

PROJECT EXECUTION PLANNING FOR COST AND SCHEDULE MANAGERS

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SUMMARY

What is a Project Execution Plan (PEP) and how will it help me to manage and control estimates/bids/schedules? What do I need in a PEP to establish project reporting and control? The paper will present important aspects of the PEP for effective cost & time management for managers. It will show the importance of the PEP is in clarifying the scope of work and how the project will be designed, constructed and controlled. By clarifying the project plan the cost estimate and schedule will be more accurate, the reporting more focused and the control more effective. The author is past national president of AACE International and past Chair of the International Cost Engineering Council. He teaches project, cost and time management courses including project execution planning.

INTRODUCTION

“The two most important responsibilities of a project manager are planning and the integration and execution of plans.” Harold Kerzner, 1989

Project success depends on many factors both within and outside the control of the project team. One of the aspects that is within the control of the project team is the planning. Almost everything we do in life requires a plan. We take many of our daily routines for granted but all require planning for their completion. Projects are no different, just the scale and complexity of the undertaking. Projects may be millions/billions of dollars in cost, years in development/construction and need a plan of how they are to be executed.

There are many reasons why projects fail to meet their objectives. Some external events may render a project unneeded. Internal events may cause a project to be delayed or cost more than expected. Almost all events that bear on project success can be anticipated and plans can be made accordingly. Projects do not succeed only because of a project execution plan but their potential success is ensured if there is an appropriate plan, effectively utilized.

PROJECT EXECUTION PLANNING DEFINED

Plan – A predetermined course of action over a specified period of time which represents a projected response to an anticipated environment in order to accomplish a specific set of adaptive objectives. (AACE International)

Project Plan – A formal, approved document used to guide both project execution and project control. (Project Management Institute)

The project plan is a roadmap to how the project will progress through all project phases. According to the Project Management Institute the project execution plan is used to:

- Guide the execution of the project
- Document the assumptions, constraints, and alternatives
- Provide a tool to communicate with stakeholders
- Establish project milestones and deliverables
- Set scope, cost and schedule baselines for progress measurement and control

What does this mean to a cost or scheduler manager? In order for the person to assemble an estimate or a schedule they need to know:

- What are the project objectives?
- What is the scope of work, both technical and functional?
- How is the project going to be organized?
- Who will be charged with the management and execution of the project?
- When does the project need to be completed?
- How much was the preliminary cost?

It is best if the cost engineer/scheduler manager has all this information but frequently the above items are not available or fully disclosed. The scope of work is the single most important item for establishing an effective plan and the cost and schedule baselines.

STRATEGIC PROJECT PLANNING

There are fifteen areas of project execution planning that are defined in The Strategic Project Planner by Richard E. Westney PE as shown in Figures 1, 2, 3:

Figure 1 - Define the business goals that will determine project success.

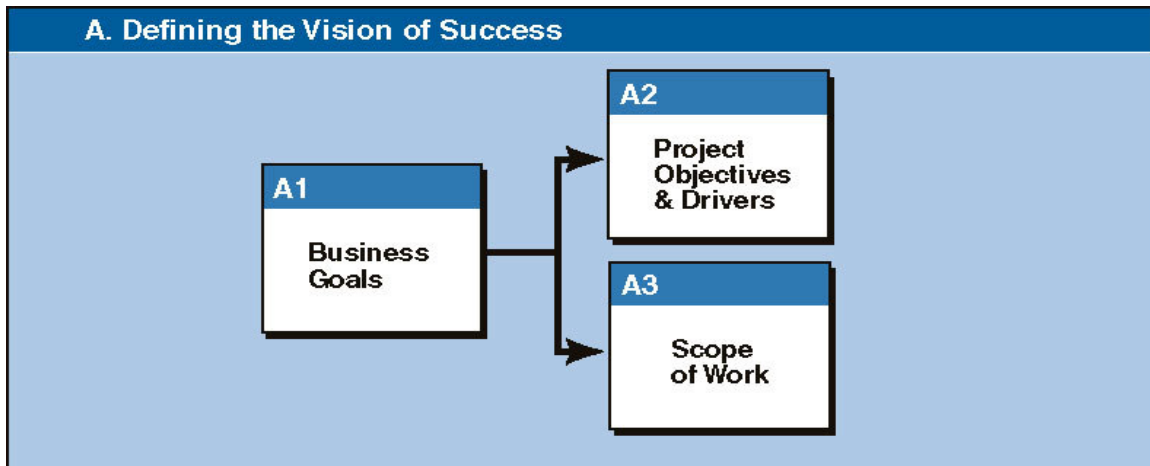
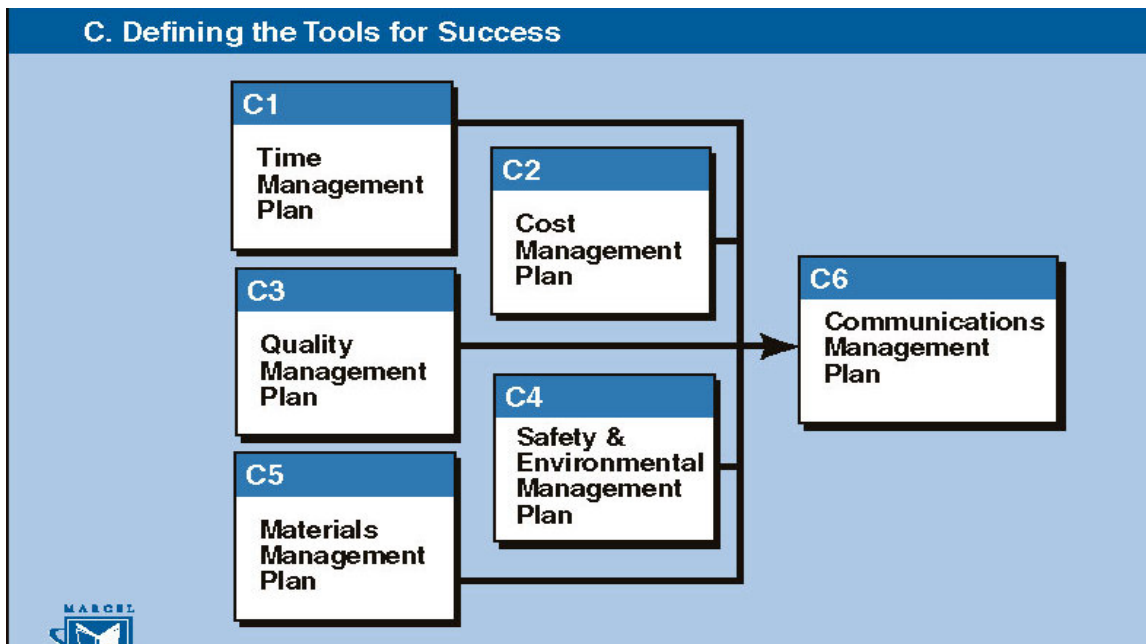


Figure 2 - Define major phases, milestones, risks, organization, staffing and best practices to be used by the project.



Figure 3 - Define how time, cost, quality and resources will be managed.



PEP FOCUS FOR COST AND SCHEDULE MANAGERS

Many of the PEP areas shown above have limited impact on the activities of the cost engineer and scheduler. We will focus on six as the ones for emphasis in order to complete an estimate, schedule and project control. The six are:

- Scope of Work
- Risk Management Plan
- Contract Plan
- Time Management Plan
- Cost Management Plan
- Change Management Plan

The Change Management Plan is extracted from the other sections because of its impact and importance to many projects. In addition it is important to note the PEP is the framework of the definition, strategy and tools of the project. It is not necessarily a “how to” of project management or project control. How to manage a planning area is generally addressed in project procedures and guidelines.

SCOPE OF WORK

The scope of work is the most important element of the PEP for the cost and schedule manager. The scope of work is the foundation upon which everything in the project depends. It is the central defining element of the cost estimate and schedule. It is therefore important that the PEP is specific on the definition of what and where the scope of work will be derived. The selected topics to consider in scope of work for the cost and schedule manager are:

Functional performance – The PEP should summarize what the facility will DO. It should also reference where the functional performance is defined in detail. Understanding customer requirements and user functionality will ensure the estimate and schedule meet project objectives. Examples of functional performance in industry include production capacity and product specifications. In the pharmaceutical industry this would include production capacity consistent with Good Manufacturing Practice (GMP) compliance.

Technical definition – How is the design to accomplish the requirements of the functional scope? Does the PEP reference the design standards to be used on the project? For software projects, what is the system design criterion and is there a communications technology that applies. For industrial projects, is the location of the project clear and is the layout of the facilities clearly referenced. Can the sparing philosophy be interpreted by the equipment vendors?

Exclusions – Is there scope to be performed or provided by others? Does the project depend on the completion of that scope to start, continue or complete. What scope is excluded from the project? Is there scope the contractor excludes or the owner expects that is excluded from this project? The most common problems encountered with scope are the owner assuming an inclusion and the contractor assuming exclusion.

Contractor’s scope – How will contractor’s scope be defined when contracts are let? What will be the type of contract: lump sum; unit price; or reimbursable cost? What will be the timing of contract award?

Work breakdown structure (WBS) – What is the work breakdown structure for the project? Is it a company standard, customized for each project or a combination of both? Will the WBS adequately address the functional performance, technical definition, exclusions and contractor’s scope?

RISK MANAGEMENT PLAN

The objective of the risk management plan is to identify the risks to project success and develop plans to mitigate them. Risk management usually follows the sequence below:

Identification → Assessment → Analysis → Mitigation

In order for the cost and schedule manager to be aware of potential impacts to cost and schedule it is important to know what the project risks are and how the project plans to address them. The planning presented here represents some qualitative techniques in dealing with project risks. The planning approach steps and things to consider for costs and schedule are:

Risk Identification – Describe each risk in sufficient detail that the quantification and potential mitigation by a single person or group is facilitated. As shown in Table 1.

Assessment - Assess the probability of occurrence of the risk and the potential impact. The occurrence is usually determined by deciding if the probability is high, medium or low. The assessment can be made with greater attempted precision, i.e. numerical probability, but most assessments are made by placing the item in a group. The potential impact is assessed and this can be by assigning a group (high/medium/low) or the actual impact can be calculated in financial or other terms. Based on the previously established criteria, a selection is performed to analyze items for potential mitigation. Most organizations will mitigate high occurrence/high impact risk items, and will not mitigate low occurrence/low impact risk items. Other risk items will be mitigated based on the criteria and analysis.

Table 1 - Risk Identification Chart

Risk Identification		
Describe Risk	Probability of Occurrence (High, Medium, Low)	Potential Impact (High, Medium, Low)

Analysis – After the risk items are narrowed and selected for analysis a process is begun where the list will be further narrowed to items that will be mitigated. Based on the risk identification, describe the mitigation action. The cost in value or group (H/M/L) is calculated or decided. A judgment of the probability of success is then determined. As shown in Table 2.

Mitigation – Based on the action, cost and probability of success will the mitigation be made? If so, who leads the effort and when is it to be completed?

Table 2 - Risk Mitigation Chart

Risk Mitigation					
Describe Action	Cost to Mitigate (H,M,L)	Probability of Success (H,M,L)	Do it? (Yes/No)	Who Leads?	By When?

CONTRACT PLAN

The objective of the contract plan is to determine how contractors will be utilized to perform the scope of work and meet project objectives. The contract plan establishes the proposed split of responsibilities between the owner and the contractors. This is important for the schedulers in the work breakdown structure and the determination of the work packages. The work packages will relate to what group performs the work, including contractor and subcontractors. The contract plan is important to the cost engineer to establish the budget for the project. It details the control activities as they relate to the

performance of the contractors. The number of contracts and contract types will determine the fundamental approach to project control. The control of lump sum contracts is different to unit price and reimbursable cost contracts. A typical contract planning chart is shown in Table 3.

Table 3 – Contract Planning Chart

Contract Planning Chart					
Contract Scope of Work	Contract Type	Potential Bidders	Key Dates	Use Alliance?	Use Incentives?

Topics to consider in the contact plan for cost and schedule managers include:

Responsibilities – What is the split of responsibilities between the owner and contractors? To what extent will the owner participate in the management of the project? Will the work breakdown structure be used to identify the allocation of responsibilities? Are there domestic content requirements for the contracts if the project is built overseas?

Scope of work – What is the scope of work for each of the planned contracts? Will the work breakdown structure be used to define contractor scope?

Contracting method – What contracting method is to be used for the contracts? What risks are in the contracting method for the location and scope of work? Has the appropriate time been allocated for bidding and contract award? Is the project on a fast track that would create additional risks for the contracting method selected?

Milestones – What are the key dates in executing the contract plan? Does the progress of design and engineering support the need for information by the contractors? Are award dates consistent with earlier strategic planning? Are there any critical permits to be obtained prior to the start of construction?

TIME MANAGEMENT PLAN

The objective of the time management plan is to determine how schedules will be developed, and progress controlled. The scheduler will be the central focus of this plan but the impact on costs is evident if projects are delayed. Many projects rely on the development, maintenance and application of a network based critical path schedule for time management. In addition the loading of resources in the schedule is an important additional capability that projects find beneficial and useful for efficient utilization of resources. Other non-network scheduling methods found in various projects include bar charts, schedule boards and task lists.

Topics to consider in the time management plan for cost and schedule managers include:

Schedule preparation – How will the schedules be prepared during each phase of the project? Will the schedules progress from milestones to bar charts to critical path based schedules? Will resources be loaded in the schedule? What type of scheduling software will be used by owner, contractor, and subcontractors? Will there be a Master Schedule, who will administer it, and how will the parties interface with the Master Schedule.

Planning & scheduling responsibilities – How will the responsibilities for planning and scheduling be allocated? The basic question is: who is doing what in planning and scheduling. The defining document for outlining responsibilities is the organization plan, not covered in this paper, which shows the strategic and tactical responsibilities of project participants, including the planning and scheduling staffs. The time management plan should restate the general responsibilities and include any details not covered in the organizational plan. Some considerations for owner and contractor responsibilities are:

Owner responsibilities

- Overall project planning
- Set schedule objectives
- Develop milestone schedules
- Identify legally binding dates
- Schedule owner activities
- Maintain the Project Master Schedule
- Review contractor schedules

Contractor responsibilities

- Plan and schedule contractual scope of work
- Plan and schedule other work as agreed or assigned by owner
- Develop and maintain schedules to ensure planned project completion
- Identify schedule variances and provide schedule forecasts
- Manage subcontractors, vendor and supplier schedules

Progress measurement and control – How will the project measure and control progress? Will earned value methods be used or required? What systems do the contractors use? Will the owner impose a system or use existing contractor methods. If there is an imposed system who will pay for it? Many owners will ensure by contract and prior agreement that an acceptable system will be used by the contractors. Schedulers should validate the systems and accuracy as early as possible. The controls staff should also establish the approach to analysis of physical progress vs. time, money and effort. What will be the split of responsibilities of progress measurement and controls among the owner, contractor, subcontractors, and vendors? Typical responsibilities for owners and contractors are as follows:

Owner responsibilities

- Define progress measurement and reporting expectations
- Review progress reports and analyze schedule variances
- Take corrective actions as necessary and guided by the PEP
- Develop independent forecasts of the project completion date
- Administer the prime contracts

Contractor responsibilities

- Measure physical progress for contractor and subcontractor scope of work
- Provide schedule analysis such as productivity and performance index
- Provide timely and unbiased progress reports
- Identify and analyze schedule variances
- Define and execute corrective actions as guided by the PEP
- Forecast the project completion date
- Administer the subcontracts

Resources – How will human resources be scheduled during each phase of the project? How will competition from other projects affect supply, quality and cost of resources? Has a labor survey been performed to assess the current status of resources? How does the current assessment of labor availability compare to project needs and plans?

Types of resources:

- Owner resources
- Contractor resources
- Project resources
- Operational resources

Management and analysis of resources:

- Resource availability
- Specialized skill requirements

- Resource-loaded schedules
- Use of resource scheduling software
- Resource density

Schedule variances – How will schedule variances be identified and corrected? Who will prepare and maintain the baseline schedule? What criteria will be used to justify changes to the baseline schedule? What criteria are to be used to define a schedule variance? Who will perform the schedule forecast and how will it be communicated. Are the parties authorized to release forecasts which indicate a change in the project completion date? What is the plan for action on schedule variances?

Forecasts – How will the time and resources needed to complete the project be forecast? Forecasting is one area of project management that is challenging and subject to much debate. Forecasting is best when the right combination of analysis and judgment is exercised. Schedulers should ensure the time management plan identifies the approach to forecasting. For example, will the forecasts be based on trend analysis and earned value statistics. Will there be a schedule performance index and how will it be used in the forecast. To what extent will the forecast use the remaining scope of work, tasks, resources, and duration? Is historical information to be used, is it relevant. To what extent will tracking curves and graphical methods be used for forecasting. When will independent schedule forecasts be used and who will perform them.

Schedule contingency – How will the schedule contingency be administrated? What is the split of schedule contingency between the owner and contractor? Is there any use of allocated schedule contingency to major/critical activities? Are target schedules to be used with no contingency? Will a schedule contingency rundown curve be used for project control?

COST MANAGEMENT PLAN

The objective of the cost management plan is to determine how costs will be estimated, reported and controlled. The cost engineer will be the central focus of this planning. Almost anything that happens on a project will have a cost impact. Cost management is closely linked and driven by the scope of work, resources and productivity trends. All of these activities need to be identified and outlined in the cost management plan. The cost engineer should ensure the cost management plan meets the objectives of the project.

Topics to consider in the cost management plan for cost and schedule managers include:

Cost estimate preparation – What cost estimates will be prepared during the project phases? There are a variety of methods and techniques to preparing cost estimates; each has its strengths and resources requirements to prepare. Project teams need to balance time, cost and quality in deciding which types of cost estimates to use. How will cost estimates be prepared to support funding decisions? Many owners have some type of review process that project teams need to address in gaining approval to progress the project. A common technique is a stage-gate approval process. Each stage or project phase has technical and information requirements, including cost estimates that require approval prior to passing the gate. Who will prepare the cost estimates? The estimating organization needs to be identified as well as the sources of data and appropriate estimators. The estimate also needs to be divided into groupings for summation and control. This is called cost coding and there are options which affect the cost estimate preparation.

Cost reporting and control – How will the estimate be converted into a budget for cost control purposes? What will be the interface between project cost control and the in-house accounting system? The project team will need to identify the capture of actual costs, their summation in the project reporting system and the interface and reconciliation to the in-house accounting system. What will be the cost reporting format and frequency? Is there a standard report format used by the owner and contractor? What is the bridging of cost information between owner and contractor if required?

Estimating responsibilities – How will the responsibilities for cost estimating be allocated? The basic question is: who is doing what on the cost estimates. As in the time management plan, the defining document outlining responsibilities is the organizing plan, not covered in this paper, which shows the strategic and tactical responsibilities of project participants including the cost estimating and controls staff. The cost management plan should restate the general responsibilities and include any details not covered in the organizational plan. Some considerations for owner and contractor responsibilities are:

Owner responsibilities

- Overall project cost
- Setting cost objectives
- Developing conceptual and early estimates
- Estimating the cost of owner's activities and materials
- Reconciling current cost estimates with previous estimates and with costs for similar projects
- Establishing the scope, planning, and estimating basis for contractor prepared estimates
- Review contractor estimates
- Ensuring a current control estimate is maintained to reflect approved changes
- Capture actual cost data for use in preparing future estimates

Contractor responsibilities

- Estimate the scope of work in the contract
- Estimate other scope of work as directed and agreed with owner
- Set up and maintain a current control estimate to reflect approved changes
- Direct the preparation of cost estimate from subcontractors
- Reconcile actual costs to the current cost estimate

Cost reporting and control responsibilities – Identifying and allocating responsibilities in cost reporting and control is similar to cost estimating with respect to the organizational plan and additional detail required in the cost management plan. Some considerations for owner and contractor responsibilities are:

Owner responsibilities

- Defining cost performance measurement and reporting expectations
- Review cost reports and analyze cost variances
- Take corrective actions as necessary
- Provide independent forecasts of cost to complete the total project
- Administer the prime contracts

Contractor responsibilities

- Prepare timely and unbiased cost reports
- Track expended and committed cost and value of work done
- Identify and analyze cost variances
- Measure productivity for contract and subcontractor scope
- Forecast cost to complete the contractors scope
- Define and execute corrective actions
- Provide final closeout reports
- Administer subcontracts

Cost tracking and performance analysis – How will cost tracking and performance analysis be accomplished? How will actual costs be captured and reported. What are the cost reporting formats? What is the bridging between contractor and owner codes of accounts? Will earned value methods be used and what will be the basis of collection and use in the reporting and invoicing system. How will the earned value reporting interface between time and cost management.

Cost variances – How will cost variances be identified and corrected? Who will prepare and maintain the current control estimate? What is the definition of cost variance between actual costs and current control

estimate? What is the definition of forecast final cost? What are the criteria for investigating the root cause of a cost variance and determining corrective action? How will variances be used in forecasting time and cost to complete? What organization and staff has the responsibility for defining variances, reporting variances and taking corrective actions?

Forecasts – How will the cost to complete the project be forecast? Who will perform cost forecasts? Many projects have changes which may potentially affect the final cost. The cost estimate is an estimate until the project is complete and the final invoice is paid. Deciding on the approach to forecasting is helpful and may prevent surprises. Forecasting is best when the right combination of analysis and judgment is exercised. Cost engineers should ensure the cost management plan identifies the approach to forecasting. Example of cost forecasting tools and techniques are:

- Trend analysis
- Earned value statistics and the cost performance index
- Detailed schedule updates reflecting the remaining scope of work, tasks, resources, cost and durations
- Historical data from similar projects
- Cost projections for outstanding purchase orders and contracts
- Graphical forecasting based on tracking curves
- Third party independent forecasts

Contingency – How will cost contingency be administered? How will contingency be allocated between the owner and contractor? Will the project use a target control estimate with no contingency? Will a contingency rundown curve be used on the project? Will contingency be allocated to major cost accounts? Will contingency be adjusted from re-forecasting as the project progresses? Will contingency be released when the project is under running?

CHANGE MANAGEMENT PLANNING

The objective of change management planning is to identify the potential for changes based on the scope of work and the management of changes by the project team. All projects must deal with the potential for changes, whether they are in a stable or dynamic environment. Changes can be imposed on the project from external sources or develop internally as a result of normal project development. The project execution plan should outline the approach to changes that are reasonably expected.

Scope of work – What is the likelihood and extent of potential future changes to the project scope? How will future changes to the scope of be controlled? Topics and things to consider in the change management plan for cost and schedule managers include:

- Degree of technical uncertainty
- Degree of customer commitment to the current scope definition
- Effectiveness of the scope management program
- Uncertainty due to design complexity
- Uncertainty due to retrofit, revamp or modification to existing facility
- Uncertainty regarding interfaces of adjoining units, preceding/succeeding processes
- Organizational tension
- Lack of effort to fully define scope
- Dependence on research developments
- Market demand changes influencing project capacity or timing
- What is the change management procedure
- Who is responsible for the cost and schedule impact of changes
- Who approves changes
- What is the criteria used to justify and approve scope changes

Best practices implementation – How will change management be applied to this project? What planning is to be considered for applying best practices to projects results in more efficient execution? Some of the considerations for change management:

- Establish responsibilities for scope definition
- Establish responsibilities for project cost and schedule change management
- Establish reporting of changes including appropriate highlighting of problems
- Ensure procedures to process changes efficiently
- Identify appropriate accountability for the impact of changes

Time management – How will the schedule impact of changes be estimated and approved? It is important to plan for the schedule impact of changes both individually and collectively. Some considerations for the planning of schedule impacts of changes are:

- Impact of changes on the critical path
- Impact of changes on resources
- Impact of changes to the forecast time to complete
- Change management procedures as regards schedule
- Methods for minimizing time to prepare change estimates
- Accuracy required for change estimates
- How will schedule impact of changes be reflected in contract administration
- What is the allocation of responsibilities for defining and estimating schedule impact of changes
- What is the schedule information in change reports, tracking and trending

Cost management – How will the cost of changes be estimated and controlled? It is equally important to plan for the cost impact of changes. Some considerations for the planning of cost impacts of changes are:

- Impact of changes on the total project cost
- Cumulative cost of changes requiring re-appropriation
- Impact of changes to the forecast cost to complete
- Methods for minimizing time required to prepare change estimates
- Accuracy required for change estimates
- How will the cost of changes be reflected in contract administration
- What is the allocation of responsibilities for defining and estimating changes
- What is the cost information in change reports, tracking and trending

Change types and category - What are the types of changes and what are the techniques to report and control changes? Some considerations for the planning of change types and control techniques:

- Scope changes – usually management approval for supplemental funding
- Design changes – usually made to optimize the facility
- Field changes- usually made to facilitate construction
- Startup changes – usually made to facilitate startup
- Potential changes – changes being considered
- Pending changes – changes being evaluated
- Approved changes – changes approved for implementation
- Contingency rundown to offset the cost of approved changes
- What is the reporting, tracking, analysis, trending, and forecasting of changes
- Who approves changes and what is the criteria

Environmental management – What changes in statutory environmental compliance requirements are anticipated during the project? Some considerations for the planning of changes from environmental projects are:

- Government changes
- Regulatory agency changes
- Evolutionary changes to regulations
- Changes in best available technology
- Changes in company policy

CONCLUSIONS

For the cost and schedule manager the project execution plan is the roadmap to preparing the cost estimates, schedules and controls for the project. If the project achieves its goals the PEP will have helped. If the project faces challenges the PEP will guide the staff in efficiently handling the issues.

In summary the cost and schedule managers need the following essentials to perform their work:

Cost Engineers → Scope and Basis

Schedulers → Scope and Timing

Scope – The definition of the scope of work would include the technical and functional definition appropriate for the phase of the project. This would include descriptions, specifications, drawings, studies, and prior work on this project. The planning for the scope of work would emphasize the physical deliverables the project must create.

Basis – The basis includes the management and organizational plans to accomplish the project. The responsibility split between the owner and contractor is important in this respect. The specific split in duties may be helpful for larger complex projects. The basis would also include the location and the specifics of the environment in which the project is to be built. If the location is overseas it is important to establish an understanding of the specifics of the social, political and work environment. The contractual approach is also an important element in the basis.

Timing – The PEP should be clear in outlining the specific project schedule goals and objectives. If the project has a contractual or regulatory completion date it should be made explicit in the documentation. The schedule planning should take into account the drivers that affect the project schedule both internal and external. If competing projects are affecting the resources the planning should identify options and alternatives to address.

Who should write the PEP? A PEP written early in project development can be a summary document that can be authored by the owner or project sponsor. The final PEP is most often written prior to approval for funding for engineering and construction. The final PEP also benefits by review and critiquing from the project management team. This review should also produce what is known as “buy in” to the PEP by the staff. If there is doubt or resistance the assistance of a third party facilitator is usually very helpful. Project execution planning workshops during detailed design and engineering assist the project team in working together more effectively.

Project Execution Goals for the Cost and Schedule Managers

- Ensure the estimating, scheduling, controls staff know the projects strategic goals and objectives
- Inform the project management team and stakeholders what is to be done, when, by whom and how for estimates, schedules, reports, analysis and action items.
- Clarify the roles and responsibilities for owner and contractor staff dealing with costs and schedules
- Help in identifying and managing issues as regards project costs and schedules

Finally, the PEP is basically a communications tool useful in outlining the ways and forms the project management team interacts. As new members join the project it serves as an orientation tool. Existing members can use the PEP as a reference to confirm what is being done or use it to facilitate an approach to a solution. The PEP should not be fixed if there are fundamental changes in the project scope, basis or timing. If there are fundamental changes the PEP should be revised and reissued as appropriate. When the

project is completed use the PEP as a tool for conducting post-project appraisal and capturing lessons learned.

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