

What Every Systems Engineer Should Know About Project Management

Presentation to INCOSE Heartland Chapter

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What Is Project Management?

The application of knowledge, skills, tools and techniques to project activities to meet project requirements

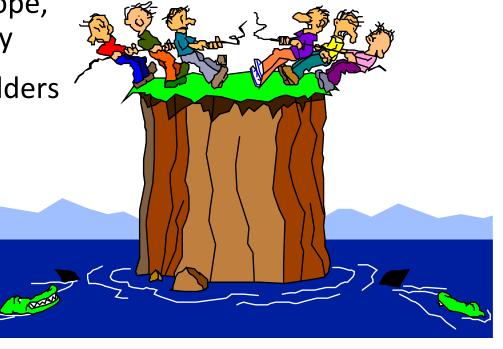
- A Guide to the Project Management Body of Knowledge (PMBOK® Guide)

Typically involves:

 Conflicting demands for scope, time, resources, risk, quality

 Satisfying multiple stakeholders with differing expectations

 Living within defined resource constraints







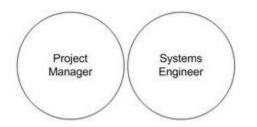
Why Is It Important for Systems Engineers to Understand Project Management?

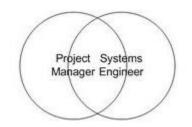
If you understand project management activities, you can contribute more effectively and accurately

The first promotion for a systems engineer is often to lead a small team on a project







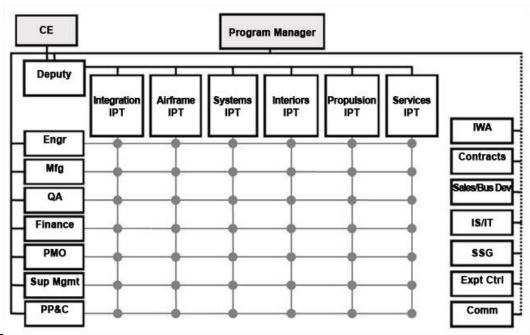








Integrated Product/Process Team (IPT) Approach



Helpful Aspects

Adverse Aspects

- Product-focused organization
- Units are multi-functional
- · Decision making at the lowest level
- Program/product integration occurs as the product is developed
- People have a "home"

Integrated Product Team (IPT) – Multiple disciplines, focused on a product

Integrated Process Team (or discipline) – Focus on processes spanning multiple IPTs

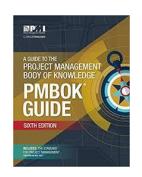
- Restricts use of critical resources
- Demands excellent interpersonal skills
- Sub-optimization often
- Team members work with people of different discipline
- Goals and procedures vary
- Power differences
- Group decision making takes time





Sources of Project Management Information

A Guide to the Project Management Body of Knowledge (PMBOK® Guide) provides an overview of project management for those seeking PMI certification (PMP®)



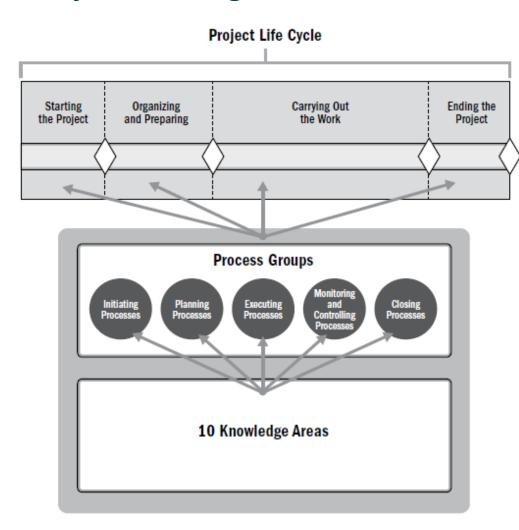
[sebokwiki.org] Systems Engineering and Project Management section addresses:

- The Nature of Project Management
- Relationships between Systems Engineering and Project Management
- The Influence of Project Structure and Governance on Systems Engineering and Project Management Relationships
- Procurement and Acquisition
- Portfolio Management





Project Management Framework (PMBOK® Guide)



Knowledge Areas

- Project Integration Management
- Project Scope Management
- Project Schedule Management
- Project Cost Management
- Project Quality Management
- Project Resource Management
- Project Communications Management
- Project Risk Management
- Project Procurement Management
- Project Stakeholder Management





Project Management Knowledge Areas

Project Integration Management	Project Scope Management	Project Time Management
 Develop Project Charter Develop Preliminary Project Scope Statement Develop Project Management Plan Direct and Manage Project Execution Monitor and Control Project Work Integrated Change Control Close Project 	 Scope Planning Scope Definition Create WBS Scope Verification Scope Control 	 Activity Definition Activity Sequencing Activity Resource Estimating Activity Duration Estimating Schedule Development Schedule Control

Project Cost Management	Project Quality Management	Project Human Resource Mgmt.
 Cost Estimating Cost Budgeting Cost Control	 Quality Planning Perform Quality Assurance Perform Quality Control	Human Resource PlanningAcquire Project TeamDevelop Project TeamManage Project Team

Project Communication Mgmt.	Project Risk Management	Project Procurement Mgmt.
 Communication Planning Information Distribution Performance Reporting Manage Stakeholders 	 Risk Management Planning Risk Identification Qualitative Risk Analysis Quantitative Risk Analysis Risk Response Planning Risk Monitoring and Control 	 Plan Purchases and Acquisitions Plan Contracting Request Seller Response Select Sellers Contract Administration Contract Closing





Project Planning

Processes performed to establish the total scope of the effort, define and refine the objectives, and develop the course of action required to attain those objectives

Project Scope **Project Time Project Cost** Management Management Management 6.2 Plan Scope Plan Schedule Define Plan Cost Management Activities Management Management 7.2 Collect Estimate Activity Sequence Estimate Activities Requirements Resources Costs 5.3 Develop Estimate Activity Define Determine **Durations** Schedule Scope Budget Create WBS **Project Quality** Management **Project Integration** Management Plan Quality Management Project Procurement 4.2 Management Develop Project 12.1 Management Plan Procurement Project Human Management Resource Management Develop Human Resource Project Risk Management Management 11.1 Perform Plan Risk **Project Communications Oualitative** Management Risk Analysis Management 10.1 Project Stakeholder Plan 11.4 11.2 Management Communications Perform Identify Management **Ouantitative** Risks 13.2 Risk Analysis Plan Stakeholder Management 11.5 Plan Risk Responses The dashed circular arrow indicates that the process is part of the Project Integration Management Knowledge Area. This Knowledge Area coordinates and unifies the processes from the other Knowledge Areas.

A Guide to the Project Management

Body of Knowledge





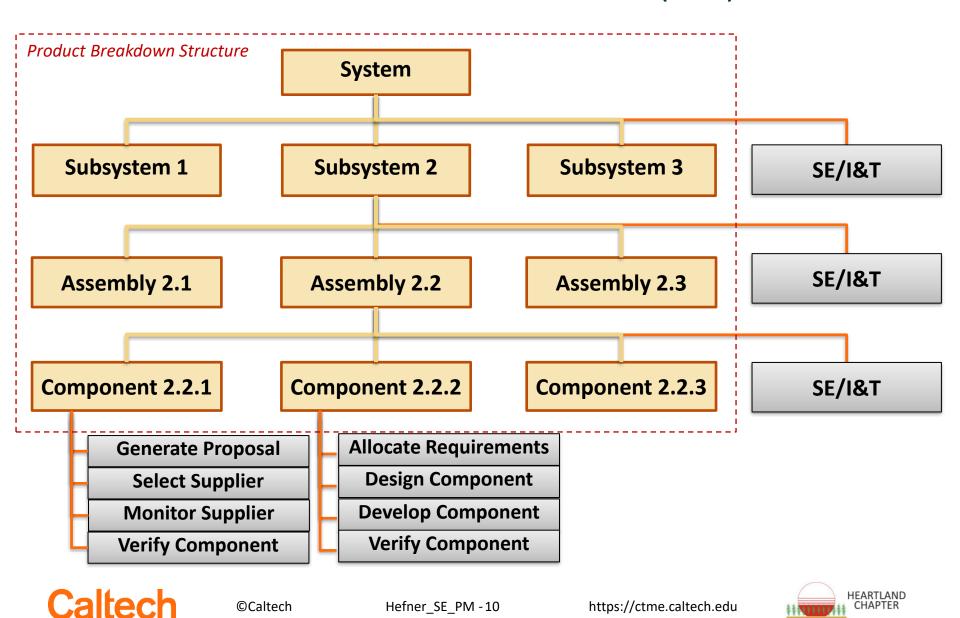
SE's Contribution to Project Planning

Planning Tasks	SE Contribution
Develop a Work Breakdown Structure	WBS driven by Product Breakdown Structure
Estimate the effort required and time duration of tasks	 Ensures that: Overall system life cycle is understood; Dependencies on other systems and organizations are identified Logical dependencies during development are identified Resources and key skills are identified and planned
Identify/optimize critical path	Provides strategies to "crash" the schedule, impacts to project risk
Allocate/level resources, including time/cost tradeoffs	Provides strategies
Evaluate/select suppliers	Make-buy decisions, technical evaluation





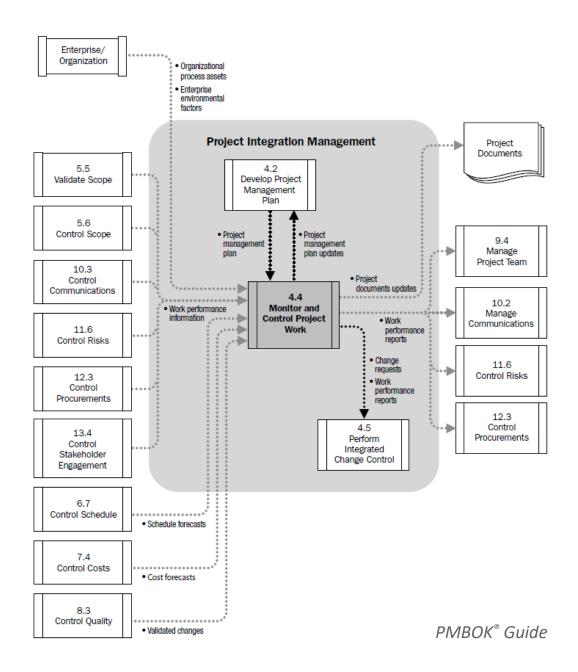
The Work Breakdown Structure (WBS) is Often Derived from the Product Breakdown Structure (PBS)



Project Monitoring and Control

Processes required to:

- Track, review, and report the progress to meet the performance objectives defined in the project management plan
- Identify and initiate any required changes to the plan







SE's Contribution to Project Monitoring and Control

Monitoring and Control Tasks

Compare actual project performance against the project management plan

Maintain accurate, timely information on the project's product(s) and process performance

Forecast cost, schedule, scope, and quality based on performance to date

Monitor risks and risk response plans, and identify new risks

Determine whether any corrective or preventive actions are indicated, and identify needed actions

Monitor suppliers





Project Risk Management

- A formal, systematic method of managing projects which concentrates on identifying and controlling areas or events that have a potential of causing change
- Risk Management skills include the processes concerned with identifying, analyzing, and responding to project risk
- Risk Management seeks to maximize the results of positive events (opportunities) and minimize the consequences of adverse events (risks)

11.1 Plan Risk Management

- .1 Inputs
- .1 Project management plan
- 2 Project charter
- .3 Stakeholder register
- .4 Enterprise environmental
- .5 Organizational process assets
- .2 Tools & Techniques
 - .1 Analytical techniques
- .2 Expert judgment
- .3 Meetings
- .3 Outputs
 - .1 Risk management plan

11.4 Perform Quantitative Risk Analysis

- .1 Risk management plan
- .2 Cost management plan
- .3 Schedule management plan
- .4 Risk register
- .5 Enterprise environmental
- .6 Organizational process assets
- .2 Tools & Techniques
 - .1 Data gathering and representation techniques
 - .2 Quantitative risk analysis and modeling techniques
 - .3 Expert judgment
- .3 Outputs
 - .1 Project documents updates

11.2 Identify Risks

- .1 Inputs
- .1 Risk management plan
- .2 Cost management plan
- .3 Schedule management plan
- .4 Quality management plan .5 Human resource
- management plan .6 Scope baseline
- .7 Activity cost estimates
- .8 Activity duration estimates
- .9 Stakeholder register
- .10 Project documents
- .11 Procurement documents
- .12 Enterprise environmental
- .13 Organizational process assets
- .2 Tools & Techniques
- .1 Documentation reviews
- .2 Information gathering techniques
- .3 Checklist analysis
- .4 Assumptions analysis
- .5 Diagramming techniques
- .6 SWOT analysis
- .7 Expert judgment
- 3 Outputs
- .1 Risk register

11.5 Plan Risk Responses

- .1 Inputs
- .1 Risk management plan
 - .2 Risk register
- .2 Tools & Techniques
- .1 Strategies for negative risks or threats
- .2 Strategies for positive risks or opportunities
- .3 Contingent response strategies
- .4 Expert judgment
- .3 Outputs
 - .1 Project management plan
 - .2 Project documents updates

11.3 Perform Qualitative Risk Analysis

- .1 Inputs
 - .1 Risk management plan
 - .2 Scope baseline
 - .3 Risk register
 - .4 Enterprise environmental
 - .5 Organizational process assets
- .2 Tools & Techniques
- .1 Risk probability and impact assessment
- .2 Probability and impact matrix
- .3 Risk data quality assessment
- .4 Risk categorization
- .5 Risk urgency assessment
- .6 Expert judgment
- 3 Outputs
 - .1 Project documents updates

11.6 Control Risks

- - .1 Project management plan
- .2 Risk register
- .3 Work performance data
- .4 Work performance reports
- .2 Tools & Techniques
- 1 Risk reassessment
- .2 Risk audits
- .3 Variance and trend analysis
- .4 Technical performance
- measurement
- .5 Reserve analysis
- .6 Meetings
- .3 Outputs
- .1 Work performance information
- .2 Change requests
- 3 Project management plan
- 4 Project documents updates
- .5 Organizational process assets

PMBOK® Guide





SE's Role in Risk Management

- The system engineer is typically the person most familiar with the technical challenges and implementation
- For many projects, technical risks are the most likely and have the greatest impact
- Often the SE is the Risk Manager (which requires them to be especially aware of programmatic risks)
- Technical personnel may resist identifying and discussing risks
 - "Shoot the messenger"
 - Micro-management
 - Perceived technical inability
 - Selection of lower risk, less technically exciting solutions

Promote a Risk-Embracing Culture

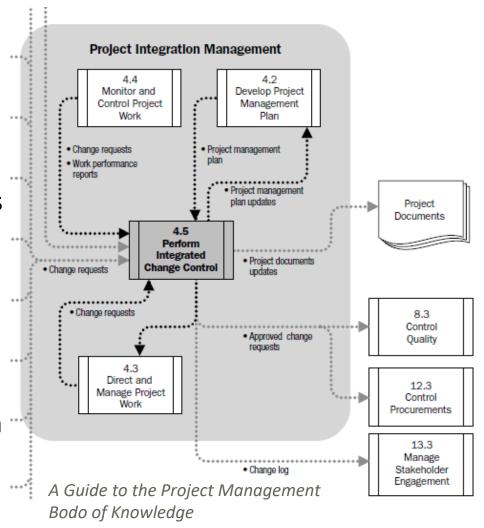
- Express management commitment
- Create awareness of the need
- Define and communicate the expected behaviors
- Reinforce the behaviors
- Encourage a frank and open discussion of risks
- Bring in external interviewers or reviewers to help identify risks
- Recognize the risk environment changes over the project life cycle





Integrated Change Control

- Process change requests (Change Control Board, Engineering Change Board)
- Maintain a valid budget baseline (time-phased budget plus management reserve plus fee)
- Maintain a valid performance baseline
- Provide a disciplined, documented control of changes to the baseline design
- Control revisions to work scope, schedules, and budgets







Other Resources

INCOSE PM-SE Integration Working Group initiatives:

- Project Breakdown Structures
- Strategic Technical Planning
- Systems Engineering Handbook V5 Update
- Comparison of PMBoK and SEBoK - updates
- PM/SE Integration Best Practices Guidelines

