores. The team next performed analysis of variance (ANOVA) calculations to confirm statistically significant differences between the high- and low-scoring BPPII groups. A one-way ANOVA test with the two groups revealed a positive result. This test was performed at a 95-percent confidence level, and the p-value of the test was 0.001 (< 0.05), meaning that the difference between the two groups is statistically significant. Based on this validation, it can be concluded that projects with high BPPII–Infrastructure scores (i.e., scores above 50 percent) have the potential to achieve better construction productivity than was originally estimated.

Chapter 3:

BPPII–Infrastructure Structure and Rating System

BPPII–INFRASTRUCTURE ELEMENTS DEFINITION

Categories, Sections and Elements

The BPPII's six categories comprise 20 sections. Each section contains between one and five elements that correspond to industry-recognized best productivity practices. The six categories and details are as below:

- Materials Management (three sections, nine elements)
- Construction Machinery and Equipment Logistics (two sections, seven elements)
- Execution Approach (four sections, 14 elements)
- Human Resources Management (five sections, eleven elements)
- Construction Methods (three sections, 12 elements)
- Environment, Health, and Safety (three sections, eight elements).

Table 1 shows the structure of the BPPII–Infrastructure. The detailed definitions of each category, section, and element can be found in Appendix C.

Table 1. BPPII–Infrastructure Structure

I – MATERIALS MANAGEMENT A. Procurement Strategy - A1. Procurement Procedures and Plans for Materials and Equipment - A2. Long-lead/Critical Equipment and Materials Identification - A3. Procurement Team B. Materials Management Systems - B1. Project Team Materials Status Database - B2. Onsite Material Tracking Technology - B3. Materials Delivery Schedule C. Receipt and Inspection of Materials - C1. Materials Inspection Process - C2. Materials Inspection Team - C3. Post-receipt Preservation and Maintenance II – CONSTRUCTION MACHINERY AND EQUIPMENT LOGISTICS A. Construction Machinery and Equipment Availability - A1. Procurement Procedures and Plans for Construction Machinery - A2. Construction Machinery Productivity Analyses - A3. Construction Machinery and Equipment Maintenance B. Tools and Equipment Management Best Practices - B1. Site Tools and Equipment Management Strategy - B2. Tools and Equipment Tracking - B3. Onsite Tools Maintenance - B4. Construction Machinery and Equipment Utility Requirements III – EXECUTION APPROACH A. Planning - A1. Short Interval Planning - A2. Well Defined Scope of Work - A3. Use of Software - A4. Dedicated Planner - A5. Construction Work Packages B. Constructability Reviews - B1. Design Readiness for Construction - B2. Utility Alignment/Adjustments - B3. Contract Types/Strategies - B4. Model Requirements/3D Visualization C. Acquisition Strategy - C1. Right-of-Way, Land, and Utilities Acquisition Strategy - C2. Contracts and Agreements with Agencies - C3. Utility Agreements D. Regulatory Requirements/Reviews - D1. Environmental Requirements - D2. Regulatory Requirements/Permitting Requirements	IV – HUMAN RESOURCES MANAGEMENT A. Planning - A1. Crews Composition/Crew Formation - A2. Skills Assessment and Evaluation B. Training and Development - B1. Employee/Trades Technical Training - B2. Career Development C. Behavior - C1. Non-financial Incentive Programs - C2. Financial Incentive Programs - C3. Social Activities D. Organizational Structure - D1. Maintain Stability of Organization Structure - D2. Clear Delegation of Responsibility E. Employment - E1. Retention Plan for Experienced Personnel - E2. Exit Interviews V – CONSTRUCTION METHODS A. Project Schedule Control - A1. Integrated Schedule - A2. Work Schedule Strategies - A3. Schedule Execution and Management B. Site Layout Plan - B1. Dynamic Site Layout Plan - B2. Traffic Control Plan - B3. Site Security Plan - B4. Machinery and Equipment Positioning Strategy C. Design/Construction Plan and Approach - C1. Communications, Coordination, and Agreements - C2. Project Start-up Plan - C3. Project Completion Plan - C4. Innovations and New Technologies - C5. Housekeeping VI – ENVIRONMENT, SAFETY, AND HEALTH A. Jobsite Safety - A1. Formal Health and Safety Policy - A2. Health and Safety Plans/Zero Accidents Techniques - A3. Task Safety Analysis - A4. Hazards Analysis - A5. Hazards Planning B. Substance Abuse Program - B1. Drug and Alcohol Testing Program C. Environment, Safety, and Health Training and Orientation - C1. OSHA Compliance Training - C2. Toolbox Safety Meetings
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BPPII–Infrastructure Rating System

The BPPII rating system takes into account the planning and implementation level (PIL) of each of the 61 BPPII elements. The element-specific PIL definitions are given values from “0” to “5,” with “0” corresponding to a non-applicable element, and “5” corresponding to a fully planned and implemented practice. (See Table 2.) The total project BPPII score is the sum of each element’s score.

Table 2. BPPII Rating Example

Section						
Element	0	1	2	3	4	5
A. Construction Machinery and Equipment Availability						
1. Procurement Procedures and Plans for Construction Machinery	0	1	10	19	28	37
2. Construction Machinery Productivity Analyses	0	1	15	23	43	59
3. Construction Machinery and Equipment Maintenance	0	1	15	29	43	59

Analyzing a BPPII–Infrastructure Score

The research team’s validation of the BPPII showed that the BPPII score has a statistically significant relationship with construction productivity. This supports the hypothesis that projects scoring higher on the BPPII also experience better performance. The validation results also established 50 percent as the approximate baseline BPPII score that divides high from low BPPII scoring groups. Therefore, if a certain project has a BPPII score of over 50 percent, the project can be considered as having the appropriate level of planning and implementation of practices that have the potential to improve its labor productivity.

Chapter 4:

Summary

RT 252 developed the BPPII–Infrastructure to help project managers and superintendents achieve higher planning and implementation levels of productivity-improving practices on infrastructure project jobsites. The tool includes six major categories: 1) Materials Management, 2) Construction Machinery and Equipment Logistics, 3) Execution Approach, 4) Human Resources Management, 5) Construction Methods, and 6) Environment, Health, and Safety. As discussed above, in developing the BPPII–Infrastructure, the research team took into account the relevant literature, as well as experts' knowledge and experience.

The relationship between a BPPII score and construction productivity was validated using the Productivity Factor as the metric. Statistical analysis with this metric indicated that projects with higher BPPII scores experienced better productivity performance.

BPPII–Infrastructure scores above 50 percent on a certain projects reflect a higher planning and implementation level of productivity-related practices. Projects with high BPPII scores have greater potential to achieve better construction productivity than was originally estimated. This version of the BPPII focused on large infrastructure projects. Therefore, there are some limitations on using this resource for different types of projects, such as industrial and building.

Appendix A:

BPPII–Infrastructure Score Sheet (Weighted)

Project Name:

Project Type:

Project Location:

Project Duration:

Company Name:

Evaluation Date:

Evaluator:

Title:

Telephone:

e-mail:

I – MATERIALS MANAGEMENT

Section						
Element	0	1	2	3	4	5
A. Procurement Strategy						
1. Procurement Procedures and Plans for Materials and Equipment	0	1	9	17	25	35
2. Long-lead/Critical Equipment and Materials Identification	0	1	13	25	37	49
3. Procurement Team	0	1	5	9	13	19
B. Materials Management Systems						
1. Project Team Materials Status Database	0	1	8	15	22	30
2. Onsite Material Tracking Technology	0	1	3	5	7	8
3. Materials Delivery Schedule	0	1	6	11	16	20
C. Receipt and Inspection of Materials						
1. Materials Inspection Process	0	1	3	5	7	9
2. Material Inspection Team	0	1	2	3	4	6
3. Post-receipt Preservation and Maintenance	0	1	2	3	4	5

II – CONSTRUCTION MACHINERY AND EQUIPMENT LOGISTICS

Section						
Element	0	1	2	3	4	5
A. Construction Machinery and Equipment Availability						
1. Procurement Procedures and Plans for Construction Machinery	0	1	10	19	28	37
2. Construction Machinery Productivity Analyses	0	1	15	29	43	59
3. Construction Machinery and Equipment Maintenance	0	1	15	29	43	59
B. Tools and Equipment Management Best Practices						
1. Site Tools and Equipment Management Strategy	0	1	10	19	28	36
2. Tools and Equipment Tracking	0	1	13	25	37	49
3. Onsite Tools Maintenance	0	1	3	5	7	9
4. Construction Machinery and Equipment Utility Requirements	0	1	3	5	7	9

III – EXECUTION APPROACH

Section						
Element	0	1	2	3	4	5
A. Planning						
1. Short Interval Planning	0	1	6	11	16	22
2. Well Defined Scope of Work	0	1	8	15	22	30
3. Use of Software	0	1	3	5	7	9
4. Dedicated Planner	0	1	10	19	28	37
5. Construction Work Packages	0	1	5	9	13	18
B. Constructability Reviews						
1. Design Readiness for Construction	0	1	11	21	31	41
2. Utility Alignment and Adjustments	0	1	10	19	28	39
3. Contract Types/Strategies	0	1	10	19	28	38
4. Model Requirements/3D Visualization	0	1	3	5	7	8
C. Acquisition Strategy						
1. Right-of-Way, Land, and Utilities Acquisition Strategy	0	1	3	5	7	9
2. Contracts and Agreements with Agencies	0	1	4	7	10	13
3. Utility Agreements	0	1	7	13	19	24
D. Regulatory Requirements/Reviews						
1. Environmental Requirements	0	1	13	25	37	51
2. Regulatory Requirements/Permitting Requirements	0	1	12	23	34	44

IV – HUMAN RESOURCES MANAGEMENT

Section						
Element	0	1	2	3	4	5
A. Planning						
1. Crews Composition/Crew Formation	0	1	14	27	40	54
2. Skills Assessment and Evaluation	0	1	13	25	37	50
B. Training and Development						
1. Employee/Trades Technical Training	0	1	13	25	37	49
2. Career Development	0	1	9	17	25	35
C. Behavior						
1. Non-financial Incentive Programs	0	1	9	17	25	32
2. Financial Incentive Programs	0	1	11	21	31	40
3. Social Activities	0	1	13	25	37	48
D. Organizational Structure						
1. Maintain Stability of Organizational Structure	0	1	2	3	4	7
2. Clear Delegation of Responsibility	0	1	6	11	16	21
E. Employment						
1. Retention Plan for Experienced Personnel	0	1	8	15	22	31
2. Exit Interviews	0	1	9	17	25	33

V – CONSTRUCTION METHODS

Section						
Element	0	1	2	3	4	5
A. Project Schedule Control						
1. Integrated Schedule	0	1	9	17	25	35
2. Work Schedule Strategies	0	1	3	5	7	10
3. Schedule Execution and Management	0	1	2	3	4	6
B. Site Layout Plan						
1. Dynamic Site Layout Plan	0	1	14	27	40	53
2. Traffic Control Plan	0	1	8	15	22	28
3. Site Security Plan	0	1	3	5	7	8
4. Machinery and Equipment Positioning Strategy	0	1	5	9	13	19
C. Design/Construction Plan and Approach						
1. Communications, Coordination, and Agreements	0	1	13	25	37	50
2. Project Start-up Plan	0	1	5	9	13	18
3. Project Completion Plan	0	1	8	15	22	30
4. Innovations and New Technologies	0	1	16	31	46	60
5. Housekeeping	0	1	11	21	31	42

VI – ENVIRONMENT, SAFETY, AND HEALTH

Section						
Element	0	1	2	3	4	5
A. Jobsite Safety						
1. Formal Health and Safety Policy	0	1	17	33	49	64
2. Health and Safety Plans/Zero Accidents Techniques	0	1	17	33	49	64
3. Task Safety Analysis	0	1	15	29	43	56
4. Hazards Analysis	0	1	15	29	43	57
5. Hazards Planning	0	1	16	31	46	60
B. Substance Abuse Programs						
1. Drugs and Alcohol Testing Program	0	1	4	7	10	13
C. Environment, Health, and Safety Training and Orientation						
1. OSHA Compliance Training	0	1	16	31	46	60
2. Toolbox Safety Meetings	0	1	12	23	34	45

Appendix B:

BPPII–Infrastructure Score Sheet (Un-weighted)

Project Name:	Project Type:
Project Location:	Project Duration:
Company Name:	Evaluation Date:
Evaluator:	Title:
Telephone:	e-mail:

I – MATERIALS MANAGEMENT

Section						
Element	0	1	2	3	4	5
A. Procurement Strategy						
1. Procurement Procedures and Plans for Materials and Equipment						
2. Long-lead/Critical Equipment and Materials Identification						
3. Procurement Team						
B. Materials Management Systems						
1. Project Team Materials Status Database						
2. Onsite Material Tracking Technology						
3. Materials Delivery Schedule						
C. Receipt and Inspection of Materials						
1. Materials Inspection Process						
2. Material Inspection Team						
3. Post-receipt Preservation and Maintenance						

II – CONSTRUCTION MACHINERY AND EQUIPMENT LOGISTICS

Section						
Element	0	1	2	3	4	5
A. Construction Machinery and Equipment Availability						
1. Procurement Procedures and Plans for Construction Machinery						
2. Construction Machinery Productivity Analyses						
3. Construction Machinery and Equipment Maintenance						
B. Tools and Equipment Management Best Practices						
1. Site Tools and Equipment Management Strategy						
2. Tools and Equipment Tracking						
3. Onsite Tools Maintenance						
4. Construction Machinery and Equipment Utility Requirements						

III – EXECUTION APPROACH

Section						
Element	0	1	2	3	4	5
A. Planning						
1. Short Interval Planning						
2. Well Defined Scope of Work						
3. Use of Software						
4. Dedicated Planner						
5. Construction Work Packages						
B. Constructability Reviews						
1. Design Readiness for Construction						
2. Utility Alignment and Adjustments						
3. Contract Types/Strategies						
4. Model Requirements/3D Visualization						
C. Acquisition Strategy						
1. Right-of-Way, Land, and Utilities Acquisition Strategy						
2. Contracts and Agreements with Agencies						
3. Utility Agreements						
D. Regulatory Requirements/Reviews						
1. Environmental Requirements						
2. Regulatory Requirements/Permitting Requirements						

IV – HUMAN RESOURCES MANAGEMENT

Section						
Element	0	1	2	3	4	5
A. Planning						
1. Crews Composition/Crew Formation						
2. Skills Assessment and Evaluation						
B. Training and Development						
1. Employee/Trades Technical Training						
2. Career Development						
C. Behavior						
1. Non-financial Incentive Programs						
2. Financial Incentive Programs						
3. Social Activities						
D. Organizational Structure						
1. Maintain Stability of Organizational Structure						
2. Clear Delegation of Responsibility						
E. Employment						
1. Retention Plan for Experienced Personnel						
2. Exit Interviews						

V – CONSTRUCTION METHODS

Section						
Element	0	1	2	3	4	5
A. Project Schedule Control						
1. Integrated Schedule						
2. Work Schedule Strategies						
3. Schedule Execution and Management						
B. Site Layout Plan						
1. Dynamic Site Layout Plan						
2. Traffic Control Plan						
3. Site Security Plan						
4. Machinery and Equipment Positioning Strategy						
C. Design/Construction Plan and Approach						
1. Communications, Coordination, and Agreements						
2. Project Start-up Plan						
3. Project Completion Plan						
4. Innovations and New Technologies						
5. Housekeeping						

VI – ENVIRONMENT, SAFETY, AND HEALTH

Section						
Element	0	1	2	3	4	5
A. Jobsite Safety						
1. Formal Health and Safety Policy						
2. Health and Safety Plans/Zero Accidents Techniques						
3. Task Safety Analysis						
4. Hazards Analysis						
5. Hazards Planning						
B. Substance Abuse Programs						
1. Drugs and Alcohol Testing Program						
C. Environment, Safety, and Health Training and Orientation						
1. OSHA Compliance Training						
2. Toolbox Safety Meetings						

Appendix C:

Elements Descriptions – BPPII–Infrastructure

Introduction

The following descriptions have been developed to help generate a clear understanding of the terms used in the Project Score Sheet located in Appendices A and B. Some descriptions include checklists to clarify concepts and facilitate ideas when scoring each element. Note that these checklists are not all-inclusive and the user may supplement these list when necessary.

The descriptions are listed in the same order as they appear in the Project Score Sheet. They are organized in a hierarchy by category, section, and element. The Project Score Sheet consists in six main categories, each of which is a series of sections and that have elements. Scoring is performed by evaluating the levels of definition of the elements. The categories, sections and elements are organized as discussed below.

Element Descriptions

Category I – Materials Management

Materials Management is made up of three sections: 1) Procurement Strategy, 2) Materials Management Systems, and 3) Receipt and Inspection of Materials.

Procurement Strategy

Procurement Strategy groups together best practices related to the procurement of materials and equipment. The procurement strategy deals with procurement procedures and plans, identification of long-lead and critical equipment and materials and procurement team. This section contains three elements:

- **Procurement Procedures and Plans for Materials and Equipment** include procedures, guidelines, requirements, or systems for purchasing, expediting, and delivery of materials and equipment for the project.
- **Long-lead/Critical Equipment and Materials Identification** deals with the planning, identification, and tracking of critical and long-lead equipment and material and their timely procurement at the construction site.
- **Procurement Team** is necessary for procurement of materials and equipment and implementing the procurement plans.

Materials Management Systems

Materials Management Systems are an integrated set of systems used to identify, track, report, and facilitate control of project materials. They consist of three elements:

- **Project Team Material Status Database** is an automated system that manages aspects such as the delivery date, date of installation, and storage location of all material used on a project.
- **Onsite Material Tracking Technology** is the system that the project team uses to track and locate material that is delivered to the project site.
- **Material Delivery Schedule** is a documented schedule of when material deliveries occur and when material needs to be on site for installation.

Receipt and Inspection of Materials

Receipt and Inspection of Materials is defined as the examination of the materials before acceptance to note completeness of the delivery and any obvious external damage of the delivered materials. It consists of three elements:

- **Material Inspection Process** is the documented plan for the inspection of all materials delivered to the project site.
- **Material Inspection Team** includes the employees that are hired to perform the material inspection process.
- **Post-receipt Preservation and Maintenance** is the upkeep, inventory, and inspection of material stored on the project site.

Category II – Construction Machinery and Equipment Logistics

The **Construction Machinery and Equipment Logistics** category consists of two sections: 1) Construction Machinery and Equipment Availability and 2) Tools and Equipment Management Best Practices.

Construction Machinery and Equipment Availability

Construction Machinery and Equipment Availability is defined as the planning and organization of all construction machinery and equipment that may be used on site. These practices ensure the availability of all light and heavy machinery, effective maintenance and optimized location of earthwork, lifting and hauling equipment. It consists of three elements:

- **Procurement Procedures and Plans for Construction Machinery** are documented plans for procurement of construction machinery to make sure that it is available at the jobsite when needed.
- **Construction Machinery Productivity Analysis** is the determining and understanding of the cost to use a piece of equipment and the maximization of trades' productivity related to the use of the equipment.
- **Construction Machinery and Equipment Maintenance** is the practice of maintaining machinery and equipment used on a jobsite to ensure that all equipment is performing at optimal levels.

Tools and Equipment Management Best Practices

Tools and Equipment Management Best Practices involve the planning and organization of all tools and equipment used on the project. Infrastructure projects require use of routine tools such as saws, hammers, grinders, and other equipment that is operated and guided by hand as well as the power sources required for their operation. These projects use heavy and light construction machinery that have fuel and power requirements. This section consists of four elements:

- **Site Tools and Equipment Management Strategy** is the development of a plan to acquire, organize, store, inventory, and maintain tools, equipment, and consumables that are necessary to complete a project.
- **Tools and Equipment Tracking** is a formal plan to monitor the location and/or responsible parties for tools and equipment when they are checked out of the storage area for use in the field.
- **Onsite Tools Maintenance** is the practice of maintaining all tools necessary on the project to ensure that they are performing up to specifications.
- **Construction Machinery and Equipment Utility Requirements** is the practice for determining the utility requirements of construction machinery and equipment to ensure that they operate at their optimal capacity.

Category III – Execution Approach

Execution Approach is composed of four sections: 1) Planning, 2) Constructability Reviews, 3) Acquisition Strategy, and 4) Regulatory Requirements/Reviews.

Planning

Planning has been identified as an important factor for efficiently executing projects. This section consists of five elements that are required for best planning of an infrastructure projects. The elements are as follows:

- **Short Interval Planning** is defined as a short-term plan in response to updated progress. It involves short-term construction schedules that include tasks to be performed, scheduling, and allocating the use of shared resources such as the tower crane; the craft workers needed on site; the duration of each task; and the required materials, tools, and equipment.
- **Well Defined Scope of Work** is a clear description of the basic requirements, goals, timeframe, and the owner's vision of the project.
- **Use of Software in Planning** is the practice of using automated software for assisting in creating schedules for project tasks and material deliveries and identifying the necessary materials needed to complete a task.
- **Dedicated Planner** is a person that is appointed to plan, organize, and approve all work activities that take place on the construction site.
- **Construction Work Packages** defines in detail a specific scope of work and should include a budget and schedule that can be compared with actual performance.

Constructability Reviews

Constructability Reviews are defined as the incorporation of construction knowledge in the planning, design, and execution of a project. Research has shown that constructability provides potential improvement in many different areas such as labor productivity. These reviews encourage simplified design and the utilization of optimal construction systems that lead to a reduction of work hours. The section consists of four elements:

- **Design Readiness for Construction** is a review of the design documents to ensure that they are correct and complete and the schedule can be made and completed before actual construction begins and relevant phases are mobilized.
- **Utilities Alignment/Adjustments** is the review of existing utilities in the vicinity of construction project. Arrangements should be made for working around these utilities and in some cases, the existing services have to be removed, modified, and reinstated after the construction.

- **Contract Types/Strategies** deals with situations when there are multiple sub projects in a large infrastructure project. Different types of project delivery methods and contracting strategies for project design and construction are reviewed.
- **Model Requirements/3D Visualization** is a scaled physical or digital representation of the project that is built.

Acquisition Strategy

Infrastructure projects usually deals with matters about acquisition of right of way, land, and utilities. Right of way and land acquisition are usually on the critical path of infrastructure projects. Research has identified that an adequate **Acquisition Strategy** can help the project to progress smoothly. This section has three elements:

- **Right-of-Way, Land, and Utilities Acquisition Strategy** deals with identification and acquisition of right of way, land, and utilities. The process may include consultation with public and owners of lands.
- **Contracts and Agreements with Agencies** determine and state the responsibilities regarding the acquisition of right of way, adjustment of utilities and cost sharing between the public agencies and owner/contractor. It describes the contractual agreements with local public agencies.
- **Utility Agreements** and contracts for joint use effectively allow the utility to share space on public or private right-of-way. It also enables completion of utility adjustments. It is important to pay attention to utility arrangements in order to ensure that the review and approval processes are coordinated in a timely and efficient manner.

Regulatory Requirements/Reviews

Infrastructure projects require having extensive environmental assessments and permits to proceed before construction work can start. The **Regulatory Requirements/Reviews** element addresses these mandatory evaluations and authorizations. This section has two elements:

- **Environmental Requirements** involve environmental assessments and mitigation techniques. These environmental assessments depend on the type, size, and scope of the project. The project's environmental classification and funding sources usually determine the type and nature of environmental studies/assessments to be performed. These assessments can influence the project's design, engineering, and construction.
- **Regulatory Requirements/Permitting Requirements** are the identification and acquisition of various permits and official project execution authorization documents from the owner, city, county, state, and nation.