ENGINEERING COMPANY OF CENTRAL AMERICA
Consulting – Engineering – Supervision
Industrial Plants – Buildings – Infrastructure

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NEWSLETTER

PROJECT EXECUTION PLAN (PEP): *An Overview*

1. INTRODUCTION

There are at least three good reasons to elaborate a Project Execution Plan (PEP) for a specific project, prior to the commencement of works:

1. Changes for a specific project can be made in the planning phase at relatively low cost and high impact on the project outcome. Once the project is being executed, the implementation of changes becomes expensive, if not impossible to achieve (see Fig. 1)
2. A project, by far, does not only consist of its participants. Its success is highly influenced by the organization system that governs the different project management areas, such as execution procedures, control strategies, procurement, quality plan, policies, etc.
3. Experience shows that most project failures are due to lack of planning and/or communication. Hence, the better is the planning, the better are the chances of success

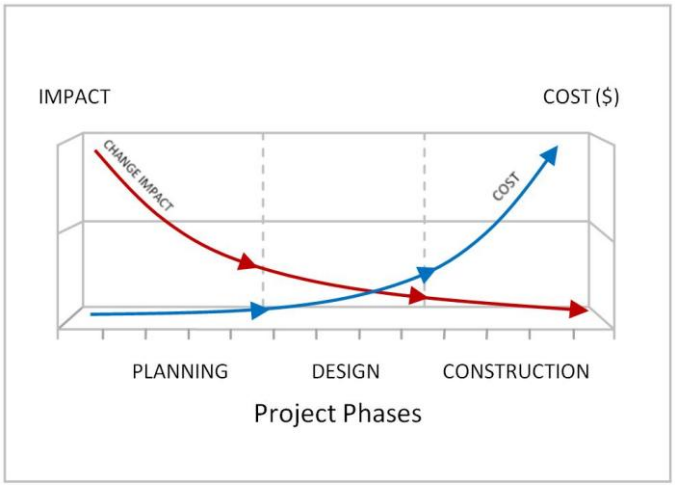

Fig. 1: Schematic illustration of the impact and cost behavior due to changes, if performed at different stages of the projects. At an early stage of a project (e.g. planning phase), important changes to the project outcome can be made at relatively low cost. The situation is dramatically different during later project stages; during construction for example, only limited changes are possible and resulting costs grow exponentially.

A Project Execution Plan is a written document which summarizes the planning work for a specific project in a structured format. It provides agreed baseline definitions with regards to scope, time, quality and costs, as well as for other key management areas. Furthermore, it sets out the project objectives, the roles and responsibilities of its members, communication strategy, risk assessment, relative priorities and the project execution strategy.

2. PEP CONTENTS

Much of a Project Execution Plan (PEP) will be standardized and compiled as part of the company's Project Handbook, i.e. the company standard guidelines, definitions of overall goals and methodologies to develop projects. However, this standard will need to be adapted to meet the particular circumstances of each project.
A typical PEP might cover the items listed below:

- Project Brief
- Roles, responsibilities and authorities
- Project Baselines (Scope, Schedule, Budget)
- Project Communication Plan
- Document Management System
- Project Risk register
- Contracting and procurement
- Safety and environmental issues, incl. construction design and management regulations
- Quality assurance/ Quality Control Strategies
- Commissioning strategies
- Close out and final documentation

The following sections of the present document provide a brief outline of some of the main chapters of a Project Execution Plan.

2.1 Project Brief

The Project Brief is a detailed description of the project, which includes a formal statement of its objectives and functional and operational requirements.
In some cases, the project brief is in sufficient detail to enable the design team to execute the detailed design and the specification of the work to be performed.
In the case of industrial facilities however, execution of the detail design also requires highly specialized inputs from various engineering disciplines. Such process-related inputs are generally referred to as basic engineering.

The key components of the Project Brief include the Project Definition and Project Approach, which are described throughout the following key elements:

- Background
- Site description
- Project objectives and desired outcomes
- Project scope and exclusions
- Constraints and assumptions
- Project Stakeholders and key success factors

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2.2 Roles & Responsibilities

There are different responsibility levels within the structure of a project, and each one corresponds to a different entity that is responsible of a specific activity in the process. It often narrows down to three main areas, namely *the project owner*, *the project director* and the *project manager* (see also Fig. 2):

Each one of these management levels has its own specific tools and guidelines in order to perform its work. It is important that the guidelines of a specific management level are fine-tuned with respect to those guidelines used at the other management levels.
It is the Project Director's responsibility that projects are executed according to the general rules set forth in the Project Handbook, which must be in perfect accordance with the Company Policies.
On the operational level during the project execution, it is the Project Manager who is responsible for the day-to-day business. The Project Manager is to develop the project according to the baselines and guidelines agreed and described in the Project Execution Plan (PEP), which, needless to say, must be well aligned with the existing guidelines at the upper management levels, i.e. Company Policies and Project Handbook.
The PEP, is thus a document which involves all management areas, whereas the roles and responsibilities defined therein correspond mainly to the activities of the project execution team.
A typical example of the roles and responsibilities used at EC to manage the engineering part of an industrial project is depicted in Fig. 3. and described briefly hereafter:

- The Engineering Project Manager has the overall lead of the engineering project and represents the sole technical interface of the engineering team to the customer organization. He is sponsored by The Project Steering Committee, and audited by the Project Committee. The project manager receives direct support from the Project Engineer, the Technical Committee, the Project Control Unit, as well as the Project Support Unit.
- The Project Engineer coordinates the activities assigned to the different Engineering Units. In the particular example depicted in Fig. 3, the engineering units comprise the structural, geotechnical, hydraulic, mechanical and electrical engineering disciplines. Other engineering support units may be included in the project organization if required. Local partners as needed are included as part of the project organization as well.
- The Project Control Unit monitors the project development with respect to its pre-defined baselines, i.e. costs, schedule, quality and handles the Document Management System. It reports directly to the Engineering Project Manager.
- The Project Support Unit is composed by the Procurement Unit, which is in charge of contracting special services required for the project, as well as the IT Support Unit. This latter Unit is in charge of maintaining the web-based communication platform.
- The Engineering Units execute the design works in each of their corresponding disciplines.

The Project Owner or investment decision-maker *takes the investment decision based on affordability and cost.*
Project scope and contents are defined according to Company Policies and Finances.

Project Director
Responsible for the overall procedures and guidelines applicable to the execution of several projects. Informed decisions are taken at this level, based on adequate knowledge and information about the business in general and the global goals of the specific project in question.

Project Manager
Is responsible for the specific, day-to-day operational matters in all particular areas of a project. The project is executed according to the specific baselines and the procedures defined in the Project Execution Plan.

Fig. 2: Different levels of responsibilities in an industrial construction project. Each level defines & applies its pertinent planning instruments.

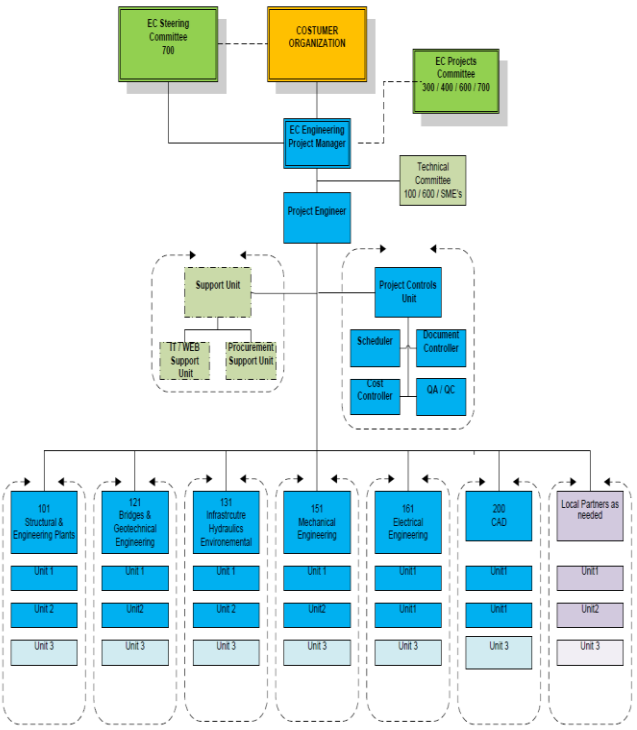


Fig. 3: Typical reporting and decision-taking lines for an engineering project team at EC (marked in blue and green colors), reporting to the assigned program manager of the customer (marked in yellow).

2.3 PROJECT BASELINES

Project execution without a Project Baseline Plan can be compared to the situation of having to reach an unknown place at a specified time, and without a map.

One needs a guide that tells you at any moment where you are, where you are going and where you should be.

In project management, reference systems are needed to determine at any time the actual vs. the planned state for all project knowledge areas. Such reference systems are referred to as the Project Baselines**.** The summation of the Project Baselines, i.e. the **Project Baseline Plan**, can be regarded as the reference system, against which the project progress can be measured.

As per basic project management practices, project baselines have to be defined in accordance with all the knowledge areas of project management. In the following, we briefly present some useful approaches in order to determine the baselines of the three principal project management areas, namely **Project Scope**, **Project Schedule** and **Project Costs**.

2.3.1 Project Scope Baseline

One of the key actions to be taken when starting to plan a project is to clearly define and validate the project scope with the relevant project stakeholders. For the case of rather complex projects, it is advised to agree on a scope matrix, which defines the scope and responsibilities of all the different participants, within all project areas.

Once the scope of the project has been defined (e.g. scope matrix), the **Work Breakdown Structure** (WBS) is established. The WBS defines and organizes the total scope of work and is a delivery-oriented grouping of the project elements. Each descending level represents an increasingly detailed definition of the project work. Importantly, the WBS of a project has to be defined according to a numbered system, which is to serve as reference for definition and tracking of the time and cost base-lines.
The ultimate level of detail is a function of the size of the project and a balance between complexity, risk, and the project manager's need for control. The lowest level of the WBS elements consists of the **Work Packages** (WPs), which represent individual assignments that cannot be further split. The WPs reflect work with specific, tangible deliverables, which are to be executed within defined timeframes and costs.

The contents of the Work Packages are defined with the help of the **Work Package Dictionary** (WPD). Once that WBS, WPs and WPD are approved by the main project stakeholders, they become the Scope Baseline of the project.
Any changes to a WBS modify the deliverables and therefore the scope of the project. Modifications of the WBS during the project execution phase thus require the use of an appropriate Project Change Control process.

2.3.2 Project Schedule and Project Cost Baselines

The Project Schedule is elaborated according to the time needs and sequence of all project work packages defined in the WBS. The approved Project Schedule becomes the Project Schedule Baseline (PSB)**.** Special attention must be given to all activities which lie in the critical path of the project, as well as to the long lead items.
The sum of the approved costs of all WPs leads to the total project costs. When all the different project costs have been defined in accordance with the Project Schedule Baseline, they become the Project Cost Baseline (PCB).

2.3.3 Earned Value Method

The Earned Value is a measure of the real progress of the project by integrating cost and time into one set of metrics. It allows effective monitoring whether the project is being executed according to its Cost and Schedule baselines.

The method relies on the principle that the work performed for a specific work package represents an earned value. When for example a project is delayed, i.e. when at a given time less work has been accomplished than originally planned, less earned value has been accumulated. The earned value method provides the quantitative financial consequences of such delay. Furthermore, the method allows calculating performance indices of the project which allow extrapolating the project outcome, both in terms of costs and timelines.

A graphical example of an earned value analysis is depicted in Fig.4

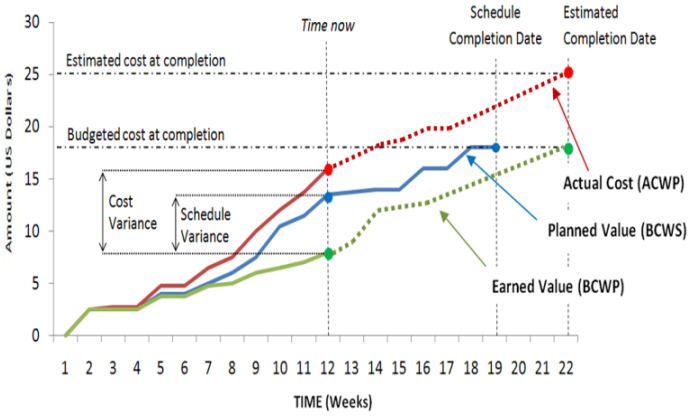


Fig.4: Earned Value Curves:
*The BCWS curve (Budgeted Cost of Work Scheduled; blue curve in Fig. 4) corresponds to the planned cumulative value of all Work Package calculated from the Project Scope Baseline. It is the **Planned Value** or Cost Baseline of the project.*
*The ACWP curve (Actual Cost of Work Performed; red curve in Fig. 4) is the measured cumulative cost of all completed Work Packages shown in the schedule. **Actual Costs** are recorded from invoices and workmen time sheets associated with the Work Package.*
*The BCWP curve (Budgeted Cost of Work Performed; green curve in Fig.4) represents the **Earned Value** of the project vs. time. It is recorded from the percentages of completion of the project Work Packages at a given time, and the corresponding Work Package Budgets.*

The benefit of the earned value method relies on the fact that the following important project parameters can now be easily assessed (see Fig. 4):

A. **Schedule and Cost Variances**

Schedule Variance (SV) is the difference between the Earned Value and the Planned Value of the works, i.e. SV=BCWP-BCWS. Cost Variance (CV) is the difference between the Earned Value and the Actual Costs of the works, i.e. CV= BCWP-ACWP.

B. **Project Performance Indices**

Schedule Performance and Cost Performance Indices give indications of the overall performance of the project status. It is determined whether the project is "on schedule" and "within budget". Schedule Performance Index (SPI) is defined as the ratio of Earned Value and the Planned Value of completed works; SPI=BCWP/ BCWS. SPI<1 is not good. Cost Performance Index (CPI) is the ratio of Earned Value and the Actual Costs of Works Performed; CPI=BCWP/ACWP. CPI<1 is not good.

C. **Estimates at project completion.**

Both the Estimated Cost at Completion and the Estimated Completion Date can be calculated by using the performance indices determined from the already performed works.

2.4 Project Risk Management

The project Execution Plan generally includes a log of all the identified project risks and the results of their event analysis. Such Risk log commonly referenced as Project Risk Register, and contains the information types listed in Table 1.

Project Risk Identification Information	Project Risk Mitigation Information
• Risk identification number • Risk type • Risk Owner (named person) • Identified Date • Last update • Risk Description • Cost if it materializes • Probability (high/med./low) • Impact (high/med./low) • Proximity	• Risk response Strategy • Possible response actions • Chosen action • Target date • Action owner (may differ from risk owner) • Closure date • Cross references to associated risks • Risk status and Risk Action Status

Table 1: Basic information contents of a Risk Register, showing the information to be compiled for Risk Identification (at left) and Risk Mitigation (right). The Risk Register is often generated in the form of a spreadsheet, which documents the information content listed above for each individual risk.

IMPACT			PROBABILITY			GENERAL RISK QUALIFIC.
low	med	high	low	med	high	
▲◆	●		▲●	◆		low
◆	▲	●	●	▲	◆	medium
	▲	●◆		◆	●▲	high

Table 2: Top: Risk qualification. Risks are here represented by different symbols. Each risk is qualified with respect to its probability of occurrence and resulting impact of the risk event.
Red circles mark a case where a specific risk event represents a relatively low impact, together with a low probability of actually happening - the risk is consequently qualified as low. The qualification result for all identified risks of a project can then be depicted graphically, as shown in Fig.5.

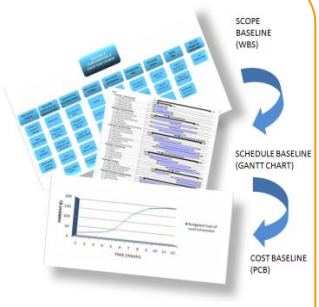
Importantly, each risk has to be associated with a Risk Owner. This is a named person, who is in charge of following up the specific risk in question and who reports directly to the project manager. A mitigation strategy for each risk, together with a description of the planned risk event mitigation measures is also imperative as part of the risk register.

In order to provide an overview of the risk status of a given project, the Risk Matrix may be used (see Fig. 5). This tool, which is directly elaborated from the Risk Register information, provides a quick visual reference of the project risks that lie above/below the project tolerance line.

It is of key importance that the project risk register is updated on a regular basis and reviewed at both project management and project director/owner levels. This counts especially for project risks that lie above the Project Tolerance Line.

Fig.5: Risk Probability/Impact matrix. The numbered risks (marked by circles) have been qualified according to the procedure shown in Table 2, and are plotted in the graph according to the identified probability of occurrence and risk event impact. Red, yellow and green colors mark the high-risk, medium-risk and low-risk areas respectively. The dotted borderline marks the Project Tolerance Line.

PROJECT MANAGEMENT BY EC



EC is an internationally active engineering firm, working within a network consisting of over 30 engineering partners.

Our involvement in large industrial projects over the past years has been a major driving factor for the Company's focus on Project Management issues.

Consequently, EC has continuously reinforced its capabilities in the project management area and is now offering the following additional services throughout the planning and execution phases of civil construction and electromechanical erection projects via its web platform which has been internationally in practice for over eight years:

- *Elaboration of Project Execution Plans*
- *Preparation of construction bid packages (civil & electro-mechanical) and conduction of corresponding tender process*
- *Coordination of site studies, including geotechnical, seismic, and hydrological studies*
- *Construction site management support and on-site technical supervision*
- *Project progress controls (scope, time & costs)*
- *Project information management (DMS, Job Book compilation)*
- *Project reporting*

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